# Appendices

# APPENDIX A: SCOPING LETTERS AND RESPONSES

# COOPERATING AGENCY CORRESPONDENCE

# United States Department of the Interior

NATIONAL PARK SERVICE
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, MA 02667
508.349.3785
508.349.9052 Fax

IN REPLY REFER TO:
L7617

September 23, 2008

Christine S. Clarke
State Conservationist
USDA Natural Resources Conservation Service
451 West Street
Amherst, Massachusetts 01002

Subject: Request for NRCS to participate as a Cooperating Agency on the EIS/EIR for the Herring River Restoration Project

Dear Ms. Clarke:

The Herring River estuary on lower Cape Cod, Massachusetts, once encompassed over 1100 acres of productive tidal salt marshes and open waters. In 1909, a dike was constructed across the mouth of the River which severely limited tidal exchange. Today, salt-marsh plants are restricted to only eight acres upstream of the dike, invasive non-native plants have invaded much of the former salt marsh, water quality has become significantly degraded, and estuarine finfish and shellfish have been nearly eliminated. This degraded system is within the Towns of Wellfleet and Truro, Massachusetts, and 80 per cent of the flood plain is within the boundary of Cape Cod National Seashore (Seashore).

Seashore scientists and cooperators have been studying the river, assessing the effects and feasibility of tidal restoration, and sharing findings with the local public since the early 1980s. In 2005, The Seashore joined with the Town of Wellfleet to form the Herring River Technical Committee (HRTC), and tasked that group with developing a Conceptual Restoration Plan for the Herring River system. In November 2007, the Seashore, the Town of Wellfleet, and the Town of Truro signed a Memorandum of Understanding establishing our shared desire to restore tide to the Herring River, and to do so through development of an integrated Environmental Impact Statement / Environmental Impact Report (EIS/EIR) prepared in compliance with the National Environmental Policy Act and the Massachusetts Environmental Policy Act. The MOU also established the Herring River Restoration Committee (HRRC) to guide development of the EIS/EIR. The HRRC consists of representatives from the two towns, the Seashore, Massachusetts Coastal Zone Management, the National Oceanographic and Atmospheric Administration, the U.S. Fish and Wildlife Service, and the Natural Resources Conservation Service (NRCS). The Seashore is serving as the lead federal agency for the EIS, and the Town of Wellfleet is the lead entity for the EIR.

The NRCS has been an important partner in this effort. An NRCS representative has served on both the HRTC and HRRC, and the NRCS Watershed Plan and Areawide Environmental Impact Statement for the Cape Cod Water Resources Restoration Project (CCWRP), completed in November 2006, identifies the Herring River as a selected priority site. Considering the link between the CCWRP and the current Herring River restoration planning effort, and in light of NRCS's expertise and capabilities, we request that NRCS consider serving as a cooperating agency for the Herring River Restoration Project EIS/EIR. As discussed with your staff, we propose that the NRCS role as a cooperating agency include:

- continuing to participate in the HRRC;
- supporting the project planning and facilitation needed to complete the EIS/EIR process efficiently;
- sharing technical experience on cultural resource issues; and
- sharing technical expertise on sediment transport and other potential effects to shellfish and aquaculture.

The Seashore and the HRRC are grateful for the contributions NRCS has already made to this restoration effort. We look forward to hearing your response to this request.

Sincerely,

George E. Price, Jr.
Superintendent

cc: Gary Joseph, Chair, Herring River Restoration Committee
Carl Gustafson, State Conservation Engineer, NRCS
Dennis Reidenbach, Regional Director, NPS NER
Jacki Katzmire, Regional Environmental Coordinator, NPS NER

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
451 West Street
Amherst, MA 01002

413-253-4350
fax 413-253-4375
www.ma.nrcs.usda.gov



October 8, 2008

George E. Price, Jr.
Superintendent
National Park Service
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, MA 02667

Re: Request for NRCS to be a Cooperating Agency under NEPA for the Herring River Restoration Project

Dear Mr. Price:

The Herring River site is an important project to NRCS. In our area-wide EIS completed for the Cape Cod Water Resources Restoration Project (CCWRRP), the Herring River site comprises over half of the estimated benefits attributed to restoring degraded salt marshes. Because of the direct link between the Herring River restoration and the CCWRRP, NRCS agrees to be a cooperating agency on the EIS for the Herring River Restoration Project, and acknowledges that our role as cooperating agency will include:

- Continued participation in the Herring River Restoration Committee;
- Supporting the project planning and facilitation needed to complete the EIS efficiently;
- Providing technical expertise on cultural resource issues; and
- Providing technical expertise on sediment transport effects to shellfish and aquaculture.

We look forward to signing a Memorandum of Understanding with the National Park Service formalizing this agreement. We have also set aside $65,000 to help fund this planning effort through an agreement with the Coastal America Foundation.

*Helping People Help the Land*
**An Equal Opportunity Provider and Employer**

I am designating Beth Schreier, our state biologist, to be our principal contact for this project. Beth may be reached at:

Beth Schreier
Natural Resources Conservation Service
451 West Street
Amherst, MA 01002
413 253-4393
413 253-4375 fax
beth.schreier@ma.usda.go

Sincerely,

Christine S. Clarke

Christine S. Clarke
State Conservationist

B. Schreier, Biologist, NRCS, Amherst
D. Liptack, District Conservationist, NRCS, Hyannis
B. Miller, State Resource Conservationist, Amherst
C. Gustafson, State Conservation Engineer, NRCS, Amherst

*Helping People Help the Land*
An Equal Opportunity Provider and Employer

United States Department of Agriculture

NRCS

Natural Resources Conservation Service
451 West Street
Amherst, MA 01002

413-253-4350
fax 413-253-4375
www.ma.nrcs.usda.gov

November 21, 2008

George E. Price, Jr.
Superintendent, National Park Service
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, MA 02667

Re: Memorandum of Understanding – Herring River

Dear Mr. Price,

Enclosed please find two signed copies of the Memorandum of Understanding between the National Park Service and the Natural Resources Conservation Service with respect to the preparation of an Environmental Impact Statement for the Herring River restoration project. Please sign both copies, keep one for your records and return the other copy to me at the above address. NRCS looks forward to working with the NPS on this endeavor.

Sincerely,

Beth Schreier

Beth Schreier
Soil Conservationist, NRCS

cc: Carrie Phillips, NPS

*Helping People Help the Land*
An Equal Opportunity Provider and Employer

# Memorandum of Understanding (MOU)
Between the
## National Park Service
## (Lead Federal Agency)
And the
## United States Department of Agriculture
## Natural Resources Conservation Service
## (Cooperating Agency)

This Memorandum of Understanding is established and entered into by and between the National Park Service (hereafter referred to as "NPS") and the United States Department of Agriculture Natural Resources Conservation Service, (hereafter referred to as "NRCS"),

This MOU outlines the roles and responsibilities of the NPS and the NRCS with respect to the preparation of an Environmental Impact Statement (EIS) for the Herring River Restoration project on Cape Cod, Massachusetts.

This MOU does not alter any other written MOUs, cooperative or grant agreements between the above parties and the project sponsors or other government agencies, or parties.

## I. BACKGROUND:

The NPS has developed a strong partnership (called Herring River Restoration Committee (HRRC)) with NRCS, the Town of Wellfleet, Town of Truro, US Fish and Wildlife Service, National Oceanic and Atmospheric Restoration Center, and Massachusetts Coastal Zone Management - Wetlands Restoration Program to prepare a plan for the restoration of the 1,100 acre Herring River estuary, the largest such project ever attempted in Massachusetts and the Gulf of Maine. Because of the size and complexity, the Herring River restoration will require an individual Environmental Impact Statement (EIS) under NEPA. The NPS, as Lead Agency, has already committed $158,000 for the preparation of the EIS.

NRCS completed the Watershed Plan and Areawide EIS for the Cape Cod Water Resources Restoration Project (CCWRRP) in November 2006. One of the three project objectives is to restore degraded salt marshes. The Herring River site comprises over half of the estimated CCWRRP benefits attributed to restoring degraded salt marshes. NRCS is waiting for the CCWRRP to be authorized and funded before proceeding with any site specific planning and design. Because of the direct link between the Herring River restoration and the CCWRRP, NRCS has agreed to be a cooperating agency under NEPA (at the request of the NPS), and has committed funding for the development of a Herring River restoration EIS plan of work, and HRRC meeting facilitation and management.

## II. PURPOSE AND BENEFITS:

NPS and NRCS worked together in the development of the CCWRRP. By combining resource efforts for the Herring River EIS, implementation of USDA programs will be improved, interagency coordination and cooperation will be strengthened, and both agencies will improve efficiencies. Therefore, the NPS and the NRCS deem it mutually advantageous to cooperate in the undertaking, and hereby agree as follows:

## III. NPS (Lead Federal Agency) RESPONSIBILITIES:

**A.** As the lead agency, the NPS has primary responsibility for meeting the requirements of the National Environmental Policy Act (NEPA), including the preparation of the Draft EIS (DEIS) and Final EIS (FEIS) for the Herring River Restoration project.

**B.** The NPS will consult with the NRCS regarding the EIS issues of concern, range of EIS alternatives considered, and associated mitigation measures to be analyzed in the EIS.

**C.** The NPS will identify NRCS as a cooperating agency in the EIS, and will include in the EIS written material which would allow the NRCS to meet its NEPA compliance requirements.

**D.** The NPS will provide NRCS with copies of the preliminary draft(s) of the DEIS and FEIS in a timely manner.

## IV. NRCS (Cooperating Agency) RESPONSIBILITIES:

**A.** As a cooperating agency, NRCS will participate in the HRRC.

**B.** NRCS will provide technical assistance on the cultural resource issues associated with the preparation of the Herring River EIS.

**C.** NRCS will provide technical assistance on sediment transport and other potential effects to shellfish and aquaculture associated with the Herring River restoration.

**D.** NRCS will review the preliminary draft of the DEIS and provide comments to the NPS within 30 working days (unless a different mutually agreed upon time frame is established) of receipt of the DEIS.

**E.** NRCS will review the preliminary draft of the FEIS and provide comments to the NPS within 30 working days (unless a different mutually agreed upon time frame is established) of receipt of the draft FEIS.

## V. IT IS MUTUALLY AGREED THAT:

**A.** The principle contacts for this MOU are:

**NPS:**
Carrie Phillips
Chief, Natural Resource Management
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, MA 02667
508 349-3785 x216

**NRCS:**
Beth Schreier
Soil Conservationist
451 West Street
Amherst, MA 01002
413 253-4393

**B.** This MOU may be modified by the parties hereto by mutual agreement only. Any modification will be in writing.

**C.** This MOU is terminated when either the Record of Decision (ROD) is signed or when written notice is given by a respective agency.

**THE NPS AND THE NRCS AGREE TO THIS MOU AS OF THE LAST DATE WRITTEN BELOW:**

Date: 12/1/08 By: [signature]

George E. Price, Jr.
Superintendent, National Park Service
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, MA 02667

Date: 11/20/08 By: [signature]

Christine S. Clarke
State Conservationist
USDA Natural Resources Conservation Service
451 West Street
Amherst, MA 01002

3

United States Department of the Interior

NATIONAL PARK SERVICE
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, MA 02667

**IN REPLY REFER TO:**
L7617 (CACO NRM)

May 19, 2010

H. Curtis Spalding
Regional Administrator
EPA New England, Region 1
5 Post Office Square, Suite 100
Mail Code ORA 01-4
Boston, Massachusetts 02109-3912

Subject: Request for EPA to participate as a Cooperating Agency on the EIS/EIS for the Herring River Restoration Project

Dear Mr. Spalding,

The Herring River estuary on lower Cape Cod, Massachusetts, once encompassed over 1100 acres of productive tidal salt marshes and open waters. In 1909, a dike was constructed across the mouth of the River which severely limited tidal exchange. Today, salt-marsh plants are restricted to only eight acres upstream of the dike, invasive non-native plants have invaded much of the former salt marsh, water quality has become significantly degraded, and estuarine finfish and shellfish have been nearly eliminated. This degraded system is within the Towns of Wellfleet and Truro, Massachusetts, and 80 percent of the flood plain is within the boundary of Cape Cod National Seashore (Seashore).

Seashore scientists and cooperators have been studying the river, assessing the effect and feasibility of tidal restoration, and sharing findings with the local public since the early 1980s. In 2005, the Seashore joined with the Town of Wellfleet to form the Herring River Technical Committee (HRTC), and tasked that group with developing a Conceptual Restoration Plan for the Herring River system. In November 2007, the Seashore, the Town of Wellfleet, and the Town of Truro signed a Memorandum of Understanding establishing our shared desire to restore tide to the Herring River, and to do so through development of an integrated Environmental Impact Statement/Environmental Impact Report (EIS/EIR) prepared in compliance with the National Environmental Policy Act and the Massachusetts Environmental Policy Act. The MOU also established the Herring River Restoration Committee (HRRC) to guide development of the EIS/EIR. The HRRC consists of representatives from the two towns, the Seashore, Massachusetts Division of Ecological Restoration, National Oceanographic and Atmospheric Administration, U.S. Fish and Wildlife Service, and Natural Resources Conservation Service. The Seashore is serving as the lead federal agency for the EIS, and the Town of Wellfleet is the lead entity for the EIR. In his Certificate date November 7, 2007, Ian Bowles, Secretary of the MA Executive Office of Energy and the Environment, established a Technical Working Group (TWG) to help guide compliance and permitting processes for the project.

The Environmental Protection Agency (EPA) has been an important partner in this effort. An EPA representative has served on the TWG and EPA is a leading proponent and sponsor of salt marsh restoration projects throughout Cape Cod and other parts of Massachusetts. In light of EPA's expertise and capabilities, we request that EPA consider serving as a cooperating agency for the Herring River Restoration Project EIS/EIR. As discussed with your staff, we anticipate that the EPA role as a cooperating agency will include:

- Continuing to participate in the TWG;
- Supporting the project planning and facilitation needed for compliance and permitting processes;
- Sharing technical experience on natural and cultural resource issues; and
- Sharing technical expertise on design of salt marsh restoration projects, wetland permitting, monitoring, and adaptive management.

The Seashore and the HRRC are grateful for the contributions EPA has already made to this restoration effort. We look forward to hearing your response to this request. If you have questions regarding this topic, please contact Tim Smith, Restoration Ecologist, at (508) 487-3262.

Sincerely,

George E. Price, Jr.
Superintendent

cc: Gary Joseph, Chair, Herring River Restoration Committee
Ed Reiner, EPA
Tim Timmerman, EPA
John Sargent, Army Corps
Dennis Reidenbach, Regional Director, NPS NER
Jacki Katzmire, Regional Environmental Coordinator, NPS NER
CACO central files

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 1
5 POST OFFICE SQUARE, SUITE 100
BOSTON, MA 02109-3912

June 8, 2010

George E. Price, Superintendent
National Park Service
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, MA 02667

RE: Request to be a Cooperating Agency for the preparation of an Environmental Impact Statement for the Herring River Restoration Project in Wellfleet and Truro, Massachusetts

Dear Superintendent Price:

Thank you for your recent letter requesting the Environmental Protection Agency (EPA) participation as a cooperating agency during the preparation of the Environmental Impact Statement (EIS) for the Herring River Restoration project. EPA New England looks forward to participation as a cooperating agency during the preparation of the EIS for this important ecological restoration effort.

EPA intends to work as a cooperating agency within the limit of our resources to help define the scope of analysis, identify sources of information and to offer input on how specific issues should be addressed in the EIS. We appreciate the leadership provided to date by Tim Smith of your office during interagency meetings to discuss the EIS and look forward to continued close coordination with the National Park Service and other interested local, state and federal agency representatives as the NEPA process continues.

If you have any questions about this letter or EPA's involvement in the EIS process, please contact Timothy Timmermann at 617-918-1025.

Sincerely,

H. Curtis Spalding
Regional Administrator

United States Department of the Interior

NATIONAL PARK SERVICE
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, MA 02667

**IN REPLY REFER TO:**
L7617 (CACO-NRM)

May 19, 2010

Mr. John C. Sargent
U.S. Army Corps of Engineers
New England District
696 Virginia Road
Concord, Massachusetts 01742

Subject: Request for Army Corps of Engineers to participate as a Cooperating Agency on the EIS/EIS for the Herring River Restoration Project

Dear Mr. Sargent,

The Herring River estuary on lower Cape Cod, Massachusetts, once encompassed over 1100 acres of productive tidal salt marshes and open waters. In 1909, a dike was constructed across the mouth of the River which severely limited tidal exchange. Today, salt-marsh plants are restricted to only eight acres upstream of the dike, invasive non-native plants have invaded much of the former salt marsh, water quality has become significantly degraded, and estuarine finfish and shellfish have been nearly eliminated. This degraded system is within the Towns of Wellfleet and Truro, Massachusetts, and 80 percent of the flood plain is within the boundary of Cape Cod National Seashore (Seashore).

Seashore scientists and cooperators have been studying the river, assessing the effect and feasibility of tidal restoration, and sharing findings with the local public since the early 1980s. In 2005, the Seashore joined with the Town of Wellfleet to form the Herring River Technical Committee (HRTC), and tasked that group with developing a Conceptual Restoration Plan for the Herring River system. In November 2007, the Seashore, the Town of Wellfleet, and the Town of Truro signed a Memorandum of Understanding establishing our shared desire to restore tide to the Herring River, and to do so through development of an integrated Environmental Impact Statement/Environmental Impact Report (EIS/EIR) prepared in compliance with the National Environmental Policy Act and the Massachusetts Environmental Policy Act. The MOU also established the Herring River Restoration Committee (HRRC) to guide development of the EIS/EIR. The HRRC consists of representatives from the two towns, the Seashore, Massachusetts Division of Ecological Restoration, National Oceanographic and Atmospheric

Administration, U.S. Fish and Wildlife Service, and Natural Resources Conservation Service. The Seashore is serving as the lead federal agency for the EIS, and the Town of Wellfleet is the lead entity for the EIR. In his Certificate date November 7, 2007, Ian Bowles, Secretary of the MA Executive Office of Energy and the Environment, established a Technical Working Group (TWG) to help guide compliance and permitting processes for the project.

The Army Corps of Engineers (Corps) has been an important partner in this effort. A Corps representative has served on the TWG and the Corps is a leading proponent and sponsor of salt marsh restoration projects throughout Cape Cod and other parts of Massachusetts. In light of the Corps' expertise and capabilities, we request that the Corps consider serving as a cooperating agency for the Herring River Restoration Project EIS/EIR. As discussed with your staff, we anticipate that the Corps' role as a cooperating agency will include:

- Continuing to participate in the TWG;
- Supporting the project planning and facilitation needed for compliance and permitting processes;
- Sharing technical experience on natural and cultural resource issues; and
- Sharing technical expertise on design of salt marsh restoration projects, hydraulic modeling, wetland permitting, monitoring, and adaptive management.

The Seashore and the HRRC are grateful for the contributions the Corps has already made to this restoration effort. We look forward to hearing your response to this request. If you have questions regarding this topic, please contact Tim Smith, Restoration Ecologist, at (508) 487-3262.

Sincerely,

George E. Price, Jr.
Superintendent

cc: Gary Joseph, Chair, Herring River Restoration Committee
Bill Hubbard, Army Corps
Ed Reiner, EPA
Tim Timmerman, EPA
Dennis Reidenbach, Regional Director, NPS NER
Jacki Katzmire, Regional Environmental Coordinator, NPS NER
CACO central files

**DEPARTMENT OF THE ARMY**
NEW ENGLAND DISTRICT, CORPS OF ENGINEERS
696 VIRGINIA ROAD
CONCORD, MASSACHUSETTS 01742-2751

REPLY TO
ATTENTION OF

July 12, 2010

Regulatory Branch
CENAE-R-NAE-2008-0759

George Price
Superintendent
National Park Service
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, Massachusetts 02667

Dear Mr. Price:

This is in response to your May 19, 2010 letter in which you requested that the Corps of Engineers participate as a cooperating agency in the development of an Environmental Impact Statement for the Herring River Restoration Project in Wellfleet and Truro, Massachusetts.

As set forth by the CEQ regulations [40 CFR 1501.5, 1501.6(a), and 1508.16], and Corps of Engineers regulations 33 CFR 325, we will coordinate with your agency as a cooperating agency.

John Sargent has been assigned as Project Manager for this project. John Sargent has already participated in a number of meetings and site visits. Through John we hope to provide you with sufficient guidance to assure that the upcoming EIS will provide us with adequate documentation to complete our 404 permit evaluation. The Corps will continue to be available to provide support in the permitting process to include participation in the Technical Working Group (TWG) and sharing technical expertise on natural and cultural resource issues.

If you have any further questions concerning this matter, please contact me at (978) 318-8220 or John Sargent of my regulatory staff at (978) 318-8026.

Sincerely,

Philip T. Feir
Colonel, Corps of Engineers
District Engineer

Attachments

Copy Furnished:

Ed Reiner, U.S. Environmental Protection Agency, 5 Post Office Square, Suite 100, Mail Code ORA 01-4, Boston, Massachusetts 02109-3912

**United States Department of the Interior**

**NATIONAL PARK SERVICE**
**Cape Cod National Seashore**
**99 Marconi Site Road**
**Wellfleet, MA 02667**

**IN REPLY REFER TO:**
L7617 (CACO-NRM)

May 19, 2010

Mr. Chris Doley, Chief
NOAA Restoration Center
1315 East-West Hwy. (F/HC3)
Silver Spring, Maryland 20910

Subject: Request for NOAA to participate as a Cooperating Agency on the EIS/EIS for the Herring River Restoration Project

Dear Mr. Doley,

The Herring River estuary on lower Cape Cod, Massachusetts, once encompassed over 1100 acres of productive tidal salt marshes and open waters. In 1909, a dike was constructed across the mouth of the River which severely limited tidal exchange. Today, salt-marsh plants are restricted to only eight acres upstream of the dike, invasive non-native plants have invaded much of the former salt marsh, water quality has become significantly degraded, and estuarine finfish and shellfish have been nearly eliminated. This degraded system is within the Towns of Wellfleet and Truro, Massachusetts, and 80 percent of the flood plain is within the boundary of Cape Cod National Seashore (Seashore).

Seashore scientists and cooperators have been studying the river, assessing the effect and feasibility of tidal restoration, and sharing findings with the local public since the early 1980s. In 2005, the Seashore joined with the Town of Wellfleet to form the Herring River Technical Committee (HRTC), and tasked that group with developing a Conceptual Restoration Plan for the Herring River system. In November 2007, the Seashore, the Town of Wellfleet, and the Town of Truro signed a Memorandum of Understanding establishing our shared desire to restore tide to the Herring River, and to do so through development of an integrated Environmental Impact Statement/Environmental Impact Report (EIS/EIR) prepared in compliance with the National Environmental Policy Act and the Massachusetts Environmental Policy Act. The MOU also established the Herring River Restoration Committee (HRRC) to guide development of the EIS/EIR. The HRRC consists of representatives from the two towns, the Seashore, Massachusetts Division of Ecological Restoration, National Oceanographic and Atmospheric Administration (NOAA), U.S. Fish and Wildlife Service, and Natural Resources Conservation

Service. The Seashore is serving as the lead federal agency for the EIS, and the Town of Wellfleet is the lead entity for the EIR.

NOAA has been an important partner in this effort. A NOAA representative has served on both the HRTC and HRRC and NOAA is a leading proponent and sponsor of salt marsh restoration projects throughout Cape Cod and other parts of Massachusetts. In light of NOAA's expertise and capabilities, we request that NOAA consider serving as a cooperating agency for the Herring River Restoration Project EIS/EIR. As discussed with your staff, we anticipate that the NOAA role as a cooperating agency will include:

- Continuing to participate in the HRRC;
- Supporting the project planning and facilitation needed to complete the EIS/EIR process efficiently;
- Sharing technical experience on natural and cultural resource issues; and
- Sharing technical expertise on hydrodynamic modeling, sediment transport, and structural design of various project components.

The Seashore and the HRRC are grateful for the contributions NOAA has already made to this restoration effort. We look forward to hearing your response to this request. If you have questions regarding this topic, please contact Tim Smith, Restoration Ecologist, at (508) 487-3262.

Sincerely,

George E. Price, Jr.
Superintendent

cc: Gary Joseph, Chair, Herring River Restoration Committee
Steve Block, NOAA Restoration Center
Dennis Reidenbach, Regional Director, NPS NER
Jacki Katzmire, Regional Environmental Coordinator, NPS NER
CACO central files

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
Silver Spring, MD 20910

APR 19 2011

George E. Price, Jr., Superintendent
Cape Cod National Seashore
National Park Service
99 Marconi Site Road
Wellfleet, MA 02667

RE: L7617 (CACO-NRM) – Request for NOAA's Participation as Cooperating Agency for the Herring River Restoration Project EIS

Dear Superintendent Price,

The National Oceanic and Atmospheric Administration (NOAA) Restoration Center recognizes the importance of restoring the degraded 1,100-acre Herring River floodplain to a healthy and vital estuary and supports the National Park Service's efforts to do so. Since 2003, Restoration Center's staff have continuously served on the several interagency committees formed to advance that restoration project, and have supported the project with funding through our partnerships with Restore America's Estuaries/Conservation Law Foundation and the Gulf of Maine Council on the Marine Environment.

NOAA accepts your invitation to participate as a Cooperating Agency on the Herring River EIS/EIR. I understand that our role as Cooperating Agency will include:

- Continuing to participate in the Herring River Restoration Committee (HRRC);
- Providing technical support for the project planning and facilitation needed to complete the EIS/EIR process efficiently;
- Sharing technical experience on natural and cultural resource issues;
- Sharing technical expertise on hydrodynamic modeling, sediment transport, and structural design of various project components; and
- Reviewing and providing comments to NPS on draft versions of the EIS.

Please note that our participation on the HRRC and with the preparation of the EIS/EIR does not preclude the necessity of the NPS from having to consult with NOAA on Essential Fish Habitat and Section 7 of the Endangered Species Act. Thank you for extending this Cooperating Agency offer to NOAA, and for your continuing efforts to advance this important restoration project.

Sincerely,

Patricia A. Montanio
Director, Office of Habitat Conservation

cc: John Catena, NOAA
Steve Block, NOAA

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United States Department of the Interior

NATIONAL PARK SERVICE
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, MA 02667

IN REPLY REFER TO:
L7617 (CACO-NRM)

May 19, 2010

Thomas R. Chapman
Supervisor, New England Field Office
U. S. Fish and Wildlife Service
70 Commercial Street, Suite 300
Concord, New Hampshire 03301

Subject: Request for USFWS to participate as a Cooperating Agency on the EIS/EIS for the Herring River Restoration Project

Dear Mr. Chapman,

The Herring River estuary on lower Cape Cod, Massachusetts, once encompassed over 1100 acres of productive tidal salt marshes and open waters. In 1909, a dike was constructed across the mouth of the River which severely limited tidal exchange. Today, salt-marsh plants are restricted to only eight acres upstream of the dike, invasive non-native plants have invaded much of the former salt marsh, water quality has become significantly degraded, and estuarine finfish and shellfish have been nearly eliminated. This degraded system is within the Towns of Wellfleet and Truro, Massachusetts, and 80 percent of the flood plain is within the boundary of Cape Cod National Seashore (Seashore).

Seashore scientists and cooperators have been studying the river, assessing the effect and feasibility of tidal restoration, and sharing findings with the local public since the early 1980s. In 2005, the Seashore joined with the Town of Wellfleet to form the Herring River Technical Committee (HRTC), and tasked that group with developing a Conceptual Restoration Plan for the Herring River system. In November 2007, the Seashore, the Town of Wellfleet, and the Town of Truro signed a Memorandum of Understanding establishing our shared desire to restore tide to the Herring River, and to do so through development of an integrated Environmental Impact Statement/Environmental Impact Report (EIS/EIR) prepared in compliance with the National Environmental Policy Act and the Massachusetts Environmental Policy Act. The MOU also established the Herring River Restoration Committee (HRRC) to guide development of the EIS/EIR. The HRRC consists of representatives from the two towns, the Seashore, Massachusetts Division of Ecological Restoration, National Oceanographic and Atmospheric

Administration, U.S. Fish and Wildlife Service (FWS), and Natural Resources Conservation Service. The Seashore is serving as the lead federal agency for the EIS, and the Town of Wellfleet is the lead entity for the EIR.

FWS has been an important partner in this effort. A FWS representative has served on both the HRTC and HRRC and FWS is a leading proponent and sponsor of salt marsh restoration projects throughout Cape Cod and other parts of Massachusetts. In light of FWS's expertise and capabilities, we request that FWS consider serving as a cooperating agency for the Herring River Restoration Project EIS/EIR. As discussed with your staff, we anticipate that the FWS role as a cooperating agency will include:

- Continuing to participate in the HRRC;
- Supporting the project planning and facilitation needed to complete the EIS/EIR process efficiently;
- Sharing technical experience on natural and cultural resource issues; and
- Sharing technical expertise on hydrodynamic modeling, sediment transport, monitoring, and adaptive management.

The Seashore and the HRRC are grateful for the contributions FWS has already made to this restoration effort. We look forward to hearing your response to this request. If you have questions regarding this topic, please contact Tim Smith, Restoration Ecologist, at (508) 487-3262.

Sincerely,

George E. Price, Jr.
Superintendent

cc: Gary Joseph, Chair, Herring River Restoration Committee
Eric Derleth, USFWS
Dennis Reidenbach, Regional Director, NPS NER
Jacki Katzmire, Regional Environmental Coordinator, NPS NER
CACO central files

# United States Department of the Interior

FISH AND WILDLIFE SERVICE

New England Field Office
70 Commercial Street, Suite 300
Concord, NH 03301-5087
http://www.fws.gov/newengland

Re: Herring River Restoration Project
Request for U.S. Fish and Wildlife Service
to become a Cooperating Agency under NEPA

August 23, 2012

George E. Price, Jr., Superintendent
National Park Service
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, MA 02667

Dear Mr. Price:

The U.S. Fish and Wildlife Service (Service) and the National Park Service (NPS) have been working together, along with other members of the Herring River Restoration Committee (HRRC), to prepare a draft Environmental Impact Statement (EIS) for the potential restoration of the Herring River in Wellfleet and Truro, Massachusetts. It is our understanding that the draft EIS is now scheduled for release in early October 2012. As part of our collective compliance under the National Environmental Policy Act (NEPA), the Service formally accepts your May 2010 invitation to become a cooperating agency for the Herring River Restoration Project EIS without the development of a Memorandum of Understanding, as indicated in our July 2, 2010 response to your original request.

The Service understands that the EIS is being prepared jointly with an Environmental Impact Report (EIR) in compliance with the Massachusetts Environmental Policy Act (MEPA). Since 2005, the Service has participated on the Herring River Technical Committee, which produced a 2007 Conceptual Restoration Plan for the project, and currently participates on the HRRC as it has developed alternatives for the Herring River.

At approximately 1,100 acres, the Herring River Restoration Project has the potential to become the largest estuarine habitat restoration project ever attempted in the northeastern United States, and if completed, would provide significant benefits to Service trust resources, including numerous species of migratory birds and fish. The Herring River Restoration Project also could be highly competitive for future Service funding through one of our habitat restoration programs. The Service acknowledges that our role as a cooperating agency will include:

- continued participation on the HRRC;
- supporting the project planning and facilitation needed to complete the EIS/EIR process efficiently;
- providing technical expertise on natural and cultural resource issues;

- providing technical expertise on hydrodynamic modeling, sediment transport, monitoring and adaptive management; and
- reviewing and providing comments to the NPS on draft versions of the EIS and assisting with responses to public comments during the development of the final EIS.

The Service looks forward to continuing our collaboration with the NPS as we complete our collective responsibilities during the NEPA process. Eric Derleth, the New England Field Office's Partners for Fish and Wildlife Program Coordinator, will continue to represent the Service on the HRRC and will be the principal contact for the project. Mr. Derleth can be reached at the above address, or by phone at (603) 223-2541, and email at eric_derleth@fws.gov.

Sincerely yours,

Thomas R. Chapman
Supervisor
New England Field Office

# AGENCY CONSULTATION

Commonwealth of Massachusetts

# Division of Fisheries & Wildlife

MassWildlife

Wayne F. MacCallum, *Director*

6/3/2008

Christopher Gajeski
The Louis Berger Group, Inc.
75 Second Ave., Suite 700
Needham MA 02494

RE: Project Location: HERRING RIVER SALT MARSH RESTORATION
Town: WELLFLEET
**NHESP Tracking No.: 04-15126**

To Whom It May Concern:

Thank you for contacting the Natural Heritage and Endangered Species Program ("NHESP") of the MA Division of Fisheries & Wildlife for information regarding state-listed rare species in the vicinity of the above referenced site. Based on the information provided, this project site, or a portion thereof, is located **within** *Priority Habitat 1232* (PH 1232) and *Estimated Habitat 821* (EH 821) as indicated in the *Massachusetts Natural Heritage Atlas* (12th Edition). Our database indicates that the following state-listed rare species have been found in the vicinity of the site:

| Scientific name | Common Name | Taxonomic Group | State Status |
|---|---|---|---|
| *Sterna dougallii* | Roseate Tern | Bird | Endangered |
| *Sterna hirundo* | Common Tern | Bird | Special Concern |
| *Circus cyaneus* | Northern Harrier | Bird | Threatened |
| *Charadrius melodus* | Piping Plover | Bird | Threatened |
| *Terrapene carolina* | Eastern Box Turtle | Reptile | Special Concern |
| *Malaclemys terrapin* | Diamondback Terrapin | Reptile | Threatened |
| *Scaphiopus holbrookii* | Eastern Spadefoot | Amphibian | Threatened |
| *Hemidactylium scutatum* | Four-Toed Salamander | Amphibian | Special Concern |
| *Catocala herodias gerhardi* | Gerhard's Underwing Moth | Butterflies and Moths | Special Concern |
| *Papaipema sulphurata* | Water-Willow Stem Borer | Butterflies and Moths | Threatened |
| *Corema conradii* | Broom Crowberry | Plant | Special Concern |

The species listed above is/are protected under the Massachusetts Endangered Species Act (MESA) (M.G.L. c. 131A) and its implementing regulations (321 CMR 10.00). State-listed wildlife are also protected under the state's Wetlands Protection Act (WPA) (M.G.L. c. 131, s. 40) and its implementing regulations (310 CMR 10.00). Fact sheets for most state-listed rare species can be found on our website (www.nhesp.org).

This evaluation is based on the most recent information available in the NHESP database, which is constantly being expanded and updated through ongoing research and inventory. If you have any questions regarding this letter please contact Amy Coman, Endangered Species Review Assistant, at (508) 389-6364.

www.masswildlife.org

Division of Fisheries and Wildlife
Field Headquarters, North Drive, Westborough, MA 01581 (508) 389-6300 Fax (508) 389-7891
*An Agency of the Department of Fish and Game*

Sincerely,

Thomas W. French, Ph.D.
Assistant Director

*The Commonwealth of Massachusetts*
*Executive Office of Energy and Environmental Affairs*
*100 Cambridge Street, Suite 900*
*Boston, MA 02114*

Deval L. Patrick
GOVERNOR

Timothy P. Murray
LIEUTENANT GOVERNOR

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SECRETARY

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http://www.mass.gov/envir

June 20, 2008

CERTIFICATE OF THE SECRETARY OF ENVIRONMENTAL AFFAIRS
ESTABLISHING A SPECIAL REVIEW PROCEDURE

| | |
|---|---|
| PROJECT NAME | : Herring River Restoration Project |
| PROJECT MUNICIPALITY | : Wellfleet and Truro |
| PROJECT WATERSHED | : Cape Cod |
| EEA NUMBER | : 14272 |
| PROJECT PROPONENTS | : Town of Wellfleet, Town of Truro, and Cape Cod National Seashore |
| DATE NOTICED IN MONITOR | : N/A |

Pursuant to the Massachusetts Environmental Policy Act (M.G. L. c. 30, ss. 61-62H) and Section 11.09 of the MEPA regulations, I hereby establish a Special Review Procedure to guide the MEPA review of the project.

Project Background and Description

As described in a letter submitted by the proponent, the Herring River Restoration Committee, to the Secretary of Energy and Environmental Affairs on May 29, 2008, the proposed project entails the restoration of ecosystem functions and values to a degraded 1,100-acre tidally restricted estuary. Prior to the 1908 construction of a dike at the mouth of the Herring River, the estuary was dominated by healthy and highly productive salt marsh plant communities. The prime objective of the project is to eventually restore tidal exchange to an extent closely approximating the normal, natural tidal range that occurred prior to diking. Tides will be restored gradually, over a period of several years, with small, incremental opening of adjustable tide gates.

The Herring River Restoration Committee (HRRC), a multi-agency group appointed by the two Towns and the National Seashore, is currently engaged in development of a comprehensive restoration plan for the estuary, building upon work completed by the preceding Town-appointed Herring River Technical Committee (HRTC). With input from the Herring River Stakeholder Group (also appointed by the Wellfleet Selectmen), the HRTC's work culminated with release of the Herring River Conceptual Restoration Plan in November 2007. As described in the Conceptual Restoration Plan, the Herring River Project comprises the following elements:

- Reconstruction of the existing 1908 dike and tide control structure at Chequessett Neck Road with a new structure, incorporating enlarged culverts and adjustable tide gates designed to allow gradual increases to tidal range.
- Replacement of at least seven additional culverts at road crossings upstream of Chequessett Neck Road to allow increased tidal exchange and better fish passage.
- Raising, relocating, or abandoning up to 22,000 linear feet of low-lying roadway occurring within the Herring River floodplain that are vulnerable to flooding from restored tidal range.
- Removal of approximately 600 acres of woody vegetation that has become established within the Herring River floodplain in order to promote recolonization of salt marsh vegetation and support fish passage coincident with restored tidal range.
- Restoration of natural channel sinuosity in the channelized portions of the Herring River system to enhance wetland habitat functions and abate mosquito production.
- Prevention and/or mitigation of flooding impacts to several private properties within the Herring River floodplain, including structures, developed lands, and domestic water wells.

MEPA Jurisdiction and Required Permits

At a minimum, it is expected that the Herring River project will alter at least one acre of salt marsh or bordering vegetated wetlands, triggering the mandatory EIR threshold described at 310 CMR 11.03(3)(a). Although the exact nature and extent of wetland alteration is unknown at this time, it is likely this threshold will be exceeded to a significant extent. In addition, the project area is known to contain both estimated and priority rare species habitat, is adjacent to significant cultural and historic resources, and is located with the Wellfleet Harbor Area of Critical Environmental Concern. The project will require numerous state permits (Chapter 91 Licenses, 401 Water Quality Certification, etc.) and has already received funding from the Massachusetts Office of Coastal Zone Management's Wetlands Restoration Program. Because the project requires a Chapter 91 License, MEPA jurisdiction is broad in scope and extends all aspects of the project with the potential to cause Damage to the Environment.

SPECIAL REVIEW PROCEDURE

The proponent has requested that I establish of a Special Review Procedure (SRP) for the review of the project under MEPA. The MEPA regulations provide that a Special Review Procedure may be established to provide for "coordination or consolidation of MEPA review with other environmental or development review and permitting processes". In addition, 301 CMR 11.09 states that "A Special Review Procedure may be appropriate, for example, for reviewing a proposed program, regulations, policy, or other Project in which there is more than one Proponent or more than one Participating Agency with a significant role, or a Project that is undefined or is expected to evolve during MEPA review, or a Project that may benefit the environment if there is early Commencement of a portion of the Project."

A SRP will enable the MEPA process to build on, rather than duplicate, the extensive analysis that has been and will be conducted by the HRRC. After considering the factors cited in Section 11.09 of the MEPA regulations, I hereby find that the review of the project would benefit from the establishment of a SRP.

*Coordination with Other Review Processes*

The SRP is largely for administrative convenience, designed to provide an opportunity for coordinated review and to consolidate the MEPA review with other environmental or development review and permitting processes.1

The Herring River Restoration Project is deemed a Development of Regional Impact (DRI) under the enabling regulations of the Cape Cod Commission and is, therefore, subject to DRI review. Additionally, approximately 80 percent of the project area is located within the Cape Cod National Seashore and, therefore, subject to compliance with the National Environmental Policy Act (NEPA). Because of the complexity, and long-term duration of the project, National Seashore staff and other cooperating federal agencies, have determined that a full Environmental Impact Statement (EIS) is appropriate.

This consolidation and coordination allows these regulatory and public review processes to be conducted in such a way that the public will be able to provide both written and oral comments, within a single timeframe, under the various regional, state and federal regulatory processes.

1 The term "coordinated review" as used in this Certificate and in the MEPA regulations refers to the practice of allowing a single set of documents to serve simultaneously for more than one environmental review process, concurrent with that conducted under MEPA. In common usage, the practice is sometimes referred to as "joint review," although this term is misleading since federal and state agencies retain independent authority to judge the adequacy of the information submitted pursuant to their respective statutory and regulatory responsibilities.

*Citizens Advisory Committee*

The MEPA regulations at 310 CMR 11.09(3) allow for the establishment of a Citizen's Advisory Committee (CAC) to assist with public and agency review and comment. For the Herring River Restoration Project, I hereby designate the Herring River Restoration Committee as the CAC. In addition to the Towns of Wellfleet and Truro and the Cape Cod National Seashore, the HRRC includes representatives from Office of Coastal Zone Management's Wetlands Restoration Program; the National Oceanic and Atmospheric Administration Restoration Center; the U.S. Fish and Wildlife Service; and the Natural Resources Conservation Service. All of these agencies were also represented on the former Herring River Technical Committee (HRTC) and have been meeting at least monthly, either as the HRTC or HRRC, since September 2005. As directed by a Memorandum of Understanding (signed in November 2007) between the two Towns and the National Seashore, the HRRC will prepare a detailed, comprehensive restoration plan, pursue funding, and obtain permits. Though actual implementation and oversight of the restoration activities may be directed by a successor committee, it is expected that any future committee will be similarly comprised.

As the CAC, the HRRC, or its successor, would continue to meet regularly as the project advances. At a yet-to-be determined frequency, the HRRC would hold meetings with regulatory agencies including, but not limited to, the MEPA Office; the Department of Environmental Protection (MassDEP); the Natural Heritage and Endangered Species Program (NHESP); the Department of Conservation and Recreation (DCR); the U.S. Army Corps of Engineers (ACOE); the Cape Cod Commission (CCC); and the local Conservation Commissions, to review project plans and designs. As the project advances to the implementation stages, these meetings also would include review of monitoring data; outcomes of prior restoration actions; and consensus-driven decision-making regarding future actions. As a publicly-appointed body, the HRRC meetings are open to the public and this will continue under the SRP. It is anticipated that additional meetings focused more directly on specific public stakeholder concerns will be held on a regular basis. The HRRC will also conduct a wide-ranging outreach campaign, including regular updates via a newsletter, a dedicated project web-site, educational programs, site walks, and other events.

Under this proposed SRP, these agency consultations and public meetings would meet the compliance and reporting requirements of MEPA and allow the Herring River Restoration Project to proceed under Adaptive Management guidelines, which acknowledge uncertainty and rely on iterative, science-based, and incremental management decisions. However, it is expected that individual restoration activities, e.g. culvert replacements and road relocations, will most likely require separate permits.

*Environmental Notification Form (ENF)*

As requested by the HRRC, I hereby waive the specific requirement to submit the form usually required as part of the Environmental Notification Form (ENF) submission. While the HRRC intends to submit a document that would serve as the ENF for the MEPA review of the project, the use of the form itself would be problematic because the project's impacts cannot be quantified at this time. In its place, the HRRC will submit a document summarizing all of the basic information on the project, including a concise narrative that will identify how and to what extent the project may exceed each of the review thresholds. I expect that the Environmental Impact Report(s) for the project will contain more detailed information on the project's environmental impacts and benefits, particularly as the HRRC identifies preferred alternatives during the course of the environmental review process.

The proponent's signature below indicates consent to the establishment of a Special Review Procedure and the specific provisions outlined in this Certificate.

June 20, 2008
Date

Ian A. Bowles
Secretary of Energy and Environmental Affairs

June 30, 2008
Date

Gary Joseph
Chair, Herring River Restoration Committee

RWG/RB/rb

CAPE COD COMMISSION
STAFF REPORT

| | |
|---|---|
| **Date:** | **August 8, 2008** |
| To: | DRI Subcommittee<br>Frank Hogan, Chair, Joy Brookshire, Roslyn Garfield, Peter Graham, Roger Putnam, Elizabeth Taylor (alt.), Royden Richardson (alt.) |
| **Proposed Project:** | **Herring River Tidal Restoration Project<br>DRI—MEPA Joint Review<br>(#ENF08009)** |
| **Commission Staff:** | Stacey Justus, Project Planner, Gabriel Belfit, Glenn Cannon, Sarah Korjeff, Heather McElroy and Scott Michaud |

## INTRODUCTION

The above referenced project comes before the Commission as a joint review with MEPA. The Herring River Restoration Committee (HRRC), chaired by Gary Joseph, is the project applicant.

The first public hearing on this project is to be held next Thursday, 8/14/08, 2:00 pm at the Wellfleet Senior Center. This hearing will serve as the joint scoping meeting with MEPA intended to allow public comment on the project to inform your letter to MEPA on the Environmental Notification Form (ENF). Next week will also serve the National Park Service as required public outreach under the NEPA process. Similarly, it will serve MEPA as their public scoping meeting. The format will accommodate all three processes.

Two documents were sent to you previously, including the ENF and the Conceptual Restoration Plan. Also being sent to you is the Joint DRI/MEPA Review Application filed with the Commission on July 25, 2008.

## ENVIRONMENTAL NOTIFICATION FORM (ENF)

An ENF was prepared and noticed in the Environmental Monitor on July 9, 2008. Comments on the ENF are due to MEPA by October 31, 2008. As a mandatory EIR is required, this project will be a DRI as well.

I anticipate that after this hearing the Subcommittee will need to hold meeting(s) in order to develop and finalize your comments on the EIR/DRI scoping, and to discuss how to review this project under the RPP. The applicant seeks specific comments on the information needed to complete a DRI application and facilitate your DRI review.

Attached to this report is a section from the Commission's Joint Review Application that nicely explains the CCC/MEPA joint review process (see **Attachment A** below).

### MEPA / NEPA Review

Prior to the ENF filing, the applicant applied to MEPA for a Special Review Procedure (SRP), which was granted by the Secretary on 6/20/08. This SRP is primarily to facilitate the NEPA/CCC/MEPA process and to identify the Herring River Restoration Committee as a Citizens Advisory Committee that is responsible for assisting with public and agency review and comment. According to the National Park Service, they do anticipate a joint EIR/EIS/DRI filing. The SRP may also enable the regular MEPA timeframes to be adjusted.

## PROJECT DESCRIPTION

The proposed project entails the restoration of ecosystem functions and values to a degraded 1,100-acre tidally restricted estuary. The project area is located within the Wellfleet Harbor Area of Critical Environmental Concern. Most of the project area is located within the town of Wellfleet and the boundary of the Cape Cod National Seashore. Should full tidal restoration ultimately be achieved, lands within the town of Truro will be affected as well.

The prime objective of this project is to eventually restore tidal exchange to an extent closely approximating the normal, natural tidal range that occurred prior to diking at Chequessett Neck Road in 1908. Tides will be restored gradually, over a period of several years, with small, incremental opening of adjustable tide gates.

As described in the Conceptual Restoration Plan, the Herring River project comprises the following elements:

- Reconstruction of the existing 1908 dike and tide control structure at Chequessett Neck Road with a new structure, incorporating enlarged culverts and adjustable tide gates designed to allow gradual increases to tidal range.
- Replacement of at least seven additional culverts at road crossings upstream of Chequessett Neck Road to allow increased tidal exchange and better fish passage.

- Raising, relocating, or abandoning up to 22,000 linear feet of low-lying roadway occurring within the Herring River floodplain that are vulnerable to flooding from restored tidal range.
- Removal of approximately 600 acres of woody vegetation that has become established within the Herring River floodplain in order to promote recolonization of salt marsh vegetation and support fish passage coincident with restored tidal range.
- Restoration of natural channel sinuosity in the channelized portions of the Herring River system to enhance wetland habitat functions and abate mosquito production.
- Prevention and/or mitigation of flooding impacts to several private properties within the Herring River floodplain, including structures, developed lands, and domestic water wells.

Four preliminary project alternatives are described in the ENF, including:

1. No action alternative
2. Modified tidegate control at Chequessett Neck Road dike
3. Open bridge with upstream tidegate controls
4. Complete opening of the existing culverts

Ultimately, the Commission should provide comments to MEPA and the Applicant on each of these alternatives in terms of their relative consistency with the RPP.

## RPP MINIMUM PERFORMANCE STANDARD CONSISTENCY REVIEW

Staff has considered the project as proposed in the ENF and Conceptual Restoration Plan in the context of the issue areas of the 2002 Regional Policy Plan. **Attachment B (RPP Minimum Performance Standards Relevant for DRI Review, Preliminary Staff Analysis – August 8, 2008)** presents tables that begin to identify the standards that will be relevant to this project review. Based on the information provided to date, staff believes that the issues areas of Water Resources, Coastal Resources, Wetlands, Wildlife and Plant Habitat, and Heritage Preservation are relevant to the project as proposed.

Attachment B provides a list of applicable MPSs, the project's consistency with them, questions/comments to focus analysis, and information requested for DRI review. We expect that as the project alternatives analysis develops this chart will be revised.

## CONCLUSION

Commission staff supports the HRRC goal of addressing the tidal restriction in the Herring River system. As the project develops we look forward to reviewing it in the context of the 2002 Barnstable County Regional Policy Plan and working with the Subcommittee throughout the DRI review.

Cc: Gary Joseph, HRRC Chair
c/o Hillary Greenberg
220 West Main St.
Wellfleet, MA 02667

Craig Woods, PWS
The Louis Berger Group
75 Second Ave., Suite 700
Needham, MA 02494

Charlene Greenhalgh, Truro DRI Liaison

Rex Peterson, Wellfleet DRI Liaison

Carrie Phillips
Chief, Natural Resource Management
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, MA 02667

**ATTACHMENT A**

**(Excerpt from Attachment 6: Request of Joint Review/DRI Review from the DRI application)**

## STEP THREE: JOINT REVIEW OF ACCEPTED APPLICATIONS

ENF Process

Once a Joint Review application has been submitted and accepted, a public hearing/scoping session will be scheduled within 20 days of the publication of the ENF in the *Environmental Monitor* (published by MEPA). The public hearing/scoping session is intended to allow interested persons to comment on the project and is held during the required ENF comment period for the project. Commission staff will prepare a Staff Report in advance of the public hearing/scoping session to provide comment on the project information submitted and contained in the ENF.

Following the public hearing/scoping session, and prior to the ENF comment period ending, the subcommittee will meet to decide on its comments to MEPA. The subcommittee then sends a comment letter to MEPA that includes a recommended scope for the Joint Review process. It should be noted that the Commission's scope of review may be broader than the MEPA jurisdiction.

Following the close of the ENF comment period, the Secretary of Environmental Affairs (Secretary) will issue a certificate for the project. If the Secretary does not require an EIR, the joint Commission/MEPA process concludes. However, the Commission DRI process continues if a mandatory threshold is exceeded and a town referral is received (see Attachment 1 for the applicable DRI review process). If the Secretary requires an EIR, the scope is detailed in the Secretary's certificate and the Joint Review process continues with the preparation of a Draft EIR.

Draft EIR Process

A Draft EIR is prepared and submitted to MEPA that responds to the scope of the Secretary's ENF certificate. The preparer should also submit 12 copies of the Draft EIR to the Commission. The preparer of the Draft EIR should ensure that all materials required for the Commission's DRI review be included in the document based on the ENF scoping letter submitted by the Commission subcommittee. During the public comment period on the Draft EIR, the Commission may hold a public hearing to receive input from the public on the document. Prior to the closing of the public comment period, a Commission subcommittee submits a letter to MEPA commenting on whether the Draft EIR adequately responds to the EIR scope. Following the close of the Draft EIR comment period, the Secretary issues a certificate on the adequacy of the Draft EIR and either requires the preparation of a supplemental Draft EIR or a Final EIR.

Final EIR Process

The proponent prepares a Final EIR that may be limited to aspects of the project or issues that require further description or analysis. The Final EIR also contains a response to comments raised by the Commission and others. The preparer submits the Final EIR to MEPA and 12 copies of the Final EIR to the Commission. During the public comment period for the Final EIR, the Commission may hold a public hearing to receive input from the public on the document. Prior to the closing of the public comment period, a Commission subcommittee will submit a letter to MEPA commenting on whether the Final EIR is adequate. Following the close of the Final EIR comment period, the Secretary issues a certificate on the adequacy of the Final EIR and either requires the preparation of a supplemental Final EIR or determines the Final EIR to be adequate. Once the Secretary issues a certificate that determines the Final EIR to be adequate, the state environmental review process concludes and the Commission's statutory timeframes begin.

Commission DRI Review Process

The Commission must open a public hearing within 45 days of the date of the certificate issued by the Secretary indicating that the Final EIR is adequate. Additional hearings may be held as necessary throughout the Commission's review process.

Before a substantive public hearing can be held, all information required for a complete DRI application must be submitted, included in the EIR or waived by the Executive Director. If the DRI application is incomplete at the conclusion of the environmental review process, a hearing officer may be required to open the public hearing for procedural purposes. The required submittals and required number of plans for a DRI application are itemized in "*Attachment 1: DRI Application Filing Procedures & Requirements*" that may be obtained from Commission staff or the Commission's web site (www.capecodcommission.org). Additional information may be required by the Commission to address any remaining issues. The Commission reviews a proposed project for its consistency with the Cape Cod Commission Act, the Regional Policy Plan, Districts of Critical Planning Concern, local regulations, and certified Local Comprehensive Plans.

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Herring River Restoration Project – Joint MEPA/DRI Review
RPP Minimum Performance Standards Relevant for DRI Review
Preliminary Staff Analysis – August 8, 2008

ATTACHMENT B

## RPP Issue Areas: Wetlands and Wildlife and Plant Habitat

| Minimum Performance Standard | Applicable (Yes/No) | Consistent (Yes/No/ Uncertain) | Comments/Questions to focus analysis (Bullet what is needed to know in order to determine consistency) | Information requested |
|---|---|---|---|---|
| **Wetlands** **Goal 2.3.1** To preserve and restore the quality and quantity of inland and coastal wetlands | Yes | Yes | While the project will restore various wetland and habitat values, some values will be lost or changed. | Quantify the nature of the changes, positive and negative, by wetland resource area, to the extent possible. |
| **MPS 2.3.1.1** Wetland alteration shall not be permitted except as provided herein and in MPS 2.3.1.3. As an exception, where there is no feasible alternative, water-dependent projects involving wetland alteration with appropriate mitigation may be permitted subject to the approval of all permitting authorities. (more) | Yes | Yes | As a water dependent wetland restoration, this project may likely be found to comply with the standard. But the Commission will have to find that the alteration is the minimum necessary to accomplish the goals of the project, and presumably that the benefits of the restoration outweigh the impacts to the existing functions of the wetlands involved. | Quantify the nature of the changes, positive and negative, by wetland resource area, to the extent possible. |
| **MPS 2.3.1.2** Vegetated, undisturbed buffer areas of at least 100 ft in width shall be maintained and/or provided from the edge of coastal and inland wetlands including isolated wetlands, to protect their natural functions. (more) | Yes | No | While a literal interpretation of this standard will result in noncompliance due to the possible alteration of buffers to wetlands, compliance with the standard may be waived through use of the Flexibility Clause, and/or demonstration that the habitat values have been improved. Mitigation could be required if there is a finding of adverse impacts to buffers. | Quantify the nature of the changes, positive and negative, by wetland resource area, to the extent possible. |
| **ODRP 2.3.1.5** measures to restore altered or degraded inland and coastal wetlands, including… restoration of tidal flushing should be encouraged; however, such areas should not be used as mitigation banking for wetland alteration projects. | Yes | Yes | This standard is not a minimum performance standard, but more of a best management practice. It is included in the RPP as a demonstration of the RPP's support of wetland restoration projects. However, it should be noted that compliance with the MPSs is primary. | Catalogue, consistent with much of the research that has been completed to date, the multiple benefits to ecology, economy, etc. known or expected from the project. To the extent these benefits may be quantified, provide quantities. |

Herring River Restoration Project – Joint MEPA/DRI Review
RPP Minimum Performance Standards Relevant for DRI Review
Preliminary Staff Analysis – August 8, 2008

ATTACHMENT B

| Minimum Performance Standard | Applicable (Yes/No) | Consistent (Yes/No/ Uncertain) | Comments/Questions to focus analysis (Bullet what is needed to know in order to determine consistency) | Information requested |
|---|---|---|---|---|
| **Wildlife and Plant Habitat** **MPS 2.4.1.1** Applications for DRIs that propose to alter undeveloped areas shall contain a natural resources inventory. (more) | Yes | | The NEPA/MEPA/DRI document should provide a natural resources inventory consistent with RPP requirements | See the NRI Technical Bulletin 92-002 |
| **MPS 2.4.1.2** Clearing of vegetation and alteration of natural topography shall be minimized, with native vegetation planted as needed to enhance or restore wildlife habitat. (more) | Yes | Uncertain | Clearing associated with the CYCC reconfiguration, relocating low-lying roadways, and other clearing and grading associated with the various alternatives should strive to minimize impacts to existing topography and habitat. | |
| **MPS 2.4.1.4** The Natural Heritage and Endangered Species Program (NHESP) has agreed to review DRIs proposed within critical wildlife and plant habitat areas… DRIs that would adversely affect habitat of local populations of rare wildlife and plants shall not be permitted. Development may be permitted where the proponent can demonstrate that such development will not adversely affect such habitat. (more) | Yes | Uncertain | The proponents should continue to work directly with the NHESP to ensure that proposed changes are consistent with the Massachusetts Endangered Species Act, and may be permitted by NHESP. | Evidence of work with the NHESP and response to their concerns. |
| **MPS 2.4.1.5** Where a project site is located adjacent to a vernal pool… development shall be prohibited within a 350 ft undisturbed buffer around these wetland resources. | Unsure | Uncertain | The NRI should evaluate whether there are any vernal pools within the proposed project area. | NRI, delineation of pools, as necessary, provision of 350 ft buffer. |
| **MPS 2.4.1.6** Development on sites where a NRI identifies the presence of invasive plant species shall provide and implement a management and restoration plan detailing the management of, and where possible, the eradication of the invasive species present, and for | Yes | Yes | The project will restore areas where invasive species are present. A full-scale management plan for the project area is impractical, but the benefits of areas where invasive species may be removed due to increased flooding or other development activities should be itemized as a benefit of the project. | Quantify, to the extent practicable, areas of invasive species to be restored, either through flood inundation or grading/revegetation activities (i.e. road and golf course relocation) |

Herring River Restoration Project – Joint MEPA/DRI Review
RPP Minimum Performance Standards Relevant for DRI Review
Preliminary Staff Analysis – August 8, 2008

ATTACHMENT B

| Minimum Performance Standard | Applicable (Yes/No) | Consistent (Yes/No/ Uncertain) | Comments/Questions to focus analysis (Bullet what is needed to know in order to determine consistency) | Information requested |
|---|---|---|---|---|
| revegetating the site with native species. | | | | |
| **ODRP 2.4.1.7** measure to restore altered or degraded upland habitat areas should be encouraged where ecologically appropriate. | Unsure | Uncertain | To the extent that upland areas may be restored through this project, they should be identified as a project benefit. | Quantify extent and nature of restoration. |

## RPP Issue Area: Water Resources

| Minimum Performance Standard | Applicable (Yes/No) | Consistent (Yes/No /uncertain) | Comments/Questions to focus analysis (Bullet what is needed to know in order to determine consistency) | Information requested |
|---|---|---|---|---|
| **MPS 2.1.1.2.A5**: Development and redevelopment shall adopt a turf and landscape management plan that incorporates water conservation measures and minimizes the amount of pesticides and chemical fertilizers through best management practices. | Yes | uncertain | This might apply to the golf course reconstruction if it was part of the review. | |
| **2.1.1.3** Development and redevelopment shall identify their proposed wells and existing private wells on abutting properties within 400 feet and assess the impact of the development on the water quality of these wells and all other existing wells that may potentially be affected by the proposed development. Septic systems and other sources of contamination shall be sited to avoid contamination of existing or proposed wells. | Yes | uncertain | How will changes in the water table and salt water fresh water interface affect the water quality in private wells as well as the functioning of septic systems? | Plans for relocation of wells and septic system and hydrodynamic modeling results with detail in area where wells and septic systems impact is projected. |
| **2.1.3.1** New direct discharge of untreated stormwater, parking-lot runoff, and/or wastewater into marine and fresh surface water and natural wetlands shall not be | Yes | uncertain | How will stormwater runoff be handled after the roadway is altered? | Plans for upgrading stormwater discharges from new roadways |

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RPP Minimum Performance Standards Relevant for DRI Review
Preliminary Staff Analysis – August 8, 2008

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| Minimum Performance Standard | Applicable (Yes/No) | Consistent (Yes/No /uncertain) | Comments/Questions to focus analysis (Bullet what is needed to know in order to determine consistency) | Information requested |
|---|---|---|---|---|
| permitted. | | | | |
| **2.1.3.2** Stormwater shall be managed and infiltrated on site to minimize runoff and maximize water quality treatment. Stormwater treatment designs shall be based upon a 25-year 24-hour storm and attain 80% total suspended solids removal and at a minimum be consistent with Massachusetts Stormwater Policy Guidelines. | Yes | uncertain | What are the specific stormwater disposal designs for the new roadways? | Plans for upgrading stormwater discharges from new roadways |
| **2.1.3.3** Development and redevelopment shall use best management practices such as vegetated swales and non-structured wetland detention basins for treatment prior to infiltration. Non-structured wetland detention basins and vegetated swales may be counted as open space within Wellhead Protection Areas. | Yes | uncertain | What are the specific stormwater disposal designs for the new roadways? | Plans for upgrading stormwater discharges from new roadways |
| **2.1.3.5** Infiltration basins or other stormwater leaching structures shall maintain a two-foot separation between maximum high water table and point of infiltration. | Yes | uncertain | What are the specific stormwater disposal designs for the new roadways? How will the alteration of the water table affect the separation distance from existing stormwater discharge locations. | Plans for upgrading stormwater discharges from new roadways. Results of hydrodynamic modeling in relation to existing and proposed stormwater discharge locations. |

## RPP Issue Area: Heritage Preservation

| Minimum Performance Standard | Applicable (Yes/No) | Consistent (Yes/No/ uncertain) | Comments/Questions to focus analysis (Bullet what is needed to know in order to determine consistency) | Information requested |
|---|---|---|---|---|
| **RPP Goal 6.1** To protect and preserve | Yes | uncertain | This project may have impacts on historic and | |

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| Minimum Performance Standard | Applicable (Yes/No) | Consistent (Yes/No/ uncertain) | Comments/Questions to focus analysis (Bullet what is needed to know in order to determine consistency) | Information requested |
|---|---|---|---|---|
| the important historic and cultural features of the Cape landscape and built environment that are critical components of Cape Cod's heritage and economy. | | | archaeological resources. It will require federal historic resource review under Section 106 of the National Historic Preservation Act, which requires federal agencies involved to identify any historic or archaeological resources that may be impacted and to consider ways to avoid adverse impacts. The project will also require review by the Massachusetts Historical Commission in a process that mirrors the federal review. | |
| **MPS 6.1.1** An historic structure's key character-defining features, including the relationship to its site and setting shall be preserved. (more) Removal or alteration of distinguishing original stylistic features or examples of skilled craftsmanship of historic or aesthetic significance shall be prohibited unless.(more). | Yes | uncertain | Protection of historic structures: The ENF states that there are no known National Register-listed historic structures located in the Herring River Estuary, but there may be historic structures that have not been inventoried or listed. | A survey of structures that will be impacted, including the dike itself and privately owned buildings that may need to be relocated due to tide level increases, should identify any that are historically significant. If any significant structures will be impacted by the project, their key character-defining features shall be preserved. |
| **MPS 6.1.3** Where development is proposed on or adjacent to known archaeological sites or sites with high archaeological sensitivity as identified by the MHC or Local Historical Commission during the review process, it shall be configured to maintain and/or enhance such resources where possible. (more) | Yes | uncertain | Protection of archaeological resources: The proposed project area encompasses archaeologically sensitive areas and several known archaeological sites. Where development is proposed on or adjacent to known archaeological sites or sites with high archaeological sensitivity, it shall be configured to maintain and/or enhance such resources. Sites determined eligible for listing on the National Register of Historic Places shall be preserved and protected from disturbance. In a letter from Massachusetts Historical Commission (MHC) dated June 24, 2008, additional information was requested to better define the areas that will be affected by the project and determine a scope for survey work. MHC's letter also noted that archaeological review of the associated golf course redevelopment project should be conducted in conjunction with this undertaking. While a permit application to conduct archaeological work in the golf course area was received in 2007, no archaeological survey permit was issued for this area. | |

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## RPP Issue Area: Coastal Resources

| Minimum Performance Standard | Applicable (Yes/No) | Consistent (Yes/No/ uncertain) | Comments/Questions to focus analysis (Bullet what is needed to know in order to determine consistency) | Information requested |
|---|---|---|---|---|
| **Public Access** **Coastal Resources Goal 2.2.1:** To protect public and traditional maritime interests in the coast and rights for fishing, fowling, and navigation, to preserve and manage coastal areas so as to safeguard and perpetuate their biological, economic, historic, maritime, and aesthetic values, and to preserve, enhance and where appropriate expand public access to the shoreline. | Yes | Yes | The ENF p.18 discusses public access improvements that will result from this project | |
| **MPS 2.2.1.1** Development and redevelopment along the coastline shall not interfere with existing public access and traditional public rights of way to and environmentally appropriate use of the shoreline. | Yes | Uncertain | Materials indicate that these interests will be expanded. (Conceptual Restoration Plan p. 72-47) | Project plans |
| **ODRPs 2.2.1.5 and 2.2.1.8** | Yes | Uncertain | There may be opportunity to enhance public access that should be part of the preferred alternative and project design | Construction design details of dike and Chequessett Neck Road or other locations as appropriate to these ODRPs |
| **Hazard Mitigation** **Coastal Resources Goal 2.2.2**: To limit development in areas subject to coastal storm flow, particularly high-hazard areas, in order to minimize human casualties and property or environmental damage resulting from storms, flooding, erosion, and relative sea level rise. | Yes | Uncertain | Restoring the natural floodplain would likely minimize storm-induced damage. However, over time development has occurred in the floodplain upstream of the dike. How will the restoration change flood heights and what development will be affected? | Project plans showing existing and projected flood elevations for each alternative. |
| **MPS 2.2.2.1 – 2.2.2.3** **(see text regarding development in flood zones)** | Maybe | Uncertain | Depending on where development (Chequessett Neck golf course redevelopment, road relocations, etc) is ultimately proposed, these standards may become relevant | Project plans with resource delineations |
| **MPS 2.2.2.4** No new non-water dependent development shall be | Maybe | Uncertain | Is the CYCC proposed reconfiguration area on coastal bank? | Project plans with resource delineations |

| Minimum Performance Standard | Applicable (Yes/No) | Consistent (Yes/No/ uncertain) | Comments/Questions to focus analysis (Bullet what is needed to know in order to determine consistency) | Information requested |
|---|---|---|---|---|
| permitted within 100 feet of the top of a coastal bank, dune crest, or beach. | | | | |
| **MPS 2.2.2.6** No new public infrastructure or expansion of existing infrastructure shall be made in flood hazard zones unless it is shown that there is an overriding public benefit provided, and provided that such infrastructure will no promote new growth and development in flood hazard areas. | Yes | Likely | | |
| **MPS 2.2.2.7** Where land subject to coastal storm flow serves to control floods and prevent storm damage, no activity shall increase the existing site elevations or the velocity of flood waters (more) | Yes | Uncertain | Will fill be needed for any component? | Narrative |
| **MPS 2.2.2.8** New development or redevelopment shall not impede the landward migration of resources areas within the 100-year floodplain (more) | Yes | Likely | | |
| **MPS 2.2.2.9** New structures... new or proposed expansions of coastal engineering structures, and new septic systems shall be prohibited within the V zone of a beach, dune, barrier beach, or coastal bank. | Yes | Likely | Would this be considered an expansion of a coastal engineering structure? | Flood zone mapping (existing and projected changes due to increased tidal range) and resource delineation overlay |
| **MPS 2.2.2.11** Monitoring and maintenance plans shall be required of all projects proposing to place dredged material on public or private beaches for nourishment of eroding features. (more) | Maybe | Uncertain | Is there dredging and disposal as part of this proposal? Will there be dredging done that will be considered new/improvement dredging? | Narrative |
| **MPS 2.2.2.12** Wherever feasible dredge materials shall be used for nourishment on public beaches subject to erosion. (more) | Maybe | Uncertain | Is there dredging and disposal as part of this proposal? Will there be dredging done that will be considered new/improvement dredging? | Narrative |
| **Coastal Resources Goal 2.2.3** To maintain and improve coastal water quality to allow shell fishing and/or | Yes | Likely | | |

Herring River Restoration Project – Joint MEPA/DRI Review
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| **Minimum Performance Standard** | **Applicable** (Yes/No) | **Consistent** (Yes/No/ uncertain) | **Comments/Questions to focus analysis** (Bullet what is needed to know in order to determine consistency) | **Information requested** |
|---|---|---|---|---|
| swimming in all coastal waters as appropriate, and to protect coastal ecosystems that support protected species and shellfish and finfish habitat. | | | | |
| **MPS 2.2.3.2** No new direct, untreated stormwater discharges shall be permitted into any coastal waters or wetlands (more). | Yes | Likely | Will new stormwater systems be proposed for relocated roadways or Chequessett Neck Road? | Stormwater plan |
| **MPS 2.2.3.3** The design and construction of stormwater management systems proposed in V-zones shall incorporate the historic rate of relative sea-level rise in Massachusetts (more) | Uncertain | Likely | Where is the V-Zone and are any stormwater systems proposed in them? | Narrative |
| **MPS 2.2.3.6** New dredging shall be prohibited except when new dredging is necessary to accomplish a substantial public benefit and no feasible alternative exists. | Uncertain | Likely | If there is new dredging it is likely that a case can be made for the project being of substantial public benefit. | |
| **MPS 2.2.3.7** Development shall have no significant direct or indirect adverse effects to eelgrass beds, unless there is no feasible alternative location or design for the project and the project is necessary to accomplish a public benefit. | Uncertain | Likely | Is there any affected eelgrass in the estuary system? | Eel grass survey if necessary |
| **MPS 2.2.3.8** Development and redevelopment shall be designed and constructed to minimize direct and secondary impacts to fish, shellfish, and crustaceans. | Yes | Likely | | Narrative |
| **MPS 2.2.3.11** Undisturbed buffer areas of at least 100 feet in width surrounding coastal wetlands and/or landward of the mean high water mark of coastal water bodies shall be protected in accordance with MPS 2.3.1.2 | Yes | No | While a literal interpretation of this standard will result in noncompliance due to the possible alteration of buffers to wetlands, compliance with the standard may be waived through use of the Flexibility Clause, and/or demonstration that the habitat values have been improved. Mitigation could be required if there is a finding of adverse impacts to buffers. | Quantify the nature of the changes, positive and negative, by wetland resource area, to the extent possible. |

MEMORANDUM

TO: Deirdre Buckley, Environmental Reviewer, MEPA Unit

THROUGH: Jonathan Hobill, Acting Deputy Regional Director,
Bureau of Resource Protection
Brenda Chabot, Deputy Regional Director, ADMIN
David Johnston, Acting Regional Director
Millie Garcia-Serrano, Deputy Regional Director, BWSC

CC: Elizabeth Kouloheras, Chief, Wetlands and
Team Leader, Cape Cod Watershed
Patti Kellogg, Wetlands Cape Cod Watershed Coordinator
Richard Keith, Chief, Municipal Services

FROM: Sharon Stone, SERO MEPA Coordinator

DATE: October 31, 2008

RE: ENF EOEEA #14272 – TRURO/WELLFLEET – Herring River Tidal
Restoration Plan

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"For Use in Intra-Agency Policy Deliberations"

The Southeast Regional Office of the Department of Environmental Protection (MassDEP) has reviewed the Environmental Notification Form (ENF) for the proposed Herring River Tidal Restoration Plan, to be located in the Towns of Truro and Wellfleet, Massachusetts (EOEEA #14272). The project proponent provides the following information for the project:

**"The project consists of the re-establishment of tidal flow to the 1,100-acre Herring River estuary and floodplain. The project is being proposed by the Herring River Restoration Committee (HRRC), a multi-agency group appointed by the Towns of Wellfleet and Truro and the National Seashore. Proposed restoration activities include reconfiguration of the Chequessett Neck Road Dike, replacement of additional upstream culverts, additional upstream tidal control structures and mitigation for low-lying roadways, structures and private properties. Tides will be restored gradually with small, incremental opening of adjustable tide gates.**

**At a minimum, it is expected that the Herring River project will alter at least one acre of salt marsh or bordering vegetated wetlands, triggering the mandatory EIR threshold described at 310 CMR 11.03(3)(a). Although the exact nature and extent of wetland alteration is unknown at this time, it is likely this threshold will be exceeded to a significant extent. In addition, the project area is known to contain both estimated and priority rare species habitat, is adjacent to significant cultural and historic resources, and is located with the Wellfleet Harbor Area of Critical**

**Environmental Concern (ACEC). The project will require numerous state permits (Chapter 91 Licenses, 401 Water Quality Certification, etc.) and has already received funding from the Massachusetts Office of Coastal Zone Management's Wetlands Restoration Program. Because the project requires a Chapter 91 License, MEPA jurisdiction is broad in scope and extends all aspects of the project with the potential to cause Damage to the Environment.**

**The project is also subject to review under the National Environmental Policy Act (NEPA) and the Cape Cod Commission Act. A Certificate Establishing a Special Review Procedure (SRP) was issued on June 20, 2008 to provide for coordination of MEPA review with other environmental and developmental review and permitting processes. The Scoping Session will also serve as a scoping session for the NEPA process and a Cape Cod Commission hearing."**

The Cape Cod Watershed Team/Wetlands and Waterways Program has reviewed the document and indicates the following comments.

The project consists of the re-establishment of tidal flow to the 1,100-acre Herring River estuary and floodplain. The project is being proposed by the Herring River Restoration Committee (HRRC), a multi-agency group appointed by the Towns of Wellfleet and Truro and the National Seashore.

Proposed restoration activities include reconfiguration of the Chequessett Neck Road dike, replacement of additional upstream culverts, additional upstream tidal control structures and mitigation for low-lying roadways, structures and private properties. The project area is known to contain both estimated and priority rare species habitat, is adjacent to significant cultural and historic resources, and is located with the Wellfleet Harbor Area of Critical Environmental Concern (ACEC). .

The Herring River Conceptual Restoration Plan includes several preliminary alternatives for restoring tidal flow to the Herring River. Therefore, the exact nature and extent of the impacts are not known at this time. However, it is expected that the project will alter at least 1 acre of salt marsh or bordering vegetated wetlands. The alteration of one or more acres of salt marsh or BVW or any alteration requiring a variance in accordance with the Wetlands Protection Act requires a mandatory EIR. Greater detail of the impacts of the alternatives will be required in the EIR.

Several potential plan components could alter coastal and inland wetlands. The project will require numerous state permits including authorization under the WPA, Chapter 91, 401 Water Quality Certification, and compliance with the Town of Wellfleet's Coastal Wetlands Restriction Order [310 CMR 12.00 and MGL c 130 s. 105]. Since the project is located within the Wellfleet Harbor Area of Critical Environmental Concern, the project must meet the standards relative to ACEC in 310 CMR 10.00 and 314 CMR 9.00 and 4.00.

The waters in and adjacent to the Cape Cod National Seashore within 1,000 feet seaward of mean low water are considered outstanding resource waters (ORW) pursuant to 314 CMR 4.06. Should the project result in a discharge to an ORW, a Major 401 Quality Certification will be required. A 401 WQC will require an alternatives analysis demonstrating avoidance, minimization and mitigation of any adverse impacts. Portions of the project are located on lands subject to the Department's Order of Restriction adopted April 19, 1982. This Order contains specific prohibitions, including substantially altering existing patterns of tidal flow. The proponent is advised to contact the Department to conduct a review of the land restricted pursuant to the Order to determine if an amendment or modification to the Order of Restriction is required.

There are known design concerns particularly for low lying roads and properties. Culvert replacements will need to be reviewed and permitted either by the local conservation commission, the Massachusetts Department of Environmental Protection (§401 Water Quality Certification), the US Army Corp of Engineers, or a combination of the three. Additional separate permits may be required for culvert replacements and road relocations. Culverts shall meet the MA Rivers and Stream Crossing Standards and stormwater management standards shall apply to any culvert replacements or road repairs that will result in a stormwater discharge. Higher standards apply to discharges to ORW. A redevelopment project must meet the stormwater standards to the maximum extent practicable.

For work effecting the Riverfront Area (the mouth of the Herring River for Riverfront Area designation is the dike at Chequessett Neck Road), the applicant shall prove by a preponderance of the evidence that there are no practicable and substantially equivalent economic alternatives to the proposed project with less adverse effects on the interests identified in M.G.L. c.131 §40 and that the work, including proposed mitigation, will have no significant adverse impact on the riverfront area to protect the interests identified in M.G.L. c. 131 §40.

As part of the EIR, the proponent should identify the specific resource areas, referenced in 310 CMR 10.25 to 10.35 and 310 CMR 10.54 to 10.57, to be impacted by the project. Evaluation of resource impacts should include the development of a map at an appropriate scale which identifies the square footage and/or linear footage of impacts to each resource area. For each resource area to be impacted by the project, the applicant should identify how the performance standards for each resource area will be achieved. Emphasis should be placed on evaluating the impacts to the flood plain and effects on the interests of the Act, particularly storm damage prevention and flood control. At a minimum, any activity in a resource area or buffer zone shall be designed and constructed using best practical measures so that adverse effects are minimized.

Although projects that restore or rehabilitate a salt marsh or bordering vegetated wetlands may be permitted pursuant to 310 CMR 10.32 (5) and 310 CMR 10.53 (4), projects located within an ACEC are subject to the provisions of 310 CMR 10.24 (5), requiring no adverse effect on the interests of the Act.

If a variance is sought for the application of any regulation, the applicant should be requested to develop the appropriate information necessary to evaluate the criteria to be considered in the issuance of a variance. (See: 310 CMR 10.36 or 310 CMR 10.58.) In order to receive a variance the applicant is required to show that there is an overriding public interest in the project, that no other reasonable alternative exists, and that mitigation efforts will be undertaken to minimize the project impacts.

The applicant should also be required to identify and discuss all reasonable alternatives which have been considered for the present project in order to avoid wetland impacts. The Applicant should be required to state why those alternatives which meet performance standards have been found to be unreasonable or why the alternatives which do not meet performance standards are less desirable for wetlands protection than the proposed alternative.

Finally, the Applicant should be required to provide a full description of the mitigation measures which are proposed for this project. The discussion of mitigation measures should detail the extent of wetlands resource impacts, the functions associated with those resources, and the mitigation measures which will minimize resource impacts and/or restore resource functions.

The applicant should be advised that if the above information is not thoroughly presented as part of the EIR process, the request for this information will be required as part of the variance review process by the Department of Environmental Protection. Since the issuance of variance decisions has, in the past, taken considerable time, it is critical that the applicant consider the standards for a variance and address informational requirements during the project planning process. The incorporation of the above information in the EIR process will save the applicant considerable time and may save the cost of the variance filing fee if a variance does not appear likely following the full assessment of the project as part of the EIR.

*Construction Activities - EPA*

The project construction activities may disturb one or more acres of land and therefore, may require a NPDES Stormwater Permit for Construction Activities. The proponent can access information regarding the NPDES Stormwater requirements and an application for the Construction General Permit at the EPA website: http://cfpub.epa.gov/npdes/stormwater/cgp.cfm

*BWSC Comments*

Based on the information provided in the ENF, the Bureau of Waste Site Cleanup (BWSC) searched its database for disposal sites and release notifications. There is one former disposal site located in the vicinity of the project. Release Tracking Number (RTN) 4-16352, located at the Chequessett Brush Dump Area, submitted a Class A2 RAO on November 14, 2001.

The Project Proponent is advised that, if oil and/or hazardous material is identified during the implementation of this project, notification pursuant to the Massachusetts

Contingency Plan (310 CMR 40.0000) must be made to MassDEP, if necessary. A Licensed Site Professional (LSP) may be retained to determine if notification is required and, if need be, to render appropriate opinions. The LSP may evaluate whether risk reduction measures are necessary or prudent if contamination is present. The BWSC may be contacted for guidance if questions regarding cleanup arise.

The MassDEP Southeast Regional Office appreciates the opportunity to comment on this proposed project. If you have any questions regarding these comments, please contact Sharon Stone at (508) 946-2846.

# The Commonwealth of Massachusetts

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November 7, 2008

CERTIFICATE OF THE SECRETARY OF ENERGY AND ENVIRONMENTAL AFFAIRS
ON THE
ENVIRONMENTAL NOTIFICATION FORM

| | |
|---|---|
| PROJECT NAME | : Herring River Restoration Project |
| PROJECT MUNICIPALITY | : Wellfleet and Truro |
| PROJECT WATERSHED | : Cape Cod |
| EOEA NUMBER | : 14272 |
| PROJECT PROPONENT | : Town of Wellfleet, Town of Truro and Cape Cod National Seashore |
| DATE NOTICED IN MONITOR | : July 23, 2008 |

Pursuant to the Massachusetts Environmental Policy Act (G. L. c. 30, ss. 61-62I) and Section 11.06 of the MEPA regulations (301 CMR 11.00), I hereby determine that this project **requires** the preparation of an Environmental Impact Report (EIR).

This project has the potential to re-introduce up to 1,000 acres of salt marsh to the Herring River floodplain and estuary. This is the largest salt marsh restoration project in Massachusetts and represents an ambitious undertaking by the Cape Cod National Seashore (CCNS), the Town of Wellfleet and the Town of Truro. The Nature Conservancy and Mass Audubon have expressed their strong support for the project. Comments on the project, including comments from the US Environmental Protection Agency (EPA), the Natural Heritage and Endangered Species Program (NHESP) and the Areas of Critical Environmental Concern (ACEC) Program and other state resource agencies, identify support for the goals of the project. Comments from residents that could be affected by the project stress the importance of planning the project carefully to avoid unintended consequences and to minimize impacts of the project on private property.

Project Description

The project consists of the re-establishment of tidal flow to the 1,100-acre Herring River estuary and floodplain to an extent closely approximating the natural tidal range that occurred prior to diking at the Chequesset Neck Road. The ecological goal of the project is to restore the full natural tidal range throughout as much of the Herring River floodplain as practicable, including up to the 100-year flood level (9.1 feet NAVD88). In certain areas where tidal flooding must be limited to protect existing land uses, the goal is to restore the maximum high tide up to the mean spring high-tide level (9.1 feet NAVD88). The project proponents plan to use an adaptive management strategy to restore tides gradually with small, incremental openings of adjustable tide gates over a period of several years allowing floodplain characteristics to be monitored and adjusted in response to these actions.

Project planning has been guided by the Herring River Restoration Committee (HRRC), a multi-agency group appointed by the towns of Wellfleet and Truro and the CCNS. The HRRC, with input from stakeholders, prepared the Herring River Conceptual Restoration Plan (November 2007) which was provided to the MEPA Office as a supplement to the ENF.

Proposed restoration activities include reconfiguration of the Chequessett Neck Road dike, replacement of additional upstream culverts, additional upstream tidal control structures and mitigation for low-lying roadways, structures and private properties.

The ENF indicates that the project will include some or all of the following activities:

- Reconstruction of the existing dike and tide control structure at Chequessett Neck Road.
- Construction of several tidegate control structures upstream of Chequessett Neck Road to protect existing land uses.
- Replacement of several culverts upstream of Chequessett Neck Road to allow increased tidal exchange and better fish passage.
- Reconfiguration of the CYCC golf course to maintain a playable layout given increased tide heights.
- Raising, relocating, or removing up to 22,000 linear feet of low-lying roadway occurring within the Herring River floodplain which would be vulnerable to flooding from a restored tidal range.
- Removal of approximately 600 acres of woody vegetation that has become established within the Herring River floodplain in order to promote recolonization of salt marsh vegetation and support fish passage coincident with restored tidal range.
- Restoration of natural channel sinuosity to enhance wetland habitat functions and abate mosquito production.
- Prevention and/or mitigation of flooding impacts to several private properties within the Herring River floodplain, including structures and domestic water wells.
- Public access improvements including additional canoe/kayak put-in locations and fishing piers.

Project Site

The project site includes the Herring River floodplain within Wellfleet and Truro. The Herring River extends from Wellfleet Harbor at the Chequesset Neck Road dike northeast about four miles to Herring Pond in Wellfleet, and to the northwest a similar distance to Ryder Beach in south Truro. Approximately 80% of the floodplain is within and is managed by the CCNS. The Chequesset Neck Dike, which was constructed in 1908, consists of three 6-foot wide culverts, two of which allow river outflow into Wellfleet Harbor, but block the inflow of seawater, while the third has a partially open sluice gate that allows some inflow of seawater. According to the ENF, the estuary was dominated by healthy and highly productive salt marsh plant communities prior to the construction of the dike. The result of the diking and subsequent drainage of the estuary has led to the conversion of hundreds of acres of intertidal salt marsh to upland vegetation, eliminating habitat for estuarine animals, including shellfish and finfish. Approximately 13.6 acres of saltmarsh remain upstream of the dike. In addition, surface waters have been acidified, toxic metals have been leached from native clays, and dissolved oxygen depletions are common, which have contributed to fish kills in the river. The dike has restricted the normal tidal range of 10 feet (ranging from 5 below to 5 feet above NAVD88) within Wellfleet Harbor just seaward of the dike to approximately 2 feet (ranging from 1.1 feet below to .9 feet above NAVD88) above the dike. Drainage has caused the wetlands upstream of the dike to subside by nearly 3 feet.

The project area contains both estimated and priority rare species habitat, contains important fisheries and shellfishery resources, is adjacent to significant cultural and historic resources, and is located with the Wellfleet Harbor Area of Critical Environmental Concern (ACEC). According to the NHESP 13th Edition of the MA Natural Heritage Atlas, the project will occur within or in the vicinity of the habitat of the following state-listed species: Roseate Tern (*Sterna dougallii),* Common Tern (*Sterna hirundo*), Northern Harrier (*Circus cyaneus*), Piping Plover (*Charadrius melodus*), Eastern Box Turtle (*Terrapene carolina*), Diamond-backed Terrapin (*Malaclemys terrapin*), EasternSpadefoot (*Scaphiopus holbrookii*), Gerhard's Underwing Moth (*Catocala herodias gerhardi*), Water-Willow Stem Borer (*Papaipema sulphurata*) and Broom Crowberry (*Corema conradii*). Diadromous fish species (Alewife and Blueback herring) use all or part of the river for passage, spawning, nursery and forage habitat. Various life stages of numerous other finfish species transit and/or inhabit the river during the year including American eel, white perch and lamprey. Oyster beds are located within the Herring River and seaward of the Chequesset Neck Road Dike. The ENF indicates that the project area is adjacent to and includes significant cultural resources. In addition, the project area includes private property including the CYCC and private residences.

Permits and Jurisdiction

At a minimum, it is expected that the Herring River project will alter at least one acre of salt marsh or bordering vegetated wetlands (BVW), triggering the mandatory EIR threshold described at 310 CMR 11.03(3)(a). The exact nature and extent of wetland alteration is unknown at this time; however, it is likely this threshold will be exceeded to a significant extent. In addition, the project may exceed other mandatory EIR thresholds including 310 CMR 11.03

(a)(1) because it will alter more than 50 acres of land and 310 CMR (3)(a)(2) because it may require a variance in accordance with the Wetlands Protection Act. The project will require Chapter 91 Licenses and 401 Water Quality Certifications from the Department of Environmental Protection (MassDEP). It may require a Conservation and Management Permit from the Natural Heritage and Endangered Species Program (NHESP). It will require Federal Consistency Review by the Coastal Zone Management (CZM) Office. It will require review by the Massachusetts Historical Commission (MHC). In addition, the project will require Orders of Conditions from the local conservation commissions.

The project has received funding from the CZM Wetlands Restoration Program. Because the project includes state funding, MEPA jurisdiction is broad in scope and extends to all aspects of the project that may cause Damage to the Environment as defined by the MEPA regulations. These include water quality, wetlands, coastal/marine resources, rare species habitat and cultural resources.

The project may require a National Pollutant Discharge Elimination System (NPDES) General Construction Permit for Stormwater from the US Environmental Protection Agency (EPA) and will require Section 404/Section 10 permits from the US Army Corps of Engineers (ACOE) and it will require Section 106 Review. The project is also subject to review under the National Environmental Policy Act (NEPA) and the Cape Cod Commission Act as a Development of Regional Impact (DRI).

Coordinated Review/Special Review Procedure

The proponent has committed to filing one set of documents that fulfill the requirements of NEPA, MEPA, and CCC. Both NEPA and MEPA regulations allow (and encourage) the preparation of joint EIS/EIR documents. Coordinated review will allow maximum public and agency understanding of the project and ensure that review by regulatory agencies is as efficient as possible. A Certificate Establishing a Special Review Procedure (SRP) was issued on June 20, 2008 to provide for coordination of MEPA review with these environmental and developmental review and permitting processes. The public meeting held on August 14, 2008 served as the scoping session for the NEPA and MEPA process and as the hearing for the Cape Cod Commission. An additional public meeting was held on September 12, 2008. The consolidation and coordination will allow these regulatory and public review processes to be conducted in such a way that the public will be able to provide both written and oral comments, within a single timeframe, under the various regional, state and federal regulatory processes. This project has been to subject to extended review under the MEPA process to align with the NEPA public comment period.

As part of the SRP, the HRRC was identified as the Citizens Advisory Committee (CAC) to assist with public and agency review and comment as allowed by the MEPA regulations at 310 CMR 11.09(3). In addition to the Towns of Wellfleet and Truro and the CCNS, the HRRC includes representatives from CZM's Wetlands Restoration Program; the National Oceanic and Atmospheric Administration (NOAA) Restoration Center; the U.S. Fish and Wildlife Service; and the Natural Resources Conservation Service (NRCS).

In addition, the SRP waived the specific requirement to submit the form usually required as part of the Environmental Notification Form (ENF) submission. The ENF submitted on this project summarizes basic information regarding the project, including a narrative that identifies how and to what extent the project may exceed each of the review thresholds.

## SCOPE

The EIR should follow the general guidance for outline and content contained in section 11.07 of the MEPA regulations, as modified by this Certificate. The Cape Cod Commission provided a comment letter on this project identifying information that will be relevant to this project's review as a DRI. Because the proponent will file a Draft EIR/EIS/DRI, I am incorporating the comment letter from the CCC into the Scope by reference.

### Project Description

The Draft EIR should include a thorough description of the project and all project elements and construction phases. The Draft EIR should include an existing conditions plan illustrating resources, including the existing floodplain, structures and abutting land uses for the entire project area and a proposed conditions plan (or plans) illustrating proposed floodplain elevations, structures and access roads. The Draft EIR should include sufficient baseline data to allow a full characterization of existing conditions and natural resources and support a meaningful analysis of feasible alternatives. The Draft EIR should identify all project related activities including structural modifications, dredging, fill and removal of vegetation. The Draft EIR should identify where and how public access will be improved or introduced.

### Project Permitting and Consistency

The Draft EIR should briefly describe state permits required for the project and should describe how the project will meet applicable performance standards or where regulatory flexibility will be requested based on the stated public purpose of the project. In accordance with section 11.01 (3)(a) of the MEPA regulations, the Draft EIR should discuss the consistency of the project with any applicable local or regional land use plans. The Draft EIR should also address the requirements of Executive Order 385 (Planning for Growth).

I am recommending the formation of a Technical Working Group (TWG), comprised of state and federal agency representatives, to support effective and coordinated consultation throughout the review of this project. The TWG will assist the proponent in developing appropriate study methodologies and protocols and should review interim studies, plans and analysis prior to inclusion in the Draft EIR to ensure that the proponent's efforts adequately address the analysis and data requirements of required permits and approvals. In addition, the TWG should assist in the development of benchmarks and criteria for environmental monitoring. Representatives from CZM, Division of Marine Fisheries (DMF), NHESP, ACEC Program, MassDEP, MHC and representatives from EPA and US ACOE will be asked to participate in the TWG.

Adaptive Management/Environmental Monitoring

The ENF indicates that tidal restoration will be restored gradually over time using an adaptive management approach that relies on iterative, science-based and incremental management decisions. The nature and timing of specific activities will be implemented based on the results of environmental monitoring and the response of the ecosystem to tidal flow as well as technical and public review of project progress. This project will include major project elements such as redesign of the Chequesset Neck Road opening to the Herring River and many discrete elements that will include installation of new tidal controls, replacement or maintenance of existing culverts and tidal controls, reconstruction, or realignment of roadways and management of vegetation. The environmental review of this project may result in phasing of the project into a number of coordinated but discrete actions that will be implemented based on adaptive management as well as funding availability and other factors.

The Draft EIR should identify how adaptive management will be employed throughout the project and include a comprehensive Environmental Management Plan that incorporates a monitoring program for pre-construction, construction and post-constructions phases that will provide sufficient information to adequately assess progress towards project goals, identify impacts and inform the development of adaptive management strategies. The Plan should identify what will be monitored, how monitoring will be conducted and the proposed duration of monitoring. At a minimum, monitoring should include water quality, rare species, fisheries, shellfish, sediment transport and vegetation.

At this conceptual stage of the project while several distinct alternatives are under consideration, it would be premature to establish phasing; however, once a Preferred Alternative is identified and phasing can be considered in more detail, the SRP may be amended to establish a process for subsequent review within an adaptive management framework under the aegis of the CAC/HRRC.

Alternatives Analysis

As noted previously, this project has the potential to restore up to 1,100 acres of salt marsh. It is a large and ambitious undertaking. Although this is an environmental restoration project and its clear intention is to improve and strengthen the ecosystem of the Herring River, MEPA imposes a requirement on project proponents to understand and fully disclose the potential impacts of a project, both positive and negative; to study feasible alternatives to a project; and to avoid, reduce, or mitigate environmental impacts to the maximum extent feasible. The environmental review process should create a strong foundation for planning and implementation of this project. The review will include consideration of alternatives to achieve the project goals and will require a straightforward analysis of environmental impacts and benefits.

The primary emphasis of the Draft EIR will be to evaluate potential alternatives. The alternatives analysis should identify benefits, impacts and mitigation associated with each alternative and provide information, data and analysis necessary for state resource agencies to evaluate the alternatives. Various regulatory programs may require the submission of an alternatives analysis as part of permitting or as a requirement for regulatory flexibility. I encourage the proponent to prepare the alternatives analysis so that it will address the needs of these regulatory processes. If a Preferred Alternative is identified in the Draft EIR, the Draft EIR should provide adequate information to support this selection and discuss mitigation approaches.

The Draft EIR should evaluate the following four alternatives:

**No Action Alternative:** Existing tidegates would remain in place and tide levels would be managed under existing conditions.

**Modified Tidegate Control at Chequesset Neck Road:** Existing dike would be replaced with a new structure with an opening 100 – 130 feet wide consisting of culverts arch spans or a bridge. The structure would be fitted with sluice gates to allow full tidal control and management.

**Open Bridge with Upstream Tidegate Controls:** An open bridge span would be constructed at the site of the Chequesset Neck Road dike. The bridge would not have any tidal control. Tidal control would be established at upstream locations with several smaller structures to regulate the limit of tidal flooding.

**Hybrid of Modified Tidegate Control at Chequesset Neck Road with Upstream Tidegate Controls:** A combination of controlling tides at the neck of the river and at upstream locations.

The Draft EIR should investigate all feasible methods of restoring salt marsh while avoiding, reducing or minimizing negative impacts, in particular impacts to private properties. The alternative analysis should include a clear comparison (quantified to the extent feasible) of the impacts of each alternative and its project components. For each alternative, the Draft EIR should quantify the amount of land altered, quantify the amount of impervious surfaces created, quantify wetlands impacts, identify impacts to rare species, identify associated dredging and identify impacts to cultural resources. The Draft EIR indicates that two-dimensional hydraulic/hydrologic modeling will be used to analyze alternatives. The results of the modeling should be included in the Draft EIR including the tidal ranges, expansion of the floodplain, salinities and velocities at road crossings and other impediments to tidal exchange. The Draft EIR should identify criteria that will be used to select a Preferred Alternative and the Draft EIR should clearly explain why certain alternatives are selected and others ruled out for further consideration. The Draft EIR should fully explain any trade-offs inherent in the alternatives analysis, such as increased impacts on some resources to avoid impacts to other resources.

The alternatives analysis should identify alternatives for avoiding impacts to private properties within each sub-basin. In particular, it should include a detailed discussion of alternatives for addressing the Chequessett Yacht and Country Club (CYCC) golf course which is located in Mill Creek adjacent to the Chequessett Neck Road dike. Portions of five holes within this nine-hole golf course were constructed in the floodplain. The majority of comments made during public meetings identify concerns with the impact of this project on the CYCC. Commentors have requested that these impacts be carefully evaluated and that the proponent work cooperatively with the CYCC to identify alternatives. In addition, some comments identify efforts the CYCC has made to address this problem and identify alternatives. The ENF indicates that the proponent and CYCC have discussed several potential alternatives including filling of this area to raise it above the floodplain or re-location of holes within land owned by the CYCC. The alternatives must consider and balance the private property concerns of the CYCC with potential impacts to wetlands, historic resources and rare species habitat.

The ENF indicates that several structures, wells and septic systems are located on private property and are at elevations low enough to be directly affected by tidal restoration up to the spring high tide elevation of 5.1 feet (NAVD88). The Draft EIR should address alternatives that will protect structures, public and private water supplies and septic systems from flooding and/or saltwater intrusion.

<u>Land Alteration</u>

The Draft EIR should quantify the amount of land alteration associated with the project. The Draft EIR should clearly identify how land will be altered, where vegetation will require removal and identify objectives and measures that will be included in the vegetation management program to minimize impacts and maximize the effectiveness of the project.

<u>Wetlands</u>

Wetlands impacts will include alterations to wetland resources associated with construction, reconstruction or maintenance of structural elements of the project and impacts associated with the introduction of tidal flow. The re-introduction of tidal flow will convert some wetland resource areas such as upland wetlands to salt marsh and introduce wetland resources to areas that are currently non-jurisdictional.

The Draft EIR should characterize wetland resources throughout the site, identify and quantify wetland alterations associated with each alternative and identify how negative impacts will be minimized consistent with the Performance Standards of the Wetlands Regulations (310 CMR 10.00). The Draft EIR should include plans at an appropriate scale that illustrate impacts to resource areas. The analysis should demonstrate how the project will support the interests of the Wetlands Protection Act and how it may impact those interests, particularly storm damage prevention and flood control. In addition, the Draft EIR should illustrate where new resource areas will be created and identify associated buffer zones. The proponent should consult with the

TWG and the Wellfleet and the Truro Conservation Commissions regarding the preparation of wetlands information for the Draft EIR.

MassDEP comments indicate that portions of the project are located on lands subject to the Town of Wellfleet's Coastal Wetlands Restriction Order (310 CMR 12.00 and MGL c 130 s. 105) adopted April 19, 1982. This Order contains specific prohibitions, including substantially altering existing patterns of tidal flow. The proponent should consult with MassDEP to conduct a review of the land restricted pursuant to the Order and to determine if an amendment or modification to the Order of Restriction is required.

If MassDEP determines that the project requires a variance in accordance with the Wetlands Protection Act or the proponent chooses to seek a variance, the Draft EIR should provide the information required as part of a variance request. This includes:

1. a description of alternatives explored that would allow the project to proceed in compliance with 310 CMR 10.21 through 10.60 and an explanation of why each is unreasonable;
2. a description of the mitigating measures to be used to contribute to the protection of the interests identified in M.G.L. c. 131, § 40; and
3. evidence that an overriding public interest is associated with the project which justifies waiver of 310 CMR 10.21 through 10.60.

MassDEP comments identify additional regulatory requirements the project may be subject to. The proponent should carefully review the MassDEP comment letter and take note of the requirements and standards identified within it.

Tidelands/Chapter 91

The reconstruction of the existing dike and upstream culvert crossing will likely require Chapter 91 licenses. The Draft EIR should identify project elements associated with each alternative that would require Chapter 91 licensing. The Draft EIR should include an analysis of the project's compliance with the Waterways Regulations. The Draft EIR should assess the project's impacts, positive and negative, on the public's right to access, use and enjoy tidelands that are protected by Chapter 91 and identify measures to avoid, minimize or mitigate any adverse impact on these rights.

Pursuant to Chapter 168 of the Acts of 2007, I am required to conduct a public benefit review for this project because it requires a license under Section 18 of Chapter 91 and is required to file an EIR. The Draft EIR should include detailed information concerning benefits to the public trust rights in tidelands or other associated rights, including but not limited to, benefits provided though community activities on site, environmental protection and preservation, public health and safety and the general welfare. In weighing the benefit to the public trust rights in tidelands, I will apply a preference for a benefit on-site that promotes access to, and use and enjoyment of, the waterfront.

Dredging

The Draft EIR should identify any dredging associated with project alternatives, estimate the amount of material to be dredged and describe the soils to be dredged. Potential impacts associated with dredging and fill activities include increased turbidity, mobilization of pollutants and downstream sediment deposition. It should identify measures that can be employed to avoid release of sediments into the river environment and to protect downstream shellfish beds.

Rare Species/Wildlife Habitat

As noted previously, the site includes habitat for many rare species. Restoration of salt marsh will alter habitats for some of these species and expand habitat for others. Comments from NHESP indicate that portions of the proposed project may qualify for a Habitat Management Exemption in accordance with the Massachusetts Endangered Species Act (MESA) (321 CMR 10.14 (11)), while other portions may require a Conservation & Management Permit. The Draft EIR should include detailed hydrologic/hydraulic models and impact analyses for all proposed alternatives to assist the NHESP in making a determination regarding the appropriate approach to permitting. Analyses should address impacts to state-listed species for both the proposed restoration efforts, as well as for any associated upland projects such as the relocation of roads or relocation of the CYCC holes. The Draft EIR should address how each alternative could be designed to avoid, minimize, and mitigate impacts to state-listed species. The proponent should consult with NHESP through the TWG regarding permitting approaches and the development of additional rare species surveys.

The Draft EIR should identify how overall habitat within the floodplain will be monitored and evaluated consistent with adaptive management goals.

Fisheries

This section should summarize the benefits of the project to fisheries and shellfish and provide projections regarding growth. It should identify temporary impacts to fish and shellfish during construction and identify measures to avoid, minimize and mitigate these impacts, including consideration of time-of-year (TOY) restrictions identified by the Division of Marine Fisheries (DMF). It should identify how restoration of tidal flow to the Herring River at Chequesset Neck Road will be designed to optimize fish passage.

Water Quality

The Draft EIR should identify baseline water quality data that measures salinity, pH and metals, dissolved oxygen and fecal coliform, identify how project alternatives will affect water quality and identify how water quality will be monitored. The Draft EIR should identify impacts on public and private water supplies and septic systems associated with each alternative. It should provide a more detailed discussion of the relationship between the restoration of tidal flow and groundwater. The Draft EIR should identify how the project will be conducted consistent with water quality standards associated with the 401 Water Quality Certification. In addition, the Draft EIR should discuss short- and long-term changes in rates and volumes of sediment transport associated with each alternative and related impacts on the river and the harbor.

Historic/Archaeological Impacts

The Draft EIR should identify historic properties and archaeological sites within the project area and its vicinity and identify potential impacts to these sites. MHC comments indicate that it will consult with the National Park Service (NPS) under Section 106 of the National Historic Preservation Act of 1966 during their review of the project under NEPA regarding the scope of work for the cultural resources survey and development of the area of potential effect (APE) for this project. Also, MHC comments indicate that it previously reviewed a portion of this project in 2006 and 2007 including a Project Notification Form (PNF) for the CYCC redevelopment and indicate that any redevelopment of the CYCC will be reviewed as part of the Herring River Restoration Project.

Greenhouse Gas Emissions

The project is subject to the EEA Greenhouse Gas Policy and Protocol because it requires an EIR and MEPA has full scope jurisdiction. This is an environmental restoration project that will not result in the emissions of Greenhouse Gases (GHG) and therefore falls within the de minimis exception of the policy. The proponent is not required to prepare an analysis of GHG emissions or identify measures to mitigate GHG emissions. The ENF indicates that the project will serve to minimize the impacts of climate change by providing additional protection from flooding and storm surges and expanding habitat for wildlife. In addition, the structure at Chequesset Neck could be designed to incorporate tidal power. The Draft EIR should identify how the impacts of climate change, including sea level rise, are being incorporated into the analysis of this project, how the project will provide protection from the impacts of climate change and whether the Chequesset Neck Dike could be designed to incorporate tidal power while balancing other project goals including improved habitat for fisheries and recreational access.

Construction Period Impacts

The Draft EIR should include a discussion of construction phasing, evaluate potential impacts associated with construction activities and propose feasible measures to avoid or eliminate these impacts. The proponent should implement measures to alleviate dust, noise, and odor nuisance conditions, which may occur during the construction activities.

Mitigation

The Draft EIR should include a separate chapter on mitigation measures. This section should form the basis of the proposed Section 61 Findings that will be presented in the Final EIR. Draft Section 61 Findings for all state permits should include a clear commitment to mitigation, an estimate of the individual costs of the proposed mitigation, the identification of the parties responsible for implementing the mitigation and a schedule for the implementation of mitigation, based on the construction phasing of the project.

Comments

To ensure that the issues raised by commenters are addressed, the Draft EIR should include a response to comments section. This directive is not intended to, and shall not be construed to, enlarge the scope of the Draft EIR beyond what has been expressly identified in this Certificate. A copy of each comment letter should be included in the Draft EIR. I defer to the proponent as it develops the format for this section, but the Response to Comments section should provide clear answers to questions raised.

Circulation

The Draft EIR should be circulated in compliance with Section 11.16 of the MEPA regulations and copies should also be sent to the list of "comments received" below and to local officials in Wellfleet and Truro. A copy of the Draft EIR should be made available for public review at the Wellfleet and Truro public libraries. The proponent should provide a hard copy of the Draft EIR to each state agency and town department from which the proponent will seek permits or approvals.

November 7, 2008
Date

Ian A. Bowles

EEA# 14272 ENF Certificate November 7, 2008

Comments Received[1]:

| | |
|---|---|
| 10/31/08 | Massachusetts Department of Environmental Protection/Southeast Regional Office (MassDEP/SERO) |
| 10/31/08 | Department of Conservation and Recreation/Areas of Critical Environmental Concern Program (DCR/ACEC) |
| 10/14/08 | Division of Marine Fisheries (DMF) |
| 10/28/08 | Division of Fisheries and Wildlife/Natural Heritage Endangered Species Program (DFW/NHESP) |
| 7/29/08 | Massachusetts Historical Commission (MHC) |
| 10/31/08 | US Environmenta1 Protection Agency (EPA) |
| 10/23/08 | Cape Cod Commission (CCC) |
| 10/31/08 | Mass Audubon |
| 8/14/08 | Chequesset Yacht and Country Club |
| 10/15/08 | Chequesset Yacht and Country Club (second letter) |
| 10/23/08 | The Nature Conservancy (TNC) |
| 8/14/08 | Nancy Deppen |
| 10/21/08 | Dale and Lee Ann Fanning |
| 9/10/08 | P. Faxon |
| 8/20/08 | Doug Franklin |
| 9/240/8 | Bill Dahl |
| 9/26/08 | Douglas E. Franklin |
| 8/26/08 | Katherine Gilmour |
| 8/14/08 | Kathryn Hubby |
| 8/15/08 | David Kew |
| 10/1/08 | Sarah Nickerson |
| 8/16/08 | John & Linda Riehl |
| 9/24/08 | Elliot Paul Rothman |
| 9/6/08 | Laura Runkel |
| 10/21/08 | Nancy N. Ryder |
| 8/28/08 | Harvey F. Schwallie |
| 9/24/08 | Marc Stahl |
| 8/14/08 | Paula Tasha |
| 8/14/08 | Jack Whalen |
| 11/3/08 | Wellfleet resident |

IAB/CDB/cdb

[1] MEPA, NPS and CCC agreed that any letter submitted to one of the agencies/organizations would be accepted by each as a comment letter. I have reviewed all comment letters submitted including the transcripts from the August 14 scoping session and the September 24, 2008 public meeting, as I am authorized under 301 CMR 11.06 (2), and they have factored into this decision to the extent that the issues raised fall within MEPA jurisdiction.

# United States Department of the Interior

NATIONAL PARK SERVICE
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, MA 02667
508.349.3785
508.349.9052 Fax

IN REPLY REFER TO:

H42

October 5, 2011

Ms. Brona Simon
State Historic Preservation Officer
Massachusetts Historical Commission
220 Morrissey Boulevard
Boston, Massachusetts 02125

Subject: Phase IA Archeological Background Research and Sensitivity Assessment, Herring River Tidal Restoration Project, Wellfleet, Truro, MA. MHC #RC.44488.

Dear Ms. Simon:

In 2008, the National Park Service (NPS) at Cape Cod National Seashore (CCNS) notified you that it was in the early stages of developing a Draft Environmental Impact Statement (DEIS) to evaluate the proposed restoration of the Herring River estuary in Wellfleet and Truro. Work on the DEIS has advanced and we are planning to release it for agency and public review in Spring 2012. Prior to release of the DEIS, we would like to update you on the progress made to begin identifying potential cultural resources within the area of potential effect (APE) for the project.

Public Archeology Lab, Inc. (PAL) has completed a Phase 1A research and assessment report which we have enclosed for your review and comment. The survey was performed at a generalized level in order to identify the known and most likely locations for archeological resources to be present within the project area, and to make recommendations regarding the need for and probable scope of additional archeological investigations. The survey documents several known and potential pre and post-contact period archeological resources within and adjacent to the Herring River Tidal Restoration Project area. Sites are located in the uplands as well as some at or near the wetland margins. These are detailed in the Conclusions and Recommendations section beginning on page 75, and seven major proposed construction areas are identified beginning on page 77. The preliminary APE has been revised as a result of hydrodynamic modeling which has determined that the maximum inundation levels will be lower than first projected, which is illustrated on page 88, Figure 5-20.

Given the complexity of the project and the ongoing refinement of the APE, the NPS suggests that a programmatic agreement executed pursuant to 36CFR 800.14 be developed in order to allow for a phased process to conduct identification and evaluation efforts as we move forward. In developing the agreement, several specific issues should be addressed, such as the level of archeological investigation necessary when project impacts in specific areas of the APE are limited to changes in water level and where potential historic features have already been identified. Please notify us if this approach is acceptable, and if so, we will prepare a draft programmatic agreement for your office to review and comment on.

If you have any questions, please contact William Burke, Section 106 Coordinator, at (508) 255-3421, ext 14.

Sincerely,

George E. Price, Jr.
Superintendent

Enclosure

cc:
Wampanoag Tribe of Gay Head-Aquinnah
Mashpee Wampanoag Tribe
Advisory Council for Historic Preservation
Wellfleet Historical Commission
Wellfleet Historical Society
Truro Historical Commission
Truro Historical Society
Secretary Ian A. Bowles, EEA, Attn: Holly Johnson, MEPA Unit
Hunt Durey, MA Division of Ecological Restoration
Bob Boeri, MA Coastal Zone Management
Vic Mastone, MA Board of Underwater Archaeological Resources
Liz Koulaheras, DEP-SERO, Wetlands
John Sargent, US Army Corps of Engineers
Tim Timmerman, US Environmental Protection Agency
Steve Block, NOAA
Charleen Greenhalgh, Town of Truro
Hillary Greenberg, Town of Wellfleet
Eric Derleth, USFWS
Jacklyn Bryant, Louis Berger Group
Mark Husbands, NPS Environmental Quality Division

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Cape Cod National Seashore
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508.349.9052 Fax

IN REPLY REFER TO:

H42

October 5, 2011

Mashpee Wampanoag Tribe
483 Great Neck Road
Post Office Box 1048
Mashpee, MA 02649

Subject: Phase IA Archeological Background Research and Sensitivity Assessment, Herring River Tidal Restoration Project, Wellfleet, Truro, MA. MHC #RC.44488.

Dear Mashpee Wampanoag Tribe:

In 2008, the National Park Service (NPS) at Cape Cod National Seashore (CCNS) notified you that it was in the early stages of developing a Draft Environmental Impact Statement (DEIS) to evaluate the proposed restoration of the Herring River estuary in Wellfleet and Truro. Work on the DEIS has advanced and we are planning to release it for agency and public review in Spring 2012. Prior to release of the DEIS, we would like to update you on the progress made to begin identifying potential cultural resources within the area of potential effect (APE) for the project.

Public Archeology Lab, Inc. (PAL) has completed a Phase 1A research and assessment report which we have enclosed for your review and comment. The survey was performed at a generalized level in order to identify the known and most likely locations for archeological resources to be present within the project area, and to make recommendations regarding the need for and probable scope of additional archeological investigations. The survey documents several known and potential pre and post-contact period archeological resources within and adjacent to the Herring River Tidal Restoration Project area. Sites are located in the uplands as well as some at or near the wetland margins. These are detailed in the Conclusions and Recommendations section beginning on page 75, and seven major proposed construction areas are identified beginning on page 77. The preliminary APE has been revised as a result of hydrodynamic modeling which has determined that the maximum inundation levels will be lower than first projected, which is illustrated on page 88, Figure 5-20.

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If you have any questions, please contact William Burke, Section 106 Coordinator, at (508) 255-3421, ext 14.

Sincerely,

George E. Price, Jr.
Superintendent

Enclosure

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Wampanoag Tribe of Gay Head-Aquinnah
Advisory Council for Historic Preservation
Wellfleet Historical Commission
Wellfleet Historical Society
Truro Historical Commission
Truro Historical Society
Secretary Ian A. Bowles, EEA, Attn: Holly Johnson, MEPA Unit
Hunt Durey, MA Division of Ecological Restoration
Bob Boeri, MA Coastal Zone Management
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Liz Koulaheras, DEP-SERO, Wetlands
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Eric Derleth, USFWS
Jacklyn Bryant, Louis Berger Group
Mark Husbands, NPS Environmental Quality Division

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Wellfleet, MA 02667
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IN REPLY REFER TO:

H42

October 5, 2011

Ms. Bettina Washington
Tribal Historic Preservation Officer
Wampanoag Tribe of Gay Head-Aquinnah
20 Black Brook Road
Aquinnah, MA 02535

Subject: Phase IA Archeological Background Research and Sensitivity Assessment, Herring River Tidal Restoration Project, Wellfleet, Truro, MA. MHC #RC.44488.

Dear Ms. Washington:

In 2008, the National Park Service (NPS) at Cape Cod National Seashore (CCNS) notified you that it was in the early stages of developing a Draft Environmental Impact Statement (DEIS) to evaluate the proposed restoration of the Herring River estuary in Wellfleet and Truro. Work on the DEIS has advanced and we are planning to release it for agency and public review in Spring 2012. Prior to release of the DEIS, we would like to update you on the progress made to begin identifying potential cultural resources within the area of potential effect (APE) for the project.

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Sincerely,

George E. Price, Jr.
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IN REPLY REFER TO:

H42

October 5, 2011

Mr. Reid Nelson
Director, Officer of Federal Agency Programs
Advisory Council on Historic Preservation
1100 Pennsylvania Avenue, NW
Suite 803
Washington, DC 20004

Subject: Phase IA Archeological Background Research and Sensitivity Assessment, Herring River Tidal Restoration Project, Wellfleet, Truro, MA. MHC #RC.44488.

Dear Mr. Nelson:

In 2008, the National Park Service (NPS) at Cape Cod National Seashore (CCNS) notified you that it was in the early stages of developing a Draft Environmental Impact Statement (DEIS) to evaluate the proposed restoration of the Herring River estuary in Wellfleet and Truro. Work on the DEIS has advanced and we are planning to release it for agency and public review in Spring 2012. Prior to release of the DEIS, we would like to update you on the progress made to begin identifying potential cultural resources within the area of potential effect (APE) for the project.

Public Archeology Lab, Inc. (PAL) has completed a Phase 1A research and assessment report which we have enclosed for your review and comment. The survey was performed at a generalized level in order to identify the known and most likely locations for archeological resources to be present within the project area, and to make recommendations regarding the need for and probable scope of additional archeological investigations. The survey documents several known and potential pre and post-contact period archeological resources within and adjacent to the Herring River Tidal Restoration Project area. Sites are located in the uplands as well as some at or near the wetland margins. These are detailed in the Conclusions and Recommendations section beginning on page 75, and seven major proposed construction areas are identified beginning on page 77. The preliminary APE has been revised as a result of hydrodynamic modeling which has determined that the maximum inundation levels will be lower than first projected, which is illustrated on page 88, Figure 5-20.

Given the complexity of the project and the ongoing refinement of the APE, the NPS suggests that a programmatic agreement executed pursuant to 36CFR 800.14 be developed in order to allow for a phased process to conduct identification and evaluation efforts as we move forward. In developing the agreement, several specific issues should be addressed, such as the level of archeological investigation necessary when project impacts in specific areas of the APE are limited to changes in water level and where potential historic features have already been identified. Please notify us if this approach is acceptable, and if so, we will prepare a draft programmatic agreement for your office to review and comment on.

If you have any questions, please contact William Burke, Section 106 Coordinator, at (508) 255-3421, ext 14.

Sincerely,

George E. Price, Jr.
Superintendent

Enclosure

cc:
MA Historical Commission
Wampanoag Tribe of Gay Head-Aquinnah
Mashpee Wampanoag Tribe
Wellfleet Historical Commission
Wellfleet Historical Society
Truro Historical Commission
Truro Historical Society
Secretary Ian A. Bowles, EEA, Attn: Holly Johnson, MEPA Unit
Hunt Durey, MA Division of Ecological Restoration
Bob Boeri, MA Coastal Zone Management
Vic Mastone, MA Board of Underwater Archaeological Resources
Liz Koulaheras, DEP-SERO, Wetlands
John Sargent, US Army Corps of Engineers
Tim Timmerman, US Environmental Protection Agency
Steve Block, NOAA
Charleen Greenhalgh, Town of Truro
Hillary Greenberg, Town of Wellfleet
Eric Derleth, USFWS
Jacklyn Bryant, Louis Berger Group
Mark Husbands, NPS Environmental Quality Division

# APPENDIX B: HYDRODYNAMIC MODELING REPORT

# EXECUTIVE SUMMARY

## ES.1 - INTRODUCTION

The Herring River is a 1000+ acre estuary system located on Outer Cape Cod. A majority of the system is located in Wellfleet, Massachusetts and is physically separated from Wellfleet Harbor by a compound dike system at the Chequessett Neck Road crossing. The system is hydraulically connected to Wellfleet Harbor through the dike by three 6-foot wide box culverts, each with a flow control structure. One culvert has an adjustable sluice gate, which is currently set to be partially open two (2) feet and allows bi-directional tidal flow. The remaining two culverts have tidal flap gates, which are designed to permit flow only during an ebbing (outgoing) tide. Tidal exchange between the tidal marsh and harbor is severely restricted by the dike and culvert system. Herring River has been tidally restricted for over a century, which has resulted in significant degradation of the ecological functions and values of the marsh.

Prior to the dike construction in 1909, Herring River was connected to Wellfleet Harbor through a natural inlet at Chequessett Neck. The marsh system consisted of nearly 1,100 acres of thriving coastal wetlands, including a productive herring run, shellfishery, and salt marsh habitats. The dike construction, intended to control mosquitoes and create additional developable land area, significantly degraded the natural marsh ecosystem. Today, after 100 years of influence, as well as numerous other anthropogenic impacts (e.g., upstream culverts, railroad crossings, ditch creation, etc.), hundreds of acres of intertidal salt marsh have been degraded. This transition has eliminated habitat for estuarine flora and fauna. On-site monitoring has documented reduced tidal amplitudes, minimal salinity levels, loss of marsh vegetation, degraded fish and wildlife habitat, decomposition and subsidence of soils/sediments, and colonization by invasive species.

The Herring River Restoration Committee (HRRC), a multi-agency group appointed by the Cape Cod National Seashore and the Towns of Wellfleet and Truro, has recognized the environmental and socioeconomic benefits of restoring this tidally restricted and degraded wetland system, and is currently developing a comprehensive restoration project/plan that is geared towards identification of restoration actions and adaptive management strategies that will improve the system through a monitored and adjustable approach. As part of the restoration effort, the HRRC requested the development of a comprehensive hydrodynamic model that could be used to assess existing conditions within the estuarine system, as well as evaluate a range of alternatives and their potential impacts. The model was required to be sufficiently flexible to integrate with the adaptive management approach, capable of simulating the complexities of the Herring River system (e.g., marsh surface wetting and drying, salinity levels, a range of flow control structures, etc.). Working with the Towns of Wellfleet and Truro, the HRRC, contracted with the Woods Hole Group (WHG) to identify and develop the hydrodynamic model for the Herring River system.

The hydrodynamic modeling effort is a major component of the restoration plan that will address numerous concerns associated with re-establishing increased tidal exchange, as well as provide the necessary information to design an appropriate system of dikes, culverts, and road crossings. The purpose of this report is to provide details on the development and implementation of the hydrodynamic model for the Herring River System. It is expected that as the restoration plan continues to progress, the model could also be used to assess final design alternatives, refine the adaptive management approach, address additional physical mechanisms as needed, provide visualizations of the proposed alternatives, and provide an adaptive tool for integration of monitoring results.

### ES.2 – MODEL SCOPING AND SELECTION

The overall goal of the Herring River Restoration Project is to create a productive, natural environment that will sustain itself with improved water quality and a strengthened ecosystem by restoring tidal flow to the estuary. While it would be desirable to allow the Herring River estuary to simply resume its previous natural state of unimpeded tidal flow, human and environmental constraints pose limitations on the extent to which the natural tidal flow can be restored. The success of the project will largely depend on the successful implementation of a comprehensive restoration plan, which addresses all the important issues related to those limitations. Hydrodynamic modeling is a central piece in developing this plan as it allows for the evaluation of specific questions about potential changes to surface water flow, velocities, water surface elevation, and salinity levels within the estuary.

Following an eel kill in the fall of 1980, which drew attention to the poor and declining water quality in the Herring River upstream of the dike, a significant amount of literature was generated documenting studies conducted within the area. These studies indicated the detrimental impact caused by the diking of the system and called for tidal restoration in order to revitalize the ecosystem. This led to the development of some hydrodynamic model efforts to assess the Herring River System. Overall and not surprisingly, the previous modeling efforts demonstrated that larger openings in the dike would cause increases to the mean tidal elevation and the tidal range. Increasing the opening would also increase the saltwater penetration distance. These modeling efforts provided a good initial evaluation of potential restoration options for Herring River.

The model developed by the WHG as part of this scope of work further advances the hydrodynamic understanding throughout the entire Herring River estuarine system. The model more precisely represents the geometry of the estuary (including its plan form); it considers variable frictional effects throughout the estuary; it allows for flooding, drying, and ponding of water; it produces accurate current velocities and water surface elevations throughout the estuary; and it properly represents the physics of mixing for a wide range of forcing conditions.

The Herring River restoration project requires a model that incorporates the physics necessary to analyze water surface elevation, current velocities, salinity, sediment transport, and water quality. The model has to be dynamic, capable of handling bi-directional flow, high resolution to identify important processes, and flexible enough to link with other potential modeling tools (e.g., biological models) in an adaptive management setting. After evaluation of over 10 of the most capable hydrodynamic models in conjunction with the goals of the restoration project, the Environmental Fluid Dynamics Code (EFDC) model was selected to simulate the Herring River estuarine system. The model has been applied to studies of circulation, discharge dilution, water quality, Total Maximum Daily Load (TMDL), and sediment transport. EFDC is capable of predicting hydrodynamics and water quality in multiple dimensions and is a widely accepted Environmental Protection Agency (EPA) approved model.

## ES.3 – MODEL APPROACH

The overall model approach that was applied to develop the hydrodynamic model for the Herring River system consisted of a phased approach that allowed for key stopping points to evaluate model performance and progress. This allowed for a flexible approach that included the incorporation of new data, and/or a re-direction of the effort based on the results of the current modeling phase. The primary steps in the modeling approach include:

1. Model Calibration - Model calibration is the process by which adjustments are made to the model parameters to ensure the model appropriately simulates measured water surface elevation, salinity, and other observed parameters.

2. Model Validation - Model validation is achieved by applying the calibrated model, with its fixed parameters, to one or more sets of observed data that are independent from the calibration data. Typically, sets of data for validation are collected at a different time and under conditions that differ from the calibration period.

3. Existing Conditions Simulations - Once the model has been calibrated and validated, additional simulations are conducted to provide a better understanding of the behavior of the system over a broader range of forcing conditions. These existing conditions simulations also provide a baseline for comparison to proposed restoration alternatives in order to gauge the potential benefits and/or risks associated with different restoration alternatives. Various conditions simulated include the spring/neap tidal conditions, storm scenarios, and sea level rise cases.

4. Chequessett Neck Road Dike Alternative Simulations – Several alternatives were simulated to evaluate the response to the Herring River system to modifications of the Chequessett Neck Road dike. These simulations included, but were not limited to, the removal of all anthropogenic structures (to provide an estimate of maximum restoration potential and assess historic conditions), optimization of a new dike opening width, and various opening heights with flow control structures to provide potential adaptive management openings.

5. Upstream Feature Evaluations and Alternative Simulations - Alternative simulations focused on the culverts located in the upstream portions of the system. Specifically, this included evaluation of the crossing at High Toss Road, removal of the large flood tidal shoal existing just upstream of the dike, and assessment of the various road/culverts upstream throughout the system.

6. Mill Creek Sub-Basin Alternative Simulations - Alternative simulations were focused on evaluation of the Mill Creek sub-basin, including the potential implementation of a new dike restricting tidal exchange into this portion of the system. Evaluation of these simulations included construction of a Mill Creek Dike, optimization of a Mill Creek dike

culvert (height and width), a re-graded Chequessett Yacht & Country Club (CYCC) golf course, and a preliminary assessment of potential groundwater impacts.

## ES.4 – MODEL DEVELOPMENT

The development of the Herring River hydrodynamic model required configuration so the model would represent the form and function of the real system (i.e., the Herring River Estuary). Model configuration involves compiling observed data from the actual estuarine system into the format required for the execution of the model. The Herring River estuary model was developed using various data observed throughout the Herring River system. Data provided were assumed to be correct and appropriate for model development of the Herring River system and the accuracy of the observations was not a component of this modeling study.

### *ES.4.1 Existing Data*

The data required for the development of a more robust and detailed hydrodynamic model, are of two distinct types, topographic and hydrographic data. The topographic data are required to construct the model geometry, while the hydrologic data are required for model forcing and proper calibration and verification to ensure the model will provide accurate predictions. Additional data types are also required to further utilize the model to assess other physical processes. For example, sediment information is required for sediment transport modeling, salinity observations to assess salt levels in the system, etc.

High-resolution photogrammetry data (approximately 200,000 points within the estuary above the mean low water elevation) were used to accurately model the flooding and drying of the marsh surface. The photogrammetry provided the necessary high resolution and precision required to accurately develop the model elevations in the marsh system. Bathymetric data (below the lower limit of the photogrammetry data) were used to provide the depths within the creeks and streams of the Herring River estuary system, as well as for the area just downstream of the dike.

Water surface elevation data were collected by the National Park Service at various locations throughout the estuary. Data were collected in 2007 and 2010. Salinity and temperature data were also collected at two (2) locations. Subsets of these data were used for both model calibration and verification. Other hydrologic data that was also used in model verification includes the data collected for the earlier modeling studies from 1999-2000. Water surface elevation, salinity, temperature, and other data records continue to be collected throughout the Herring River estuary system by National Park Service.

Various types of sediment data were also used to analyze and model sediment mobilization and transport. These data included sediment samples and associated grain size analysis, sediment cores, synoptic measurements of total suspended solids, and continuous measurements of turbidity.

### *ES.4.2 Model Grid Generation*

The development of a model grid defines the spatial domain on which the model performs its calculations. The model grid is a digital abstraction of the real life geometry of the Herring

River system. The grid building process involves using geo-referenced digital maps or aerial photos to define the model domain, generating a grid within this domain providing the desired degree of spatial resolution, and assigning elevation values to the grid using the topographic and bathymetric data sets. The accuracy of the model is highly dependent on accurate representation of the form of the real system expressed through the model grid. For this system, a curvilinear orthogonal grid was developed because of its increased flexibility, allowing grid boundaries to better follow natural irregular boundaries. The curvilinear orthogonal grid also allows gradual variation in horizontal resolutions, such that higher resolution areas can be defined in areas where greater detail is required. The resulting Herring River grid has over 85,000 cells with resolution in critical areas of less than 10 feet. The grid has satisfactory orthogonality and aspect ratio, as well as smooth boundary point distribution and smooth resolution change. A portion of the model grid is depicted in Figure ES-1.

### *ES.4.3 Boundary Conditions and Model Parameters*

In order for the Herring River model to compute a hydrodynamic solution it is necessary to specify the model variables on the domain boundaries. The Herring River model consisted of the following:

- Most of the model's boundary is considered to be a "land" boundary, which for the Herring River model was specified at an elevation of 12 feet NAVD88. This elevation provides the upper limit of expected water surface elevation during extreme storm events (100-year return period). At these land boundaries, water is constrained to flow only parallel to the boundary.

- The primary forcing for the model is provided by an open boundary at the southern end of the model domain in Wellfleet Harbor. At this location, time dependent water surface elevation and salt concentration is specified, as observed by gauge data from Wellfleet Harbor.

- Freshwater inflow volumetric flux is also specified in the model at three separate locations (Bound Brook, upper Herring River, and Pole Dike Creek) to simulate freshwater inflow into the estuary.

- Bihourly precipitation data collected at the National Atmospheric Deposition Program (NADP) station MA01 was used to provide rainfall input to the model.

- Bottom friction (or roughness length) throughout the model domain was assigned to individual cells to represent the characteristics of the flow through the system. Physically, bottom drag forces depend on a number of phenomena that are difficult to characterize. These include bottom material type, growth of biota, and the amount of channel meander, which all contribute to the overall energy loss that are accounted for by the bottom friction. Bottom friction parameters are typically used for "tuning" hydrodynamic model to reproduce the data observations. For the Herring River model, local adjustments were made to the roughness length values in order to improve the model results to match observed data. For example, observed data at the Pole Dike Creek gauge locations show the complete dampening of the tidal signal at this point in the estuary. This is likely due to the dense submerged aquatic vegetation (SAV) that exists in this creek and other vegetative influences in this relatively narrow channel. Observations conducted in 2008 indicated the creek to be almost impenetrable by canoe. Therefore, there are significant frictional and/or constriction influences in this portion of the estuarine system and a higher frictional parameter was assigned to replicate the real world conditions. All final assigned values are considered within the range of normal bottom friction values determined through empirical laboratory testing.

- Various types of flow control structures were also modeled throughout the systems. This included developing hydraulic routines embedded in the model to simulate culverts, slide (sluice) gates, and flap gates.

### *ES.4.4 Model Calibration and Validation*

Model calibration is the process in which model parameters are systematically adjusted through a range of acceptable values and results are examined using standard measures of error. The Herring River model was calibrated to water surface elevation observations collected between September 5, 2007 and October 3, 2007 at seven locations throughout the estuary and salinity at a station in the Lower Herring River. The model performance is evaluated by comparing time series output from the model at specific observation points to the observed time series of both water surface elevation and salinity. The results are presented visually as time series plots and scatter plots, and absolute error of the model is quantified by calculating the bias and Root Mean Square Error (RMSE). Additionally, the most dominant tidal constituents (both amplitude and phase) as determined from tidal constituent analysis are compared.

The magnitudes of the water surface elevation errors were well within bounds of standard calibration limits for hydrodynamic models. The model bias was less than 0.1 feet for all locations meaning that the calibration simulation reproduced average water levels that were within an inch or two of observed levels. The root mean square error was less than 0.4 feet for all locations indicating that on average the modeled water level is within a few inches of the observed level at any given time. Relative errors were approximately 1-2% at all locations. Representative plots portraying modeling calibration are provided in Figures ES-2 and ES-3.

Salt penetration in the Herring River in its current restricted state is not normally observed above High Toss Road. As such, verifying that the model could accurately simulate salinity throughout the entire system was not feasible since currently salt only penetrates into the lower portion of the Herring River system. In the Lower Herring River where salinity data are available, the model is well calibrated with a relative error of 11%, which is well below the EPA recommended value.

Following calibration, the model was also validated to two additional data sets collected in 1999 and 2010. Validation involves applying the calibrated model to set of observed data that are independent from the calibration data set without changing the model configuration or parameterization. The water surface elevation relative errors were 1.7% and 2.8% for the 1999 and 2010 data sets, respectively.

## ES.5 – EXISTING CONDITIONS

The calibrated and validated model was further applied to simulate a number of scenarios to aid in understanding the behavior of the Herring River estuary in its current restricted state. In addition to providing better understanding of the current system, these simulations also provided a baseline for comparison to alternative simulations. For example, the impact of opening the Chequessett Neck Road dike on the potential storm surge signal throughout the estuary system can be evaluated compared to existing conditions.

The existing conditions simulations consisted of normal tidal conditions, storm scenarios, and sea level rise cases. Normal tidal conditions were simulated by using the same water surface elevation data used during calibration and validation without the inclusion of temporally specific atmospheric forcing (wind, rainfall, etc.). Storm events and forecasted sea level rise (SLR) scenarios were simulated by modifying the water surface elevation boundary conditions to represent storm surge and/or long-term sea level rise increases.

The return-period tidal flood simulations demonstrate the effectiveness of the existing Chequessett Neck Dike in reducing storm surge. For example, during the 100-year flood event, the greatest increase in peak elevation is only 0.7 feet above the normal high water conditions in Lower Herring River, a 63% reduction in storm surge height between Wellfleet Harbor and High Toss Road. Sea level rise simulations were also conducted to provide an estimate of future predicted water levels in the Herring River over the next half century. Three (3) predicted rates of sea level rise (high, intermediate, and low) were used based on federal guidelines for incorporating sea level change considerations in civil works programs.

## ES.6 – ALTERNATIVE EVALUATION AND SCREENING

A series of alternatives were simulated that were geared towards gaining a better understanding of system response to potential modifications, while determining potential adaptive management steps and restoration endpoints. The results of alternative evaluation and screening were used to assist in defining specific restoration alternatives that were further analyzed, detailed, and selected for design consideration.

First a simulation of the “natural” Herring River system through the removal of all anthropogenic features (e.g., culverts, dikes, railroad beds, etc.) was conducted. In this scenario, the system was allowed to be fully open to tidal flow and allow relatively uninhibited exchange throughout the entire estuarine system. This simulation could be considered a reasonable representation of the greatest restoration level that may be expected for a natural system (excluding natural and/or anthropogenic changes to the bathymetry/topography) and a reasonable facsimile of the historic (a century ago) conditions of the system. Although the fully open alternative is not likely a reasonable final solution given the upland infrastructure that has been developed over the last century, this alternative does provide a reasonable estimate of the maximum restoration potential for the Herring River system and is used for comparison purposes.

Next, a range of potential opening widths at Chequessett Neck Road was simulated to determine the water surface elevations, tidal ranges, and salinity levels throughout the Herring River system. The results indicated that a 100 foot opening would optimize the water surface elevations and tidal range within the Herring River system, while a 165 foot opening would optimize the salinity penetration into the system. Although wider openings (greater than 165 feet) continued to let more tidal water and salt into the system, the changes were minimal and therefore produced diminishing restoration value. A 165 foot opening at Chequessett Neck Road was determined to be the largest width required to optimize restoration. A comparison of model results for a range of Chequessett Neck Road dike openings in provided in Figure ES-4. Predicted salinity penetration for 100- and 165-foot wide dike openings are shown in Figures ES-5 and ES-6.

Following the selection of the optimal Chequessett Neck Road dike opening width, simulations for various opening heights (assumed to be controlled by slide/sluice gate structures in the new dike opening) were conducted. These simulations evaluated targeted endpoints for restoration (based on limiting water surface elevations that could be accepted during storm conditions throughout the system) and provided opening sizes that could be used as initial set points in the adaptive management process. Results indicated that:

- A uniform 3’ slide (sluice) gate opening across the entire 165’ dike opening would limit the 100-year storm event water surface elevation to less than 6.0 feet NAVD88 throughout the system.

- A uniform 10’ slide (sluice) gate opening, which is fully vertically open, limits the 100-year storm event water surface elevation to less than 7.5 feet NAVD88 throughout the system.

Based on the width and height variants simulated, recommended alternatives were selected for the new dike opening at Chequessett Neck Road that represented specific restoration endpoints. These restoration endpoints were intended to be eventually achieved through an adaptive management approach that would allow for controlled advancement towards the endpoints. Specifically, the following three alternatives were defined for the Chequessett Neck Road dike:

1. A new Chequessett Neck Road dike with a 165’ wide opening and a future targeted maximum 100-year storm water surface elevation of 6.0 feet NAVD88 in the Lower Herring River (achieved with an approximate 3’ slide [sluice] gate opening). Golf course re-grading and other flood proofing would be required in the Mill Creek sub-basin for this alternative. Several segments of low-lying roads would also require elevation increases and re-grading. Restoration would be significant through most of the system, but would not be maximized since the lower infrastructure elevations in the Mill Creek sub-basin would limit the maximum water surface elevation allowed in the system as a whole.

2. A new Chequessett Neck Road dike with a 165’ wide opening and a future targeted maximum 100-year storm water surface elevation of 7.5 feet NAVD88 in the Lower Herring River (achieved with an approximate 10’ slide [sluice] gate opening) with a new dike at Mill Creek to ***eliminate*** tidal exchange. A new proposed dike at the entrance to

Mill Creek with a one-way flap gate flow control structure would be installed to eliminate the tidal exchange into Mill Creek. This would allow freshwater flow out of the Mill Creek basin, but would not allow tidal water into the Mill Creek basin. As such, this alternative would maximize restoration throughout the Herring River system, but the Mill Creek sub-basin would remain a non-tidal system. No re-grading or flood proofing in the Mill Creek sub-basin would be proposed, but flood mitigation would be required in other sub-basins, including elevating and re-grading low lying roads.

3. A new Chequessett Neck Road dike with a 165' wide opening and a future targeted maximum 100-year storm water surface elevation of 7.5 feet NAVD88 in the Lower Herring River (achieved with an approximate 10' slide [sluice] gate opening) with a new dike at Mill Creek to ***limit*** tidal exchange. This alternative would maximize restoration throughout the entire system; however, the new dike at the entrance to Mill Creek with appropriate flow control structure(s) would limit the tidal exchange into Mill Creek. This new Mill Creek dike would produce similar water levels as the 3' slide/sluice opening alternative within the Mill Creek sub-basin. Flood proofing and mitigation would be needed in selected locations within the Herring River flood plain.

Since the Mill Creek sub-basin was a critical element of each of these defined alternatives, these three (3) final alternatives were further detailed through detailed assessment of the Mill Creek sub-basin. Therefore, simulation of potential tidal control at the entrance to the Mill Creek sub-basin, which followed a similar approach to the modeling and assessment of an opening at the Chequessett Neck Road dike, were conducted. This includes (1) optimization of an opening width at a new Mill Creek dike; (2) potential opening heights of a flow control structure to allow limited water into Mill Creek sub-basin; (3) simulations of a re-graded golf course region; (4) evaluation of the Mill Creek sub-basin completely blocked from tidal exchange and the effect on freshwater outflow, and (5) a preliminary assessment of potential groundwater impacts in the Mill Creek sub-basin relative to both sea level rise and the restoration effort. These results indicated that:

- A 25 foot opening in a new dike at the entrance to Mill Creek would optimize restoration in the Mill Creek sub-basin with the optimized opening at the Chequessett Neck Road dike.

- Alternatives that could be considered for managing water levels within Mill Creek include a maximum 3 foot sluice opening at CNR with no dike at Mill Creek, or a dike at Mill Creek that would allow for managed water levels when the sluice opening at the CNR dike is increased to opening sizes greater than 3 feet. The Mill Creek sluice/slide gate could also be closed completely and only allow flow out of the system.

- A re-graded golf course would remove some flood storage capacity from the Mill Creek sub-basin. For example, under the alternative with a 10 foot sluice opening at CNR and a 3 foot sluice opening at Mill Creek, a peak water surface elevation of approximately 6.4 feet would occur during a 100-year storm surge event in the re-graded Mill Creek sub-basin, while a peak water surface elevation of 6.0 feet would occur with the existing topography. Therefore, for a re-graded golf course area, an adaptive management approach would need to be implemented that would be able to adequately anticipate and manage water surface elevations in the Mill Creek sub-basin.

- Simulations of freshwater storm events (heavy rainfall) in the Mill Creek sub-basin, indicated that proposed alternatives would decrease the ability of the additional water to drain from the system, but would not increase the water surface elevation level above the normal mean high water level within Mill Creek. For the alternative that would completely eliminate tides from the Mill Creek sub-basin, the water surface elevation would not exceed 2 feet NAVD88 during any of the storm cases considered.

- Using the results of a preliminary evaluation, the impacts of sea level rise on the groundwater levels in the Mill Creek sub-basin indicate that under all three sea level rise scenarios (low, intermediate, high), the greatest increase in water table elevation would be 1.12 feet in 50 years in areas closest to Wellfleet Harbor. In general, a larger increase in water table elevation is expected at locations closer to Wellfleet Harbor, while a smaller increase is expected at locations near Mill Creek.

Additional findings and recommendations, corresponding to the overall restoration effort, include:

- Lowering the culvert inverts at the Chequessett Neck Road dike does allow a greater volume of flow (slightly higher tides); however, without a significant adjustment to the local bathymetry upstream and downstream of the dike, the low water level does not decrease. It may be feasible that a lower culvert invert, combined with the increased volumetric flow, would cause scour and an eventual lowering of the river bed and thereby a more significant change to the mean low water elevation. However, this lowering would have to occur over a significant distance both upstream and downstream of the dike and it is more likely that the actual scour would occur in a localized area at the dike only.

- Assessment of High Toss Road indicates that under restored conditions (Chequessett Neck Road dike openings of 65 feet or greater), the roadway will be overtopped. As such, the road would require mitigation to remain useable, or be abandoned. The existing High Toss Road and culvert also negatively impact restoration potential in the upper portions of the Herring River estuary. Specifically, the restrictive culvert and causeway impede the draining of the upper system during an ebbing tide, resulting in a reduced tidal range, excessive ponding, and higher MLW. The removal of the High Toss Road culvert and creation of an open channel at this location is recommended.

- As the restoration process advances, several upstream culverts, specifically the culverts at Pole Dike Road and Old County Road, may need to be replaced with larger culverts. However, since the effect on water surface elevation is relatively small, especially in the early stages of the restoration, these culverts do not need to be replaced during the initial restoration effort. Monitoring of water surface elevations and salinities during the adaptive management process should be conducted to determine the potential influence of these anthropogenic structures.

## ES.7 – FINAL ALTERNATIVE ASSESSMENT AND MODEL OUTPUT

Modeling results of the recommended alternatives were summarized to analyze potential changes to the Herring River system and to provide more easily digestible modeling output. The detailed results of the hydrodynamic model were also used to complete a preliminary sediment transport assessment. This assessment does not determine actual sediment movement but rather areas where there is potential for erosion or deposition. However, the analysis does provide reasonable results that can be utilized to help guide the adaptive management restoration approach.

### *ES.7.1 Tidal Benchmarks and Salinity*

Water surface elevations and salinity throughout the Herring River system were evaluated using the results of the hydrodynamic model. Water surface elevation results from the alternative simulations were presented in three specific ways:

1. Tables that present relevant tidal benchmarks (Mean Low Water, Mean High Water, Mean High Water Spring, Annual High Water), the 100-year storm water level, and potential future sea level rise scenarios for restoration endpoint alternatives. These water surface elevation values were provided for each sub-basin.

2. Graphical aerial overviews and geo-rectified bounds of the water surface elevation level for each specific tidal benchmark.

3. Interactive Google© Earth files that provide both tabular and spatial data files for each of the simulated water levels.

Results are provided within each sub-basin and include data for existing conditions, fully open, and a range of sluice/slide gate openings associated with the proposed opening sizes both at Chequessett Neck Road and Mill Creek. Water surface elevation results show the limited tidal range under existing conditions, as a vast majority of the system is non-tidal, and the overall intertidal area is minimal, even just upstream of the dike. From a salinity perspective, under existing conditions, the salt water does not propagate beyond High Toss Road, while for the proposed 3 foot sluice opening and greater, salt water advances into a significant portion of the upper sub-basins. Modeling results for all the various adaptive management cases can be used to determine changes to intertidal areas, expected high water locations, and assess potential marsh vegetation areas.

### *ES.7.2 Tidal Flushing*

The proposed opening at Chequessett Neck Road would result in substantially improved flushing within the system. The improved opening size is particularly effective at flushing the extents of the system beyond High Toss Road. Under existing conditions, the sub-basins of the system do not exchange water efficiently with Wellfleet Harbor. For example, the Herring River System above High Toss Road takes approximately 200 days to fully flush with Wellfleet Harbor under existing conditions, while under the alternative opening scenarios the flushing time is reduced to 6-8 days.

### *ES.7.3 Sensitive Receptors*

Sensitive receptors include specific low-lying infrastructure (e.g., roadways, etc.), as well as other critical locations (e.g., golf course areas) that may potentially be influenced by the restoration and changes to the water surface elevations. Model results were evaluated to determine the water surface elevation at critical locations. Water surface elevation results from the alternative simulations were presented at the sensitive receptor locations as:

1. Tables that present relevant tidal benchmarks (Mean Low Water, Mean High Water, Mean High Water Spring, Annual High Water), the 100-year storm water level, and potential future sea level rise scenarios for restoration endpoint alternatives. These water surface elevation values are provided for each sensitive receptor (e.g., roadway).

2. Interactive Google© Earth files that provide the tables at each sensitive receptor location.

### *ES.7.4 Marsh Receptors*

Similar to the sensitive receptors, water surface elevations and salinity values were evaluated at specific locations throughout the marsh plain. Additional metrics, hydroperiod, percent of tides wetting, and a classification values were also determined at each marsh receptor location. These locations can be used to assess the relative changes, and potential ecological changes that may occur throughout the Herring River system. The model results for the marsh receptor locations are presented as:

1. Tables that present relevant tidal benchmarks (Mean High Water and Mean High Water Spring) critical for marsh vegetation delineation, mean and maximum salinity levels, hydroperiod (the length of time [in hours] a point stays wet once it has gotten wet), and percent wetting (the percentage of high tides that wet that point). The tables also provide a classification of values.

2. Interactive Google© Earth files that provide the tables at each marsh receptor location.

### *ES.7.5 Ponding*

Simulations of the adaptive management steps and restoration endpoints revealed there were certain areas within the system that were prone to ponding of water with the introduction of the increased tidal exchange. These areas are generally due to subsidence that has occurred over the century of marsh degradation, or caused due to poor drainage pathways. Although these potential ponding areas appear in the hydrodynamic model for restoration endpoint simulations (3 foot and 10 foot height openings), this does not indicate that these will occur during the restoration process. The hydrodynamic model is using the existing bathymetry to simulate future restoration endpoints. However, due to the adaptive management approach that is intended to be applied to the system (smaller incremental openings over time), it is likely that this topography will change as the system responds to increased tidal exchange. For example, it is expected that additional sediment will be transported into the system and be deposited in the lower velocity zones of the subsided areas. Additionally, existing channels leading to limited drainage areas will be naturally widened and deepened due to the increased tidal flux during the restoration process. Therefore, widespread ponding during the restoration effort is not expected as long as monitoring is conducted and the appropriate adaptive management actions are applied.

### *ES.7.6 Sediment Mobilization and Transport*

In order to assess the potential impact of the proposed dike openings, a preliminary sediment transport assessment was conducted using the results of the hydrodynamic model. The analytical sediment transport model employed was based on the established concept that sediments begin to move when sufficient stress is applied to the grains on the estuary seabed. The sediment transport potential was determined for normal tidal conditions and for a 100 year extreme storm surge event. Each scenario was simulated for existing conditions, and for the restoration alternative with a 165 feet wide span at Chequessett Neck Road with sluice openings of 3 feet.

- Under existing conditions with normal tides, increased tidal asymmetry imposed by Chequessett Neck Road dike reduces the total volume of water and suspended sediment that can physically be transported into the lower Herring River. Any suspended sediment that does pass through the sluice gate quickly settles out because flood tide currents in the lower Herring River are severely reduced by the dike (this is supported by existence of the flood tide shoal in that is present in the existing system). The dike also causes a significant reduction in the flood tide current velocity in the area downstream of the dike. This reduction in current velocity likely deposits a portion of suspended sediment in the upper region of the area downstream of the dike during slack flood tide.

- When compared to existing conditions, the 3 foot opening shows similar pathways for sediment transport in the areas downstream of the dike. Generally, bed load is expected to move slightly seaward or remain in the same location, while a majority of the suspended sediment would ultimately be transported farther upstream into the estuary. For the 3 foot opening conditions, this general process is expected to increase, with potential bed load transport extending from the lower Herring River to the area downstream of the dike, while increased loads of suspended sediments would make their way upstream past Chequessett Neck Road during flood tides. Over time, these processes would likely lead to a coarsening of the sediment, particularly in the area downstream of the Chequessett Neck Road dike. With the new dike opening, potential sediment transport in the lower Herring River during both the flood and ebb tides would begin to occur. Initially, this is likely to lead to some transport of fine-grained material out of the lower Herring River that will not easily settle and would be transported into Cape Cod Bay and possibly dispersed within Wellfleet Harbor. In addition, a significant portion of this material would be transported into the subsided, upper portions of the estuary due to asymmetry in the tidal current and trapping by vegetation. The upper Herring River would remain primarily a depositional environment with the exception of the area near High Toss Road during the flooding tide. Considering the greater volume of sediment that is able to enter the upper Herring River, it is likely that 3 foot opening will lead to significant deposition of suspended sediment and fines in the upper estuary, specifically in lower lying areas that have historically subsided.

- During the 100-year storm under existing conditions, there is a large area of potential transport just downstream of the dike and sediment would be mobilized and transported upstream towards and potentially beyond Chequessett Neck Road (if the material can make it past the existing dike). Overall, the storm surge is not expected to cause significant mobilization of sediment in the lower or upper Herring River, although more suspended sediment would be carried above Chequessett Neck Road than during normal tidal conditions from outside the dike. The model results show a larger area of potential mobilization during the rising surge suggesting a net upstream transport bed load and coarser suspended sediment. Fines entrained during the surge would likely make their way out of the system and ultimately become dispersed in Cape Cod Bay.

- Qualitatively, sediment transport pathways in the area downstream of the dike are similar for both existing conditions and the restoration alternatives. However, because the Chequessett Neck Road dike severely restricts flow in the upstream reaches under existing conditions, a significantly smaller volume of water enters the estuary during the 100-year storm surge when comparing current conditions to proposed conditions. For existing conditions, there is practically no sediment mobilization above Chequessett Neck Road even during the 100-year storm surge. However, there will be a moderate increase of suspended sediment entering the lower Herring River and being deposited during a storm event when compared to normal tidal conditions. For the 3 foot opening, storm surge simulations indicate a significant mobilization of sediment in both the lower Herring River, as well as in the lower portion of the upper Herring River near High Toss Road. Significantly greater mobilization and erosion exists at the area near High Toss Road as the storm surge floods into the upper estuary and transports sediment upstream into depositional areas (primarily subsided regions). Downstream of High Toss Road, it is likely that bed load will be moved in both directions resulting in little net movement. Some sediment suspended during the flooding storm tide will likely deposit in areas of the estuary that are not typically flooded during normal conditions. As the surge recedes fines that are not deposited in the upper estuary will proceed toward the dike. Some of this sediment may make it into Wellfleet Harbor and become dispersed before the following tide brings it back into the estuary or it is carried into Cape Cod Bay.

Sediment transport processes are expected to change when the Herring River system is restored. Since the restoration project will use an adaptive management approach, it is expected that the changes to the sediment transport regime will occur over smaller incremental steps (via incremental opening of the sluice gates). As such, the sediment transport changes and amount of sediment transported will be less than is indicated in the modeling, which represents a significant opening size immediately after construction of a new dike.

Significant and valuable shellfish aquaculture exist in Wellfleet Harbor and there are concerns that the proposed restoration may result in smothering of these resources areas with sediment discharged from the Herring River system due to the increased tidal exchange. It is expected that when the system is initially opened, some fine grain material would be likely transported downstream into the Wellfleet Harbor area. Over the long-term however, sediment would be transported upstream into the Herring River system. In addition, the amount of sediment deposited in the Wellfleet Harbor area is not expected to be significant. The adaptive management approach will limit the total amount of material mobilized and a significant portion of the fine grained material will stay in suspension to areas seaward of Wellfleet Harbor. Additionally, the total volume of sediment mobilized from within the Herring River system is small compared to the area of Wellfleet Harbor. For example, if it is assumed that (1) all sluices are immediately opened to 3 feet (e.g., no adaptive management), (2) all sediment mobilized is transported downstream and deposited in Wellfleet Harbor, and (3) the depth of erosion for all mobilized areas is 1 foot, then the total thickness of sediment deposited in Wellfleet Harbor would be less than 1 cm (approximately 0.76 cm). As such, even using conservative assumptions, the potential sediment deposition thickness is minimal.

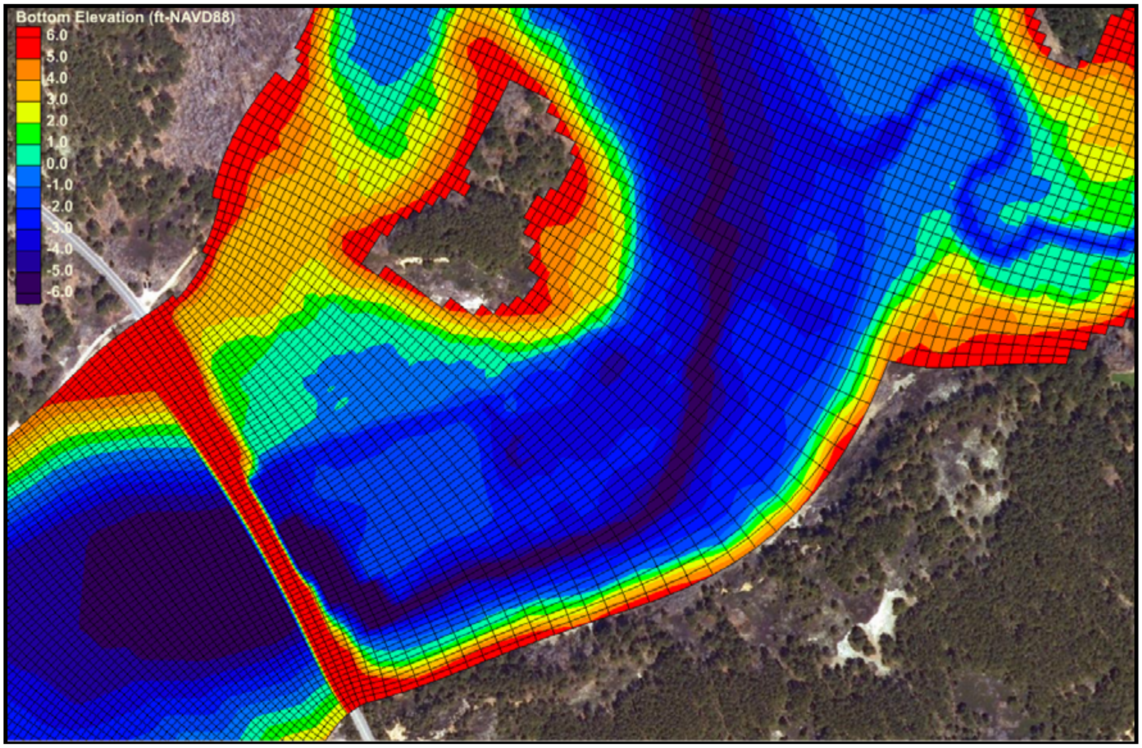


**Figure ES-1. Detail of model grid showing bottom elevation contours and individual grid cells near the Chequessett Neck Road Dike.**

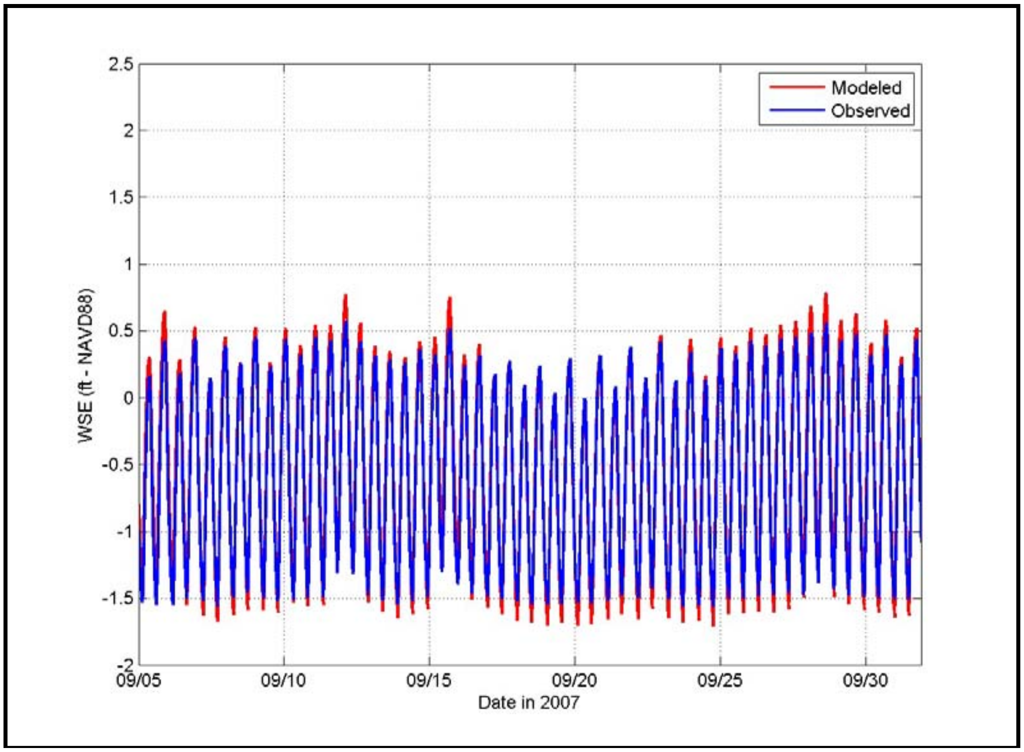


**Figure ES-2. Upstream of High Toss Road (HT_up) water surface elevation comparison for modeled (red) and measured (blue) time series.**

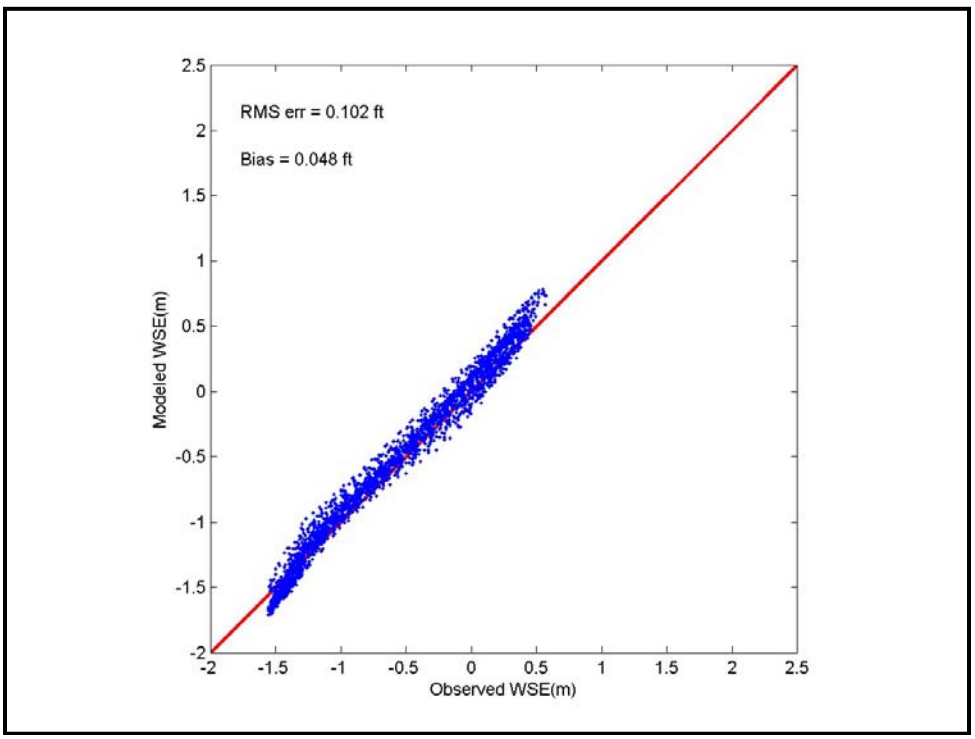


**Figure ES-3. HT_up water surface elevation scatter plot comparing modeled and measured water surface elevations.**

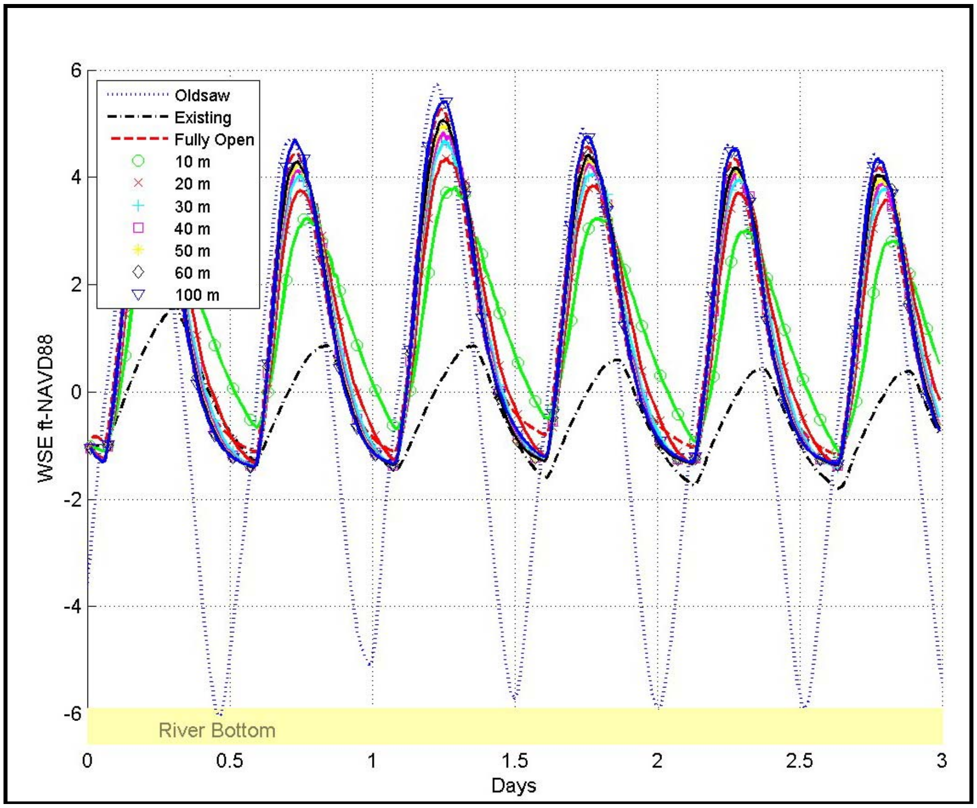


**Figure ES-4. Water surface elevation (WSE) results in the Lower Herring River location for all alternative cases of dike opening width.**

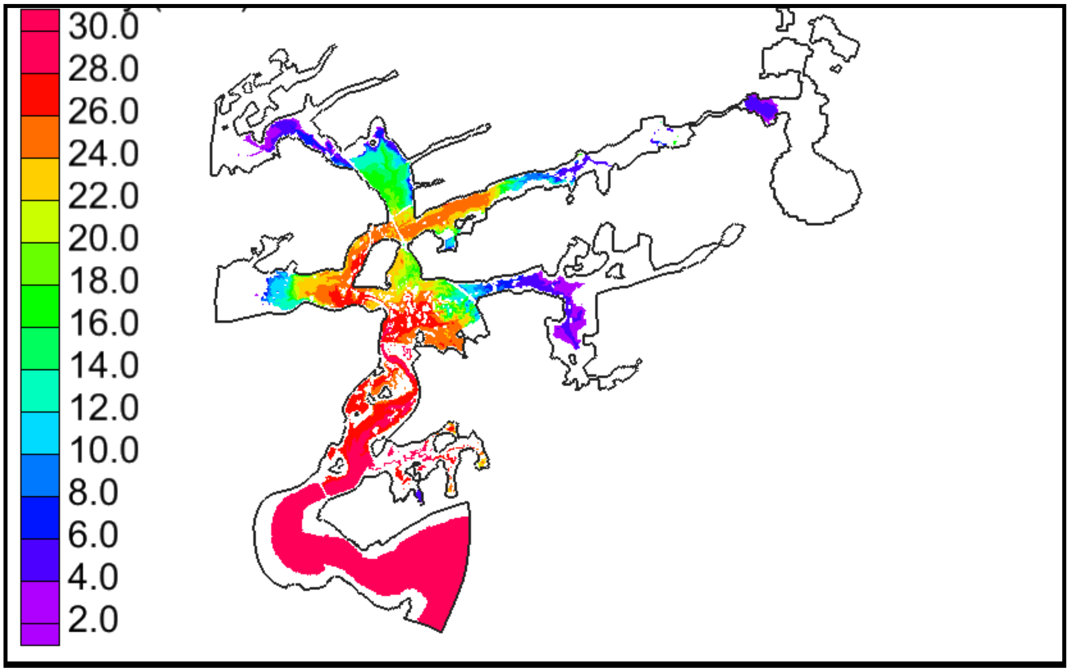


**Figure ES-5. Salinity concentration throughout the Herring River system with an opening of 30 meters at the Chequessett Neck Road. Salinity contours are presented in ppt.**

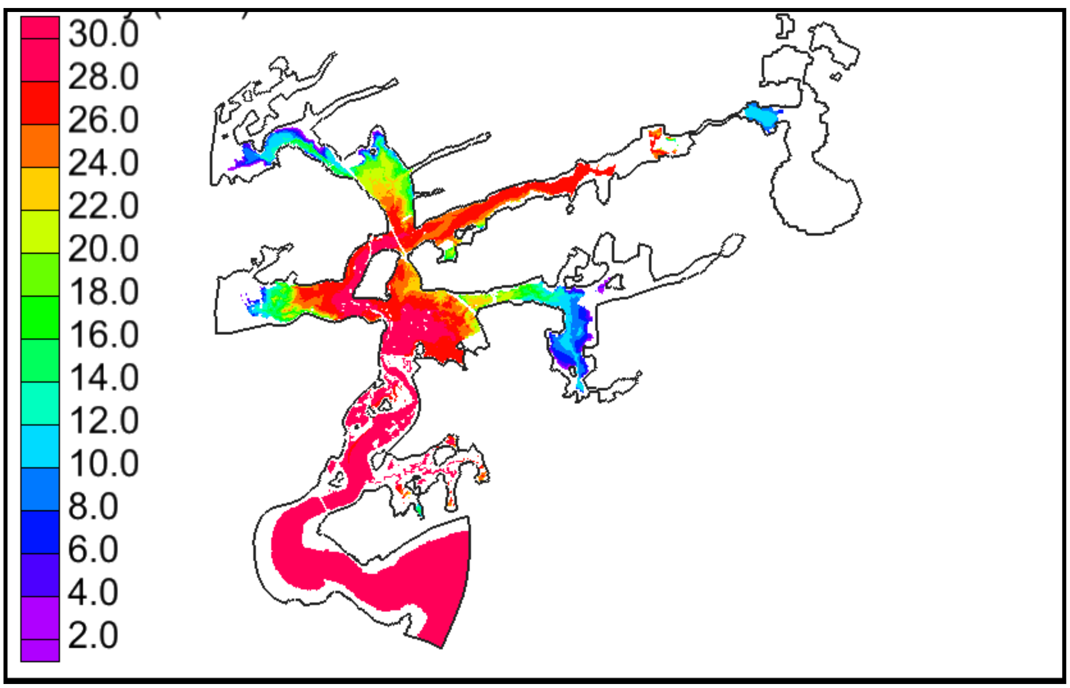


**Figure ES-6. Salinity concentration throughout the Herring River system with an opening of 50 meters at the Chequessett Neck Road. Salinity contours are presented in ppt.**

# APPENDIX C: OVERVIEW OF THE ADAPTIVE MANAGEMENT PLAN PROCESS FOR THE HERRING RIVER RESTORATION PROJECT

## GENERAL OVERVIEW OF ADAPTIVE MANAGEMENT

As described in the draft EIS/EIR, the Herring River project will be implemented by following an adaptive approach to achieve restored tidal conditions through the management of adjustable tidal control gates and the implementation other restoration actions over a period of years. This adaptive approach is designed to minimize risk to property and the environment given current uncertainties about the response of the Herring River system to the restored tidal conditions that have not been experienced in the last 100 years. Such risks necessitate a cautious start, when uncertainty is greatest; monitoring the outcomes of initial (and subsequent) tidal influx will reduce uncertainties regarding how the Herring River system responds to new conditions and allow the restoration project to proceed at a faster rate with greater confidence and less risk of unintended outcomes.

Adaptive management (AM), in the context of natural resources, is an approach for simultaneously managing and learning about the dynamics of resources under management. It is a formal process intended to aid decision making in situations where the outcomes are uncertain and learning is achieved by monitoring the system after management actions are implemented. Learning is targeted specifically at those uncertainties that impede decision-making and, thus, serves to improve our ability to predict outcomes and make better future decisions. An AM approach is designed to address decisions that are iterated over time, permitting learning to accumulate as decisions are implemented and responses are monitored. Monitoring is used to compare observed outcomes with predictions of how the system was expected to respond to management interventions (a form of hypothesis-testing). Learning is then applied at each decision point to refine the relative amount of support (credibility) for each hypothesis of system dynamics.

## USE OF ADAPTIVE MANAGEMENT FOR THE HERRING RIVER PROJECT

Each action alternative presented in the draft EIS/EIR (see Chapter 2) is based on the end-point (ecological) conditions of a step-wise process for achieving a prescribed maximum tidal range. The draft EIS/EIR is intended to address foreseeable long-term, permanent impacts of restored tidal inundation resulting from a specified tidal control gate configuration. The selection and, ultimately, the implementation of the preferred alternative in the draft EIS/EIR does not mean that the maximum specified tide regime or tide gate configuration would necessarily be achieved. Instead, the preferred alternative is intended to describe the desired end-point condition which the project aims to achieve. The sequence of decisions to increase tide range and apply other restoration actions to approach or reach conditions predicted by the preferred alternative will be guided by a process that is laid out in the Adaptive Management Plan (AMP).

Many elements of the Herring River Restoration Project make it ideally suited to a formalized adaptive management approach. Most fundamentally and despite many years of study in the Herring River (see references), much is still unknown about this very large, complex system. As such, uncertainties remain about how specific ecological processes will respond to tidal restoration. In addition, implementation of the project will involve multiple decisions, repeated over an extended timeframe (estimated as several years), with each decision carrying its own specific range of uncertainty. Various groups of stakeholders will view the project based on their own interests and may perceive some objectives differently than other stakeholders. In some instances, project objectives may be in conflict; i.e., actions required to achieve one objective may deter or delay achievement of another, making informed trade-offs a necessary factor in the decision-making process.

## GENERAL STEPS FOR ADAPTIVE MANAGEMENT PLANNING

Adaptive management is founded on general principles of structured decision making (SDM), an approach that was developed in the mid-20$^{th}$ century for applications in engineering, operations research, and economics. Adaptive management is a component of SDM and is characterized by implementing repetitive management decisions that are inferred by learning from the results of past management actions. It has been applied to natural resource management since the 1970s (Walters & Hilborn, 1978) but even today, formal usage of AM is not common. SDM is a logical, prescriptive framework for making decisions by clearly distinguishing components of a decision that are typically subjective and values-oriented (e.g., management objectives, risk attitudes, possible actions) from more objective, science-based components (system models, measures of system state). A SDM framework can guide a transparent decision-process by explicitly linking the anticipated outcomes of all possible management alternatives to well-stated objectives. The process seeks to balance competing objectives and risk attitudes of multiple stakeholders, and incorporates quantitative measures of uncertainty to identify the policy most likely to achieve management objectives.

Implementation of adaptive management requires careful planning, which can be described as a two-step process: a deliberative or set-up phase in which key components are formalized and an iterative phase consisting of the decision making, implementation, monitoring and feedback.

### SET-UP PHASE

#### Stakeholder Involvement

Identifying appropriate individuals or groups that have 1) an interest in the resources proposed for management, and 2) a willingness to come to an agreement on the scope of the problem, the objectives of other stakeholders, and potential courses of action. Representation of the full range of stakeholder values is key to successful decision making; actual stakeholder involvement at various stages of the process is context-specific.

#### Objectives

Desired conditions of the resource constitute the management objectives and are the foundation for any decision. Careful deliberation of clear, measurable and fundamental objectives at the beginning of the set-up phase permits a clearer understanding of the consequences and trade-offs involved with any decision, as well as a transparent means for evaluating progress towards ‘success’.

#### Alternatives/Management Actions

A complete set of available management actions, or combinations of actions (‘portfolios’), from which to select must be described. Alternatives should span all reasonable actions available to a decision maker and be distinct enough to predict discernible outcomes by which learning and feedback can proceed.

### Predicted Consequences/Models

Predicting the outcome of an action is an essential (and natural) part of any decision making. A SDM/AM framework links management decisions to resource objectives via models that predict the outcome (both costs and benefits) of all possible alternative actions. Because of the iterative nature of AM actions and the opportunity to learn from their implementation, reducing uncertainty is a central focus during the establishment of predictive models. Important areas of uncertainty are represented by multiple hypotheses about how the system functions. Each hypothesis is given a relative credibility weight based on prior knowledge (i.e., from previous research) or stakeholder agreement and optimal decisions are based on weighted mean predictions.

### Monitoring Design

A careful monitoring plan should be designed to track appropriate measures of system response after implementation of a management decision. Monitoring data should specifically track (i) progress toward achieving objectives; (ii) current resource status (state) to evaluate the next appropriate management action; and (iii) the differences between predictions of alternate hypotheses (models) and the observed system response. Comparisons between observed and predicted outcomes constitute the learning component of AM as they provide support for those hypotheses with the best predictive ability, thereby permitting updating of the weighting of competing models to improve predictive power for the next decision cycle.

## ITERATIVE PHASE

### Decision Making

The set-up phase provides the necessary framework for selecting the most appropriate actions for each step to achieve multiple management objectives, given the status of the current system, and predicted outcomes of each possible management alternative. Predictions consider uncertainty in the system through multiple hypotheses and, thus, are robust given the current state of knowledge. Selecting the best alternative involves balancing the anticipated costs and benefits of any action, when compared to the stated management objectives, and accounting for such trade-offs into the future.

### Monitoring and Assessment

Confidence in our decision making will improve over time as our understanding of the system evolves with new information collected from the monitoring program and as hypotheses (models) are supported or refuted by empirical observations. Monitoring also provides needed information about the new state of the system in order to evaluate the appropriate action at the next point in the decision cycle.

# ADAPTIVE MANAGEMENT PLANNING STEPS FOR THE HERRING RIVER PROJECT

Using the steps outlined above, this section describes the basic logic and framework being followed in the development of the Herring River AMP.

## SET-UP PHASE

### Stakeholder Involvement

Although not explicitly framed under the AM approach, formal engagement with Herring River stakeholders began in 2005 with the development of the first Memorandum of Understanding (MOU I) between the Town of Wellfleet and the Seashore, formation of the Herring River Technical (HRTC) and Stakeholders Committees, and the 2007 completion of the Conceptual Restoration Plan (CRP). During this process, the HRTC solicited input from the Stakeholder Committee and others (including flood plain landowners, town officials, and representatives from various interest groups) regarding their specific concerns, questions, and issues related to the restoration project. The CRP was developed to partially address these concerns and to frame unanswered questions for further analysis during the NEPA process and AMP. With the approval of the CRP by the Seashore and Wellfleet Board of Selectmen, execution of a second MOU, and formation of the current Herring River Restoration Committee (HRRC), stakeholder involvement and input has continued through regularly scheduled monthly public meetings, periodic public events sponsored by the Friends of the Herring River, and HRRC public outreach presentations at the State of Wellfleet Harbor Conference, Seashore sponsored canoe trips, and a variety of other public forums. In general, issues and questions raised by stakeholders include:

- flooding impacts to low lying roads, private properties, and the CYCC golf course,
- potential sediment and water quality impacts within Wellfleet Harbor,
- changes to freshwater habitats that have become established in the flood plain since the Chequessett Neck Road dike was constructed,
- obstructions to river herring migration,
- nuisance mosquitoes,
- project costs and timeline,
- And impacts occurring during construction.

### Objectives

Decisions made regarding the control of water flow into and out of the Herring River estuary will necessarily be based on considerations of the objectives for the restoration project. By 'objectives', we refer to the desired future state of the Herring River system, which considers both the ecological state of the watershed and the human values derived from the estuary and its environs. Some of these objectives may be in conflict, necessitating a consideration of the risks and trade-offs between them to arrive a decision that will maximize the overall benefits across objectives.

The fundamental ecological goals for the Herring River restoration project are to restore natural hydrological conditions and ecosystem functions in the watershed. Because full control over all functions within the Herring River ecosystem is unrealistic, the achievable objectives that represent the most important components of ecosystem function include, 1) benefits to native fauna and, 2) restoring the extent and quality of native vegetation communities. From these two over-arching fundamental objectives, a number of means objectives can be stated which collectively describe the inter-related physical, chemical, and biological processes which need to be established to achieve the project goals. Means objectives include targeted water surface elevations, salinity levels, sediment transport and other estuarine processes. Conceptualized relationships among fundamental and means are depicted in the objectives hierarchy show in Figure A-1.

Based on the articulation of stakeholder concerns, socioeconomic objectives have also been factored into the consideration of risks from management interventions to other resources in the Herring River system. Some of these issues, such as the risk of flooding private properties, have already been incorporated into the development of the action alternatives analyzed as part of the draft EIS/EIR, where maximum tidal water surface elevations are limited and impacts will be mitigated. In other cases, socioeconomic concerns and other constraints to fulfilling project objectives will be discussed further with stakeholders and project planners as the AMP is developed.

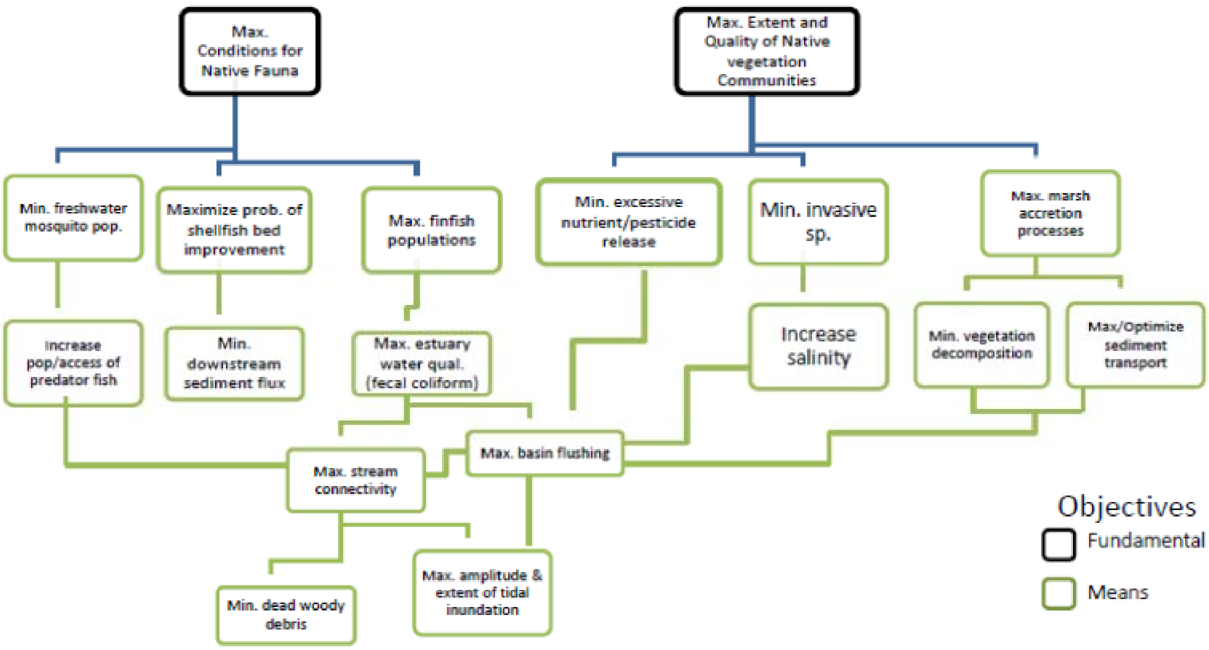


**FIGURE A-1: CONCEPTUALIZED RELATIONSHIPS AMONG ECOSYSTEM OBJECTIVES FOR THE HERRING RIVER RESTORATION ADAPTIVE MANAGEMENT PLAN**

Achieving the desired system states articulated by the objectives could be hindered by lack of knowledge about how the Herring River functions and how it will respond to various management actions. Based on the impact topics which comprise the draft EIS/EIR alternatives analysis, the uncertainties about Herring River tidal restoration are generally related to:

- **Salinity**: the extent to which salinity levels above 18 parts per thousand will reach mid- and upper sub-basins.
- **Water and Sediment Quality**: the rate and duration of nutrient, metals, and bacteria release and potential effects in downstream receiving waters.
- Sediment Transport:
  - the ability of subsided marsh surfaces to regain inter-tidal elevations relative to increasing tidal range,
  - the extent to which sediment will move out of the river and affect Wellfleet Harbor.

- Wetland Habitat and Vegetation Change:
  - the ability of subsided marsh surfaces to support native, estuarine vegetation,
  - the extent to which brackish marsh plant communities will shift throughout the flood plain,
  - composition of tidally influenced freshwater plant communities,
  - effect of dead and dying woody shrubs and trees on recovery of native estuarine plant communities.
- Aquatic Species:
  - the effects of the new Chequessett Neck Road dike on migrating river herring and American eels,
  - the rate and extent of colonization of shellfish,
- **State-listed Rare Species**: extent and rate of change in distribution of water-willow (*Decodon verticillatus*) and occupancy of suitable habitat by water-willow stem borer (*Papaipema sulphurata*).
- **Terrestrial Species**: suitability of restored estuarine habitat for estuarine-dependent bird species.
- **Cultural Resources**: potential effects of tidal flow and construction activities on potentially sensitive areas.
- Socioeconomics:
  - extent and rate of change from freshwater dominant to salt water dominant mosquito species,
  - sedimentation impacts to Wellfleet Harbor aquaculture areas,
  - unanticipated flood impacts to low-lying road or properties.
  - property value changes based on changes to vegetation, viewscapes, and aesthetics.

## Alternatives/Management Actions

Management actions are considered those activities which need to be undertaken to achieve project objectives. For the Herring River project, the primary management actions involve the incremental opening of a series of adjustable tidal control gates over a period of several years. A central assumption for the project is that by doing so, increased tidal range and salinity (believed to be the core drivers for reestablishment of estuarine function) will stimulate a series of responses leading to the achievement of fundamental objectives of improved estuarine conditions for estuarine fauna and vegetation. Other secondary management actions may be needed to achieve the desired conditions. Because of inherent uncertainties about how the Herring River ecosystem functions and how it will respond to tidal restoration, it cannot be known whether secondary management actions will be necessary until implementation of the project begins and ecological changes can be monitored. In addition to tidal control gate management, secondary management actions for the Herring River project may include:

- Targeted herbicide application to control non-native, invasive plant species.
- Planting, seeding, or supplementing seed source of native estuarine plants.

- Removal of woody vegetation to facilitate tidal circulation and promote recovery of estuarine plants.
- Reestablishment and/or creation of sustainable tidal channels to promote tidal circulation and freshwater drainage.
- Creation of salt pannes and pools and related hydraulic connections to function as estuarine fish habitat for control of salt marsh mosquito larvae.
- Applying layers of sediment to subsided areas to supplement natural accretion processes and promote establishment of inter-tidal habitats.

### Predicted Consequences/Models

A set of models for the Herring River project will link stakeholder concerns, objectives, management actions, and monitoring variables to predict the outcome of each management action in order to select the best alternative given current system characteristics. Although the existing hydrodynamic model (Woods Hole Group 2012) provides the central basis for predicting changes in tidal regime and salinity based on varying tide gate configurations, related models are needed to predict resultant changes in vegetation, water quality, sediment distribution and other processes as a function of modified hydrodynamics. In addition, development of predictive models linking actions to outcomes will facilitate identification of key ecological relationships as well as those that are most uncertain. Models will also highlight the most relevant state variables for system characterization and monitoring. The models do not necessarily need to be complex, but do need be sophisticated enough to capture the range of uncertainty for any possible outcome of management so that competing hypotheses can be represented and tested.

### Monitoring Design

With objectives, risks, and management actions fully articulated, and predictive models developed to capture the uncertainty in our understanding of system behavior, appropriate state variables will be identified to track and measure progress toward achieving objectives and test the hypotheses represented in the models to increase their predictive power. The monitoring variables identified by the AM planning process and specified in the AMP are intended to provide needed information for comparing predictions to observations in order to discern among alternative hypotheses of system functioning. The prime intent is to reduce uncertainty (i.e., learning) to optimize decisions over time through the AM process.

Although the AM planning process has not been completed for the Herring River project, based on anticipated uncertainties and the general project objectives, there are several areas for which it is clear that monitoring will be necessary to inform the decision making process prescribed in the AMP. Among these are:

- Water surface elevations
- Water column salinity
- Vegetation and wetland habitat states
- Sediment spatial distribution
- Marsh accretion

- Abundance and distribution of state-listed rare species and obligate habitat
- Water quality

The AMP will describe in detail the specific state variables for each category and the monitoring activities associated with each, as well as the relationship between state variables and project objectives and models. The Seashore has already collected data for all of these in the Herring River and several studies are on-going. Formal protocols developed by the NPS Inventory and Monitoring Program are either completed or in development and are used to guide study design, data collection, analysis, and other technical procedures. However, for the AMP, these protocols will need to be reviewed, and possibly modified, to ensure that the monitoring plan is designed efficiently for providing appropriate information within the spatial and temporal scales required by the AM decision making process. It is likely that additional parameters and metrics will be incorporated into the plan as the AM planning process proceeds.

Monitoring in the context of AM is distinct from standard, omnibus monitoring programs commonly used in research programs. In those situations data collection and analyses are performed solely for scientific curiosity and for detecting change along a trajectory from one condition to another. In contrast to a general monitoring program conducted without specific management models to evaluate, the monitoring plan for the Herring River AMP is intended to apply 'learning' specifically to reduce uncertainty about the system in order to inform management decisions and maximize project benefits. Because of this, variables commonly monitored in tidal restoration projects may not be included as part of the Herring River AMP. Examples may include changes to fish, macroinvertebrate, and bird populations and certain water quality indicators. This isn't meant to imply that these elements are not important or that knowledge about them has no value, but that information obtained from such measures are unlikely to affect decisions to alter management policies for the system. This could be because there is relatively little uncertainty or risk about the variable, changes in the variable are not detectable in the spatial and/or temporal scale at which it can be monitored, or because no practicable alternate management actions are known which could stimulate a response. Some of these variables may be monitored outside of the AMP depending on the interests of particular investigators, agencies, funding programs, or other stakeholders, but for the Herring River restoration project as a whole they would be approached at a lower level of priority compared to the monitoring needs defined by the AMP.

## ITERATIVE PHASE

### Decision Making

The preceding steps described as part of the AM Set-up Phase will be conducted as the AMP is developed, beginning with the preparation and review of the DEIS, FEIS, and Record of Decision (ROD) and through final design, permitting, and outreach, leading up to actual implementation of the project. A central component of the AMP will be a strategy for how management decisions for the project are made and who will make them. As described previously, broad primary decisions will involve modifications to the tidal control structure(s) installed as part of the project and more narrow decisions about any number of secondary management actions in order to achieve the project objectives articulated in the AMP.

Although the details are currently not known, it is envisioned that several integrated groups will be established to oversee and manage the implementation of the Herring River project and the AMP (see Figure A-2, below). At the core of these groups would be an executive committee representing the superintendent of the Seashore and the Wellfleet and Truro Boards of Selectmen, the entities ultimately responsible for stewardship of the Herring River flood plain. A management committee, with a composition and purpose similar to the current HRRC, would be established by the executive committee to meet regularly to review and discuss day-to-day project details and make management recommendations to the towns and the Seashore. The management committee would also develop a science team to work closely with Seashore natural resource staff and other collaborators to be responsible for monitoring and data reporting. The management committee would review data provided by science team and incorporate it into the adaptive decision making framework. In addition, a stakeholder and outreach team would be formed to provide information to the public at regular intervals and proactively seek public input and involvement in the management process. A technical oversight committee, analogous to the current Technical Working Group established by MEPA (see draft EIS/EIR Chapter 5, Section 5.2.1), would also be established to meet on a regular basis (perhaps once or twice per year) to review monitoring reports and results of predictive models, management committee recommendations, and authorize proposed management actions requiring regulatory review according to guidelines set forth by individual permitting agencies (see draft EIS/EIR Chapter 5, Section 5.3).

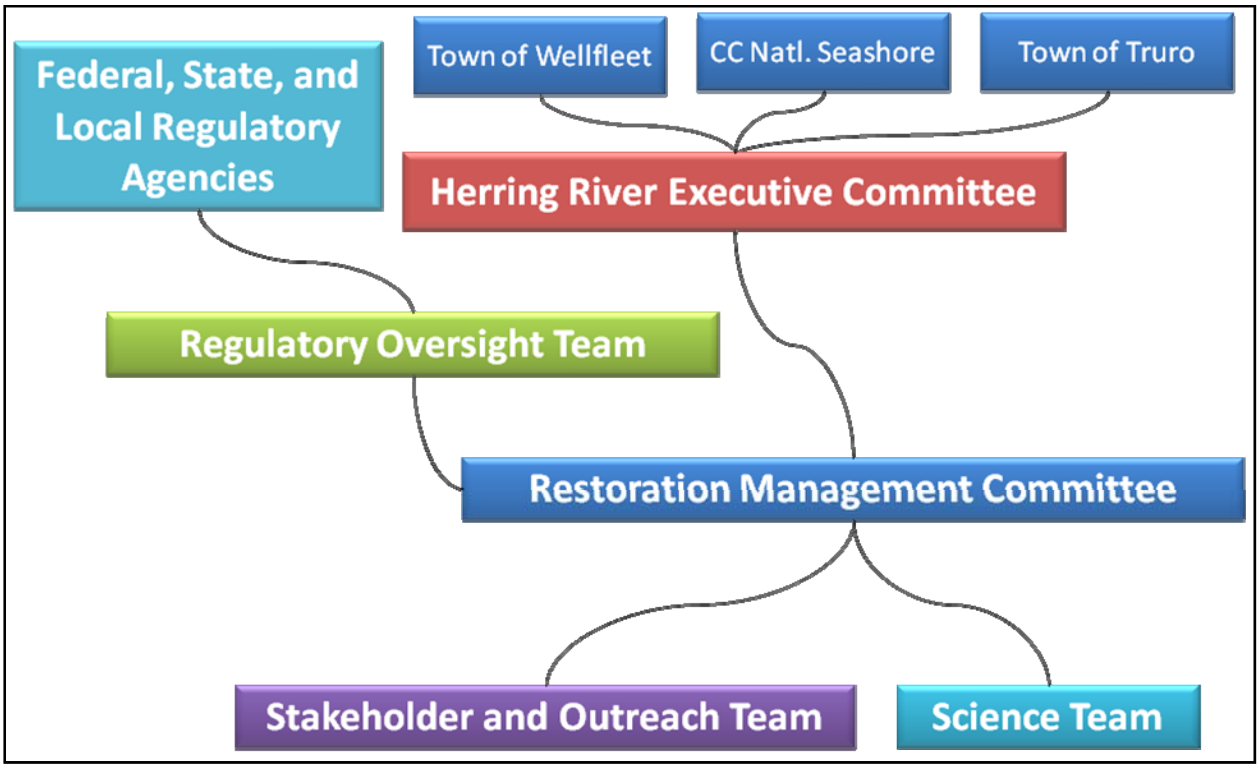


FIGURE A-2: POTENTIAL MANAGEMENT STRUCTURE FOR HERRING RIVER RESTORATION PROJECT AND ADAPTIVE MANAGEMENT PLAN IMPLEMENTATION

## Monitoring and Assessment

Monitoring of the parameters needed to establish baseline conditions and to evaluate and optimize predictive models will begin as the AMP is completed and monitoring plan details are developed. The science team will oversee monitoring as the project is implemented and the AMP is carried out. At each decision point to alter tidal control gate openings or to implement any of the secondary management actions, the management committee will review monitoring data and reports and revisit the predictive models to assess system responses to previous decisions. New data will be integrated into the models to update the credibility in each proposed hypothesis, ensuring that subsequent decisions draw on empirical observations from the Herring River, and thereby increase our knowledge of the system and the confidence in our management at each decision point. Throughout this process, the management team will continue to receive feedback from stakeholders as the system changes, revisit the AMP objectives, and refine management actions, models, and the monitoring plan as new information becomes available.

## HERRING RIVER ADAPTIVE MANAGEMENT CASE STUDY EXAMPLE

Although the full suite of objectives, models, and other elements of AM planning have not been fully developed to date for the Herring River project, it is possible to illustrate how the process is envisioned to unfold through a hypothetical case study. Discussions among various stakeholders to date have raised a specific concern about plant community dynamics in response to tidal restoration and changes in water column and porewater salinity. As discussed in detail in Section 4.5, salinity values in the lower sub-basins are expected to be high enough to stress the non-native invasive species *Phragmites australis* and to support the recovery of salt marsh vegetation. However, mid-level salinity values may persist over the long-term in some upper sub-basins, creating conditions where *Phragmites* could gain a competitive advantage over less salt-tolerant plants. Increased coverage of *Phragmites*, especially within sub-basins where it presently does not exist, would be considered an adverse impact and in conflict with the goals of the project to restore native tidal wetland habitats. Uncertainty in the current hydrodynamic models regarding predicted salinity levels following a tide-gate opening leads to lower confidence in any prediction as to which vegetation community type will eventually become established. Model uncertainty represents different hypotheses of how the system responds to actions; confidence in each hypothesis can be modified by comparing its predictions to actual outcomes via a monitoring program. Thus, for the AMP an objective statement needs to be developed which articulates project objectives to restore native tidal wetland vegetation. Uncertainty in the belief of how salinity and vegetation will respond to management can be represented by competing hypotheses which can be used to select the most probable outcome and then be tested by comparing observations to predictions. An example of an appropriate objective statement could be: “Restore native tidal wetland vegetation through natural recolonization in response to reintroduction of tidal exchange while minimizing establishment of non-native invasive plant species throughout the project area”. During development of the actual AMP, meetings and discussions will held with various groups to appropriately frame all stakeholders’ concerns in order to construct specific, measurable and achievable objective statements.

With the objectives adequately articulated, we can then develop applicable models for describing key drivers and dynamics of tidal marsh habitat transition as related to a policy of tide gate openings and other restoration actions. Models are intended to identify key relationships between the driving forces, the physical and chemical conditions likely to be affected by the project, and the biological communities of concern. For the Herring River project, the hydrodynamic model is a key tool for simulating and predicting tidal regimes, salinity levels, and other hydrologic-driven factors resulting from various culvert and tide gate configurations. Much of the information derived from the hydrodynamic model, combined with professional judgment and knowledge from experts in salt marsh ecology and tidal wetland vegetation communities can be applied to formulate a set of hypotheses and predictions about the conditions which could result in increased probability of *Phragmites* expansion. This synthesis of factors could be expressed in a number of formats, ranging from a relatively simple, narrative form conceptual model or influence diagram to a complex, dynamic computer simulation. Regardless of the format, the central point of the model, or models, is to represent two or more alternate hypotheses about the predicted consequences of implementing any particular action. For the Herring River vegetation colonization case study, example hypotheses could be:

- Hypothesis #1: Restoring mean high spring tides will result in salinity levels high enough to stress and kill *Phragmites* in the Middle Herring River sub-basin.
- Hypothesis #2: Restoring mean high spring tides will result in salinity levels which will cause *Phragmites* to expand its range in the Middle Herring River sub-basin.

These two competing hypotheses, and possibly others, would be translated into vegetation dynamics models that can be used as the basis for a management decision. Based on expert opinion, published literature, or prior experience, one model could be weighted in favor of the other to express a greater level of confidence. If there's no basis for a priori confidence in one or the other, they would both be weighted equally. The optimal decision at any point in time will be based on the outcome predicted under each hypothesis, weighted by their respective confidence levels. As management proceeds, the observed response of *Phragmites* in the sub-basin would be monitored, along with water surface and salinity levels. Given the observed data, the relative likelihood of each hypothesis will be used to update its confidence value. As more data are collected over time, the better performing model will be weighted more favorably and thus will contribute more to the selection of an optimal decision. Learning will increase our understanding and confidence about how *Phragmites* will respond to future management. These analyses and discussions will be part of the routine activities of the management committee, with input from the science and outreach teams. When proposed management actions involve issues pertaining to the regulatory agencies, similar reviews and discussions will be held with the oversight team before receiving permitting approval.

Just as the AMP will describe a strategy for a flexible and iterative approach to implementing the Herring River project, the plan and decision making process itself, will be similarly adaptive, flexible, and iterative. Although the overview describes an AM team framework in general, which will be addressed in more detail in the actual AMP, it is expected that, like the AM process, the management team structure will be modified and adapt to the needs of the project as the implementation and evaluation processes unfold.

# APPENDIX D: APPLICABLE LAWS, POLICIES, AND REGULATIONS

## NPS ORGANIC ACT

The 1916 NPS Organic Act (16 USC § 1) commits the NPS to making informed decisions that perpetuate the conservation and protection of park resources unimpaired for the benefit and enjoyment of future generations. In the Organic Act, Congress directed the U.S. Department of the Interior and the NPS to manage units of the national park system "to conserve the scenery and the natural and historic objects and wildlife therein and to provide for the enjoyment of the same in such a manner and by such a means as will leave them unimpaired for the enjoyment of future generations" (16 USC § 1). Congress reiterated this mandate in the Redwood National Park Expansion Act of 1978 by stating that NPS must conduct its actions in a manner that will ensure no "derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress" (16 USC § 1a-1).

While some actions and activities cause impacts, the NPS cannot allow an adverse impact that constitutes resource impairment (NPS 2006, sec. 1.4.3). The Organic Act prohibits actions that permanently impair park resources unless a law directly and specifically allows for the action (16 USC § 1a-1). An action constitutes an impairment when its impacts "harm the integrity of park resources or values, including the opportunities that otherwise would be present for the enjoyment of those resources or values" (NPS 2006, sec. 1.4.5). To determine impairment, the NPS must evaluate "the particular resources and values that would be affected; the severity, duration, and timing of the impact; the direct and indirect effects of the impact; and the cumulative effects of the impact in question and other impacts" (NPS 2006, sec. 1.4.5). Therefore, this EIS/EIR analyzes the context, duration, and intensity of impacts related to restoration activities within the Herring River estuary and the Seashore as well as the potential for resource impairment as required by Director's Order 12 (NPS 2001).

## NPS MANAGEMENT POLICIES 2006

The introduction to "Chapter 4, Natural Resources Management" of NPS *Management Policies 2006* states that parks "will strive to understand, maintain, restore, and protect the inherent integrity of the natural resources, processes, systems, and values of the parks" and that the NPS "manages the natural resources of parks to maintain them in an unimpaired condition for present and future generations" (NPS 2006).

The *NPS Management Policies 2006* acknowledge that park units are parts of much larger ecosystems and that parks can contribute to the conservation of regional biodiversity (NPS 2006). Conversely, many parks cannot meet their natural resource preservation goals without the assistance and collaboration of neighboring landowners and resources to achieve ecosystem stability and other resource management objectives. Therefore, section 4.1.4 of the NPS *Management Policies 2006* states that the agency will pursue cooperative conservation with other agencies, Indian tribes, other traditionally associated people, and private landowners in accordance with Executive Order 13352 (Facilitation of Cooperative Conservation).

Section 4.1.5 (Restoration of Natural Systems) of the NPS *Management Policies 2006* states that the NPS will seek to return areas impacted by human disturbances "to the natural conditions and processes characteristic of the ecological zone in which the damaged resources are situated" and that impacts on natural systems resulting from human disturbances include among other things "changes to hydrologic patterns and sediment transport…and the disruption of natural processes" (NPS 2006).

Other sections of the NPS *Management Policies 2006* most relevant to this restoration plan/EIS/EIR include Section 4.4.1, General Principles for Managing Biological Resources; Section 4.4.2, Management of Native Plants and Animals; Section 4.4.2.2, Restoration of Native plant and Animal Species; Section 4.4.2.3, Management of Threatened and Endangered Plants and Animals; Section 4.4.2.4, Management of Natural Landscapes; Section 4.4.4, Management of Exotic Species; Section 4.6.3, Water Quality; Section 4.6.4, Floodplains; Section 4.6.5, Wetlands; Section 4.6.6, Watershed and Stream Processes; and Section 8.2, Visitor Use.

## Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision Making and Handbook

NPS Director's Order 12 and its accompanying handbook (NPS 2001) lay the groundwork for how the NPS complies with NEPA. Director's Order 12 and the handbook set forth a planning process for incorporating scientific and technical information and establishing a solid administrative record for NPS projects.

NPS Director's Order 12 requires that impacts to park resources be analyzed in terms of their context, duration, and intensity. It is crucial for the public and decision-makers to understand the implications of those impacts in the short term and long term, cumulatively, and within context, based on an understanding and interpretation by resource professionals and specialists. Director's Order 12 also requires an analysis of impairment to park resources and values as part of the NEPA document.

## Director's Order 77: Natural Resource Protection

Director's Order 77 addresses natural resource protection with specific guidance provided in Reference Manual 77: Natural Resource management. This director's order includes Director's Order 77-1: Wetland Protection and Director's Order 77-2: Floodplain Management, both of which were considered during the development of this draft EIS/EIR.

## Director's Order 28: Cultural Resource Management

This director's order sets forth the guidelines for management of cultural resources, including cultural landscapes, archeological resources, historic and prehistoric structures, museum objects, and ethnographic resources. This order calls for the NPS to protect and manage cultural resources in its custody through effective research, planning, and stewardship in accordance with the policies and principals contained in the NPS *Management Policies 2006*.

## Other Federal Legislation, Executive Orders, Compliance, and NPS Policy

### National Environmental Policy Act, 1969, as Amended (NEPA)

NEPA is implemented through regulations of the Council on Environmental Quality (40 CFR 1500-1508) (CEQ_. The NPS has in turn adopted procedures to comply with the act and the CEQ regulations, as found in Director's Order 12: Conservation Planning, Environmental Impact Analysis, and Decision Making and its accompanying handbook (NPS 2001). Section 102(2) (c) of this act requires an EIS for proposed major federal actions that may significantly affect the quality of the human environment.

## National Parks Omnibus Management Act of 1998

The National Parks Omnibus Management Act of 1998 (16 USC 5901 et seq.) underscores NEPA in that both are fundamental to NPS park management decisions. Both acts provide direction for articulating and connecting the ultimate resource management decision to the analysis of impacts using appropriate technical and scientific information. Both also recognize that such data may not be readily available and provide options for resource impact analysis in this case.

National Parks Omnibus Management Act of 1998 directs the NPS to obtain scientific and technical information for analysis. The NPS handbook for Director's Order 12 states that if "such information cannot be obtained due to excessive cost or technical impossibility, the proposed alternative for decision will be modified to eliminate the action causing the unknown or uncertain impact or other alternatives will be selected" (NPS 2001).

## Redwood National Park Act of 1978, as Amended

Reasserting the system-wide standard of protection Congress established in the original *Organic Act*, the Redwood Amendment states:

> The authorization of activities shall be construed and the protection, management, and administration of these areas shall be conducted in light of the high public value and integrity of the National Park System and shall not be exercised in derogation of the values and purposes for which these various areas have been established, except as may have been or shall be directly and specifically provided by Congress (P.L. 95-250, USC Sec 1a-1).

Congress intended the language of the Redwood Amendment to the General Authorities Act to reiterate the provisions of the Organic Act, not to create a substantively different management standard. The House committee report described the Redwood Amendment as a "declaration by Congress" and that the promotion and regulation of the national park system is to be consistent with the Organic Act. The Senate committee report stated that under the Redwood Amendment, "[t]he Secretary has an absolute duty, which is not to be compromised, to fulfill the mandate of the 1916 Act to take whatever actions and seek whatever relief as will safeguard the units of the national park system." Although the Organic Act and the General Authorities Act, as amended by the Redwood Amendment, use different wording ("unimpaired" and "derogation") to describe what the NPS must avoid, both acts define a single standard for the management of the national park system, not two different standards. For simplicity, NPS *Management Policies 2006* uses "impairment," not both statutory phrases, to refer to that single standard.

## Endangered Species Act of 1973, as Amended

This act requires all federal agencies to consult with the Secretary of the Interior on all projects and proposals with the potential to impact federally endangered or threatened plants and animals. It also requires federal agencies to use their authorities in furtherance of the purposes of the Endangered Species Act by carrying out programs for the conservation of endangered and threatened species. Federal agencies are also responsible for ensuring that any action authorized, funded, or carried out by the agency is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of designated critical habitat.

## Migratory Bird Treaty Act of 1918

The Migratory Bird Treaty Act implements various treaties and conventions between the United States and Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds. Under this act, it is prohibited, unless permitted by regulations, to "pursue, hunt, take, capture, kill, attempt to take, capture, or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export at any time or in any manner, any migratory bird included in the terms of this Convention…for the protection of migratory birds…or any part, nest, or egg of any such bird" (16 USC 703). Subject to limitations in the Act, the Secretary of the Interior may adopt regulations determining the extent to which, if at all, hunting, taking, capturing, killing, possessing, selling, purchasing, shipping, transporting, or exporting of any migratory bird, part, nest, or egg will be allowed, having regard for temperature zones, distribution, abundance, economic value, breeding habits, and migratory flight patterns.

## Code of Federal Regulations, Title 36 (1992)

Title 36, Chapter 1, provides the regulations "for the proper use, management, government, and protection of persons, property, and natural and cultural resources within areas under the jurisdiction of the National Park Service" (16 USC 3).

## National Historic Preservation Act of 1966, as Amended

The National Historic Preservation Act (NHPA), as amended, is the principal legislative authority for managing cultural resources associated with NPS projects. Generally, Section 106 of the NHPA, as amended, and as implemented in 36 CFR 800, requires all federal agencies to consider the effects of their actions on cultural resources listed and/or determined eligible for listing in the National Register. Such resources are also termed "historic properties."

Moreover, the federal agency must afford the Advisory Council on Historic Preservation (ACHP) the opportunity to comment in the event that an undertaking will have an adverse effect on a cultural resource that is eligible for or listed in the National Register, and must consult with the State Historic Preservation Officer (SHPO) and other interested parties in an effort to avoid, minimize, or mitigate adverse effects.

Eligibility for the National Register is established according to the official Criteria of Evaluation (36 CFR 60.4) issued by the Department of the Interior. The criteria relate to the following:

> The quality of significance in American history, architecture, archeology, engineering, and culture present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and:
>
> (a) That are associated with events that have made a significant contribution to the broad patterns of our history; or
>
> (b) That are associated with the lives of persons significant in our past; or
>
> (c) That embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic

values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or

(d) That has yielded, or may be likely to yield, information important in prehistory or history.

A historic property can be considered significant under one or more of the criteria.

Other important laws and regulations designed to protect cultural resources are listed below:

- Native American Graves Protection and Repatriation Act, 1990
- American Indian Religious Freedom Act, 1978
- National Environmental Policy Act, 1969
- Archeological Resources Protection Act, 1979
- Protection of Historic Properties (36 CFR 800), as amended 2004
- Executive Order 11593: Protection and Enhancement of the Cultural Environment, 1971
- Executive Order 13007: Indian Sacred Sites, 1996

## Historic Sites Act of 1935

This act declares as national policy the preservation for public use of historic sites, buildings, objects, and properties of national significance. It authorizes the Secretary of the Interior and the NPS to restore, reconstruct, rehabilitate, preserve, and maintain historic or prehistoric sites, buildings, objects, and properties of national historical or archaeological significance.

## Marine Mammal Protection Act, 1972

The Marine Mammal Protection Act prohibits, with certain exceptions, the taking of marine mammals in United States waters and by United States citizens on the high seas and the importation of marine mammals and marine mammal products into the United States. The act defines "take" as "to harass, capture, kill, or attempt to harass, hunt, capture, or kill any marine mammal." It defines harassment as "any act or pursuits, torment or annoyance which has the potential to injure a marine mammal or marine mammal stock in the wild; or has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering." This act recognizes that some marine mammal species or stocks may be in danger of extinction or depletion as a result of human activities and that these species or stocks must not be permitted to be depleted. The act, as amended in 1994, provides for certain exceptions to the take prohibitions, such as for Alaska Native subsistence and permits and authorizations for scientific research; a program to authorize and control the taking of marine mammals incidental to commercial fishing operations; preparation of stock assessments for all marine mammal stocks in waters under United States jurisdiction; and studies of pinniped (fin-footed mammals)-fishery interactions.

## Magnuson-Stevens Fishery Management and Conservation Act of 1976

The Magnuson-Stevens Fishery Management and Conservation Act was established to promote conservation of marine fishery (shellfish and finfish) resources and included the establishment of eight regional fishery management councils that develop fishery management plans to properly manage fishery resources within their jurisdictional waters. The 1986 and 1996 amendments to the Act recognized that many fisheries depend on nearshore and estuarine habitats for at least part of their lifecycles and included evaluation of habitat loss and protection of critical habitat. The marine environments important to marine fisheries, referred to as essential fish habitats (EFH), are defined to include "those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity." The Act further mandates that National Marine Fisheries Service (NMFS) coordinate with other federal agencies to avoid, minimize, or otherwise offset adverse effects on EFH that could result from proposed activities. To delineate EFH, regional fishery management councils mapped coastal waters and superimposed ten minute by ten minute (10′ × 10′) square coordinate grids. The Cape Cod Bay grid contains Wellfleet Harbor and the Herring River within.

## Coastal Zone Management Act 1972, as Amended

The Coastal Zone Management Act (CZMA) (16 USC 1451 et seq.) seeks to preserve and protect coastal resources. Through the CZMA, states are encouraged to develop coastal zone management programs (CZMPs) to allow economic growth that is compatible with the protection of natural resources, the reduction of coastal hazards, the improvement of water quality, and sensible coastal development. The CZMA provides financial and technical incentives for coastal states to manage their coastal zones in a manner consistent with CZMA standards and goals. CZMA Section 307 requires that federal agency activities that affect any land or water use or natural resource of the coastal zone must be consistent to the maximum extent practicable with the enforceable policies of the state CZMP. Federal agencies and applicants for federal approvals must consult with state CZMPs and must provide the CZMP with a determination or certification that the activity is consistent with the CZMP's enforceable policies, where those policies will have a possible effect on state coastal resources, as the CZMP and local land use plans define them.

## Clean Water Act of 1972, as Amended

The Clean Water Act (CWA) is a comprehensive statute aimed at restoring and maintaining the chemical, physical, and biological integrity of the nation's waters. The U.S. Army Corps of Engineers (USACE) administers section 404 of this Act and regulates discharge of dredged and fill material to waters of the United States, including wetlands under federal jurisdiction. The CWA also requires the establishment of state water quality standards for surface waters, as well as federal water quality standards, and the development of guidelines to identify and evaluate the extent of nonpoint source pollution. Section 401 of the Act – Water Quality Certification – gives states the authority to review projects that must obtain federal licenses or permits and that result in a discharge to state waters. The purpose of the Water Quality Certification is to ensure that a project will comply with state water quality standards and other appropriate requirements of state law, and it is required for any project that also requires a USACE Section 404 wetland permit.

## Section 10 of the Rivers and Harbors Act of 1899

The USACE New England District administers Section 10, which is required for all work including work seaward of the mean high water line in navigable waters of the United States. Given the nature and extent of the restoration project, it is most likely that the general permit, a consolidation of all USACE permits, would not suffice, and applications for individual permits would be necessary. Under this latter review process, applications are submitted to the USACE, which in turn issues a Public Notice and initiates a comment period. The USACE evaluates comments, public interest criteria, and compliance with the federal CWA, and issues a permit, as deemed appropriate.

### Executive Order 11990: Protection of Wetlands

This executive order directs federal agencies to avoid, to the extent possible, the long-term and short-term adverse impacts associated with the destruction or modification of wetlands, and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative.

### Executive Order 11988: Floodplain Management

This executive order directs federal agencies to avoid, to the extent possible, the long-term and short-term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct or indirect support of flood plain development wherever there is a practicable alternative.

### Executive Order 13112: Invasive Species

This executive order defines an invasive species as "an alien species whose introduction does or is likely to cause economic or environmental harm or harm to human health." and is intended to prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause. By this executive order, federal agencies are directed to expand and coordinate their efforts to combat the introduction and spread of plants and animals not native to the United States.

### Executive Order 11593: Protection and Enhancement of the Cultural Environment

This executive order directs federal agencies to support the preservation of cultural properties and to identify and nominate to the NRHP cultural properties in the park and to "exercise caution… to assure that any NPS-owned property that might qualify for nomination is not inadvertently transferred, sold, demolished, or substantially altered."

### Executive Order 13186: Responsibilities of Federal Agencies to Protect Migratory Birds

Migratory birds are of great ecological and economic value to this country and to other countries. They contribute to biological diversity and bring tremendous enjoyment to millions of people who study, watch, feed, or hunt these birds throughout the United States and other countries. The United States has recognized the critical importance of this shared resource by ratifying international, bilateral conventions for the conservation of migratory birds. Such conventions include the Convention for the Protection of Migratory Birds with Great Britain on behalf of Canada 1916, the Convention for the Protection of Migratory Birds and Game Mammals-Mexico 1936, the Convention for the Protection of Birds and Their Environment-Japan 1972, and the Convention for the Conservation of Migratory Birds and Their Environment-Union of Soviet Socialist Republics 1978. These migratory bird conventions impose substantive obligations on the United States for the conservation of migratory birds and their habitats, and through the Migratory Bird Treaty Act, the United States has implemented these migratory bird conventions with respect to the United States. This executive order directs executive departments and agencies to take certain actions to further implement the Migratory Bird Treaty Act.

## STATE AND LOCAL LAWS, POLICIES, REGULATIONS, AND PLANS

### Massachusetts Environmental Policy Act

The Massachusetts Environmental Policy Act (MEPA) is the state equivalent of NEPA. MEPA provides meaningful opportunities for public review of the potential environmental impacts of projects for which state agency action is required and assists each agency in using—in addition to applying any other applicable statutory and regulatory standards and requirements—all feasible means to avoid damage to the environment or, to the extent damage to the environment cannot be avoided, to minimize and mitigate damage to the environment to the maximum extent practicable.

MEPA considers projects that may meet or exceed review thresholds for various resource categories found in 301 CMR 11.00. For this project, those categories include land, rare species, wetlands, waterways, and tidelands, water supply, transportation, and historic and archaeological resources.

The project area is located in the Wellfleet Harbor Area of Critical Environmental Concern (ACEC). While restoration of the Herring River would help to achieve the goal of preserving, restoring, and enhancing the resources in the ACEC (301 CMR 12.12), it will have to be carried out in a manner that minimizes adverse effects on marine and aquatic productivity, surface and groundwater quality, habitat values, storm damage prevention or flood control, historic and archaeological resources, scenic and recreational resources, and other natural resource values of the area.

Because the restoration plan also includes state funding and other state permits, it is subject to MEPA.

### Massachusetts Waterways Licensing Program (M.G.L. c.91)

The Massachusetts Waterways Licensing Program (Chapter 91) is the Commonwealth's primary tool for protection and promotion of public use of its tidelands and other waterways. The Commonwealth formally established the program in 1866, but the philosophy behind Chapter 91 dates back to the earliest days of the Massachusetts Bay Colony, most notably in the Colonial Ordinances of 1641–1647. The Colonial Ordinances codified the "public trust doctrine," a legal principle that dates back nearly 2000 years which holds that the air, the sea, and the shore belong not to any one person, but rather to the public at large. The oldest program of its kind in the nation, Chapter 91 regulates activities on both coastal and inland waterways, including construction, dredging, and filling in tidelands, great ponds, and certain rivers and streams. The restoration plan would undergo a Chapter 91 review due to new structures (culverts) over tidelands and modifications to previously licensed or unlicensed structures.

### Massachusetts Endangered Species Act (M.G.L. c. 131A)

The Massachusetts Endangered Species Act (M.G.L c.131A and regulations 321 CMR 10.00) (MESA) protect rare species and their habitats by prohibiting the "taking" of any plant or animal species listed as endangered, threatened, or species of concern by the Massachusetts Division of Fisheries and Wildlife. Taking includes the harassing, killing, trapping, collecting of species as well as the disruption of nesting, breeding, feeding, or migratory activity, including habitat modification or destruction. Three types of filings under MESA are coordinated through the Natural Heritage and Endangered Species Program at the Division of Fisheries and Wildlife: (1) MESA Information Request for rare species information; (2) MESA Project Review; and (3) the Conservation and Management Permit Application. Projects resulting in a "take" of state-listed rare species may be eligible for a Conservation and Management Permit (321 CMR 10.23). A Rare Species Habitat assessment or survey may be required as part of the Conservation and Management Permit process.

### Cape Cod Commission – Development of Regional Impact

An Act of the Massachusetts General Court in 1990 created the Cape Cod Commission (CCC). The Commission reviews projects that present regional issues identified in the Act, including water quality, traffic flow, historic values, affordable housing, open space, natural resources, and economic development.

The law requires a Development of Regional Impact (DRI) review if a project exceeds a specific threshold. Examples of projects that need to go through mandatory DRI review by the CCC are those involving:

- subdivisions of 30 acres or more
- development of 30 or more residential lots or dwelling units
- development of 10 or more business, office, or industrial lots
- commercial development or change of use for buildings greater than 10,000 square feet
- transportation facilities for passage to or from Barnstable County
- demolition or major changes to some national- or state-recognized historic structures
- bridge, ramp, or road construction providing access to several types of water bodies and wetlands
- new construction or change of use involving outdoor commercial space greater than 40,000 square feet
- construction of any wireless communication tower exceeding 35 feet in height
- site alterations or site disturbance greater than 2 acres without a valid local permit
- mixed use residential and non-residential developments with a floor area greater than 20,000 square feet

Projects that do not meet a threshold but are forwarded to the CCC from the town in which they are located also require a DRI review. The Commission must first vote to accept this type of referral as a development that has regional impacts. The Herring River Restoration Project would meet the threshold for a DRI review because an EIR is required by MEPA.

### Massachusetts Historical Commission

The Massachusetts Historical Commission (MHC) must review any projects that require funding, licenses, or permits from any state agency in compliance with Massachusetts General Laws (MGL) Chapter 9, sections 26–27C. This law creates the MHC, the office of the State Archaeologist, and the State Register of Historic Places among other historic preservation programs. It provides for MHC review of state projects, State Archaeologist's Permits, the protection of archaeological sites on public land from unauthorized digging, and the protection of unmarked burials. These regulations set up a process that mirrors the federal Section 106 regulations, which include identification of historic properties; assessment of effect; and consultation among interested parties to avoid, minimize, or mitigate any adverse effects.

## Massachusetts Wetland Protection Act and Rivers Protection Act

The Wetlands Protection Act (MGL Chapter 131, Section 40) protects wetlands and the public interests they serve, including flood control, prevention of pollution and storm damage, and protection of public and private water supplies, groundwater supply, fisheries, land containing shellfish, and wildlife habitat. These public interests are protected by requiring a careful review of proposed work that may alter wetlands. The law protects not only wetlands, but other resource areas, such as land subject to flooding (100-year flood plains), the riverfront area (added by the Rivers Protection Act), and land under water bodies, waterways, salt ponds, fish runs, and the ocean.

These regulations set forth a public review and decision-making process by which activities affecting areas subject to protection under the law are to be regulated in order to contribute to the following public interests and values:

- protection of public and private water supply
- protection of ground water quality and supply
- flood control
- erosion and sedimentation control
- storm damage prevention
- prevention of pollution
- protection of land containing shellfish
- protection of fisheries
- protection of wildlife habitat

## Wellfleet Environmental Protection Bylaw

At the local level, the community's conservation commission administers the Wetlands Protection Act. The Wellfleet Conservation Commission promulgated the Wellfleet Environmental Protection Regulations pursuant to the authority granted under the Wellfleet Environmental Protection Bylaw as approved on April 28, 1986 at a town meeting. In addition to the regulations required by the Wetlands Protection Act, these regulations set forth a public review and decision-making process by which activities affecting areas subject to protection under the bylaw are to be regulated in order to contribute to public interests and values.

The bylaw and regulations subject the following Wetland Resource Areas to protection under:

- any freshwater wetland, inland bank, coastal wetland, coastal bank, beach, dune, flat, marsh, wet meadow, bog, or swamp
- any estuary, creek, river, stream, pond, lake, and lands under these bodies of water; land under the ocean
- land subject to tidal action, land subject to coastal storm flowage, bordering land subject to flooding, and isolated land subject to flooding
- all land within 100 feet (200 feet for rivers, streams, and fresh creeks) of any freshwater wetland, inland bank, coastal wetland, coastal bank, beach, dune, flat, marsh, wet meadow,

bog, swamp, estuary, creek, river, stream, pond, lake, lands under these bodies of water, and land under the ocean

### Massachusetts Water Quality Certification

The MassDEP's Division of Wetlands and Waterways is responsible for ensuring clean air and water within the Commonwealth of Massachusetts. MassDEP administers regulations relating to the discharge of dredged or fill material, dredging, and dredged material disposal activities in waters of the United States within the state that require federal licenses or permits and that are subject to state water quality certification under 33 USC 1251, et seq. For work in USACE jurisdiction involving a discharge to waters of the United States, MassDEP must provide or waive certification before work can proceed. This permit represents the state's assurance that land disturbing activities will not adversely affect water quality. The Section 401 review ensures that a proposed dredge and/or fill project that can result in the discharge of pollutants complies with Massachusetts Surface Water Quality Standards, the Massachusetts Wetlands Protection Act, and otherwise avoids or minimizes individual and cumulative impacts to Massachusetts waters and wetlands.

### Coastal Zone Management Act Consistency Review

Massachusetts CZMP administers the Federal Consistency Review under the federal CZM Act of 1972, which ensures that any federal activities in or affecting Massachusetts coastal resources are consistent with state coastal policies. CZM's mission is to balance the impacts of human activity with the protection of coastal and marine resources. Massachusetts CZM was specifically established to work with other state agencies, federal agencies, local governments, and the general public to promote sound management of the Massachusetts coast. The Massachusetts CZM is not a permitting agency; however, it does have the authority to review federal activities in the Massachusetts coastal zone to ensure that they are consistent with CZM program policies. Because this restoration project is a federal undertaking, CZM must approve the action before the action can take place.

# APPENDIX E: BIRDS OF THE HERRING RIVER AREA

| Common Name | Scientific Name |
|---|---|
| American Black Duck | *Anas rubripes* |
| American Crow | *Corvus brachyrhynchos* |
| American Goldfinch | *Carduelis tristis* |
| American Green-Winged Teal | *Anas c. carolinensis* |
| American Redstart | *Setophaga ruticilla* |
| American Robin | *Turdus migratorius* |
| American Wigeon | *Anas americana* |
| American Woodcock | *Scolopax minor* |
| Atlantic Brant | *Branta b. bernicla* |
| Baltimore Oriole | *Icterus galbula* |
| Bank Swallow | *Riparia riparia* |
| Barn Swallow | *Hirundo rustica* |
| Belted Kingfisher | *Megaceryle alcyon* |
| Black-And-White Warbler | *Mniotilta varia* |
| Black-Bellied Plover | *Pluvialis squatarola* |
| Black-Billed Cuckoo | *Coccyzus erythropthalmus* |
| Black-Capped Chickadee | *Poecile atricapillus* |
| Black-Cheeked Warbler | *Basileuterus melanogenys* |
| Black-Crowned Night-Heron | *Nycticorax nycticorax* |
| Black-Throated Blue Warbler | *Dendroica caerulescens* |
| Blue Jay | *Cyanocitta cristata* |
| Blue-Gray Gnatcatcher | *Polioptila caerulea* |
| Blue-Headed Vireo | *Vireo solitarius* |
| Bonaparte's Gull | *Chroicocephalus philadelphia* |
| Bronzed Cowbird | *Molothrus aeneus* |
| Brown Creeper | *Certhia americana* |
| Brown Thrasher | *Toxostoma rufum* |
| Brown-Headed Cowbird | *Molothrus ater* |
| Bufflehead | *Bucephala albeola* |
| Cackling Goose | *Branta hutchinsii* |
| Carolina Wren | *Thryothorus ludovicianus* |
| Cedar Waxwing | *Bombycilla cedrorum* |
| Chimney Swift | *Chaetura pelagica* |
| Chipping Sparrow | *Spizella passerina* |

| Common Name | Scientific Name |
|---|---|
| Common Eider | *Somateria mollissima* |
| Common Goldeneye | *Bucephala clangula* |
| Common Grackle | *Quiscalus quiscula* |
| Common Loon | *Gavia immer* |
| Common Merganser | *Mergus merganser* |
| Common Tern | *Sterna hirundo* |
| Common Yellowthroat | *Geothlypis trichas* |
| Cooper's Hawk | *Accipiter cooperii* |
| Double-Crested Cormorant | *Phalacrocorax auritus* |
| Downy Woodpecker | *Picoides pubescens* |
| Eastern Kingbird | *Tyrannus tyrannus* |
| Eastern Phoebe | *Sayornis phoebe* |
| Eastern Towhee | *Pipilo erythrophthalmus* |
| Eastern Wood-Pewee | *Contopus virens* |
| European Starling | *Sturnus vulgaris* |
| Field Sparrow | *Spizella pusilla* |
| Forster's Tern | *Sterna forsteri* |
| Golden-Crowned Kinglet | *Regulus satrapa* |
| Great Black-Backed Gull | *Larus marinus* |
| Great Blue Heron | *Ardea herodias* |
| Great Crested Flycatcher | *Myiarchus crinitus* |
| Greater Yellowlegs | *Tringa melanoleuca* |
| Green Heron | *Butorides virescens* |
| Grey Catbird | *Dumetella carolinensis* |
| Hairy Woodpecker | *Picoides villosus* |
| Hermit Thrush | *Catharus guttatus* |
| Herring Gull | *Larus argentatus* |
| Hooded Merganser | *Lophodytes cucullatus* |
| House Finch | *Carpodacus mexicanus* |
| Killdeer | *Charadrius vociferus* |
| Laughing Gull | *Leucophaeus atricilla* |
| Least Sandpiper | *Calidris minutilla* |
| Lesser Yellowlegs | *Tringa flavipes* |
| Little Blue Heron | *Egretta caerulea* |
| Mallard | *Anas platyrhynchos* |
| Merlin | *Falco columbarius* |

| Common Name | Scientific Name |
|---|---|
| Mourning Dove | *Zenaida macroura* |
| Mute Swan | *Cygnus olor* |
| Myrtle Warbler | *Dendroica c. coronata DENCCO* |
| Nashville Warbler | *Oreothlypis ruficapilla* |
| Northern Cardinal | *Cardinalis cardinalis* |
| Northern Flicker | *Colaptes auratus* |
| Northern Gannet | *Morus bassanus* |
| Northern Harrier | *Circus cyaneus* |
| Northern Mockingbird | *Mimus polyglottos* |
| Northern Parula | *Parula americana* |
| Northern Waterthrush | *Parkesia noveboracensis* |
| Osprey | *Pandion haliaetus* |
| Ovenbird | *Seiurus aurocapilla* |
| Palm Warbler | *Dendroica palmarum* |
| Pied-Billed Grebe | *Podilymbus podiceps* |
| Pine Warbler | *Dendroica pinus* |
| Prairie Warbler | *Dendroica discolor* |
| Red-Bellied Woodpecker | *Melanerpes carolinus* |
| Red-Breasted Merganser | *Mergus serrator* |
| Red-Breasted Nuthatch | *Sitta canadensis* |
| Red-Tailed Hawk | *Buteo jamaicensis* |
| Red-Throated Loon | *Gavia stellata* |
| Red-Winged Blackbird | *Agelaius phoeniceus* |
| Ring-Billed Gull | *Larus delawarensis* |
| Ruby-Crowned Kinglet | *Regulus calendula* |
| Ruby-Throated Hummingbird | *Archilochus colubris* |
| Ruddy Turnstone | *Arenaria interpres* |
| Ruff | *Philomachus pugnax* |
| Sanderling | *Calidris alba* |
| Semipalmated Plover | *Charadrius semipalmatus* |
| Semipalmated Sandpiper | *Calidris pusilla* |
| Sharp-Shinned Hawk | *Accipiter striatus* |
| Slate-Colored Junco | *Junco h. hyemalis* |
| Song Sparrow | *Melospiza melodia* |
| Spotted Sandpiper | *Actitis macularius* |
| Swamp Sparrow | *Melospiza georgiana* |

| Common Name | Scientific Name |
|---|---|
| Tree Swallow | *Tachycineta bicolor* |
| Tufted Titmouse | *Baeolophus bicolor* |
| Turkey Vulture | *Cathartes aura* |
| Vesper Sparrow | *Pooecetes gramineus* |
| Wedge-Rumped Storm-Petrel | *Oceanodroma tethys* |
| Whimbrel | *Numenius phaeopus* |
| White-Breasted Nuthatch | *Sitta carolinensis* |
| White-Throated Sparrow | *Zonotrichia albicollis* |
| Willet | *Tringa semipalmata* |
| Wood Thrush | *Hylocichla mustelina* |
| Yellow Warbler | *Dendroica petechia* |
| Yellow-Billed Cuckoo | *Coccyzus americanus* |
| Yellow-Shafted Flicker | *Colaptes a. auratus* |

Kearney and Cook 2001; MassAudubon 2006; Veit and Peterson 1993.

# APPENDIX F: ESSENTIAL FISH HABITAT ASSESSMENT FOR THE HERRING RIVER RESTORATION PROJECT

## INTRODUCTION

Many aquatic habitats are critical to the productivity and sustainability of marine fisheries. The Magnuson-Stevens Fishery Conservation and Management Act, amended by the Sustainable Fisheries Act in 1996 (the Act), requires the National Oceanic and Atmospheric Administration National Marine Fisheries Services (NMFS) and eight regional fishery management councils (Councils) to protect and conserve the habitat of marine, estuarine, and anadromous finfish, mollusks, and crustaceans. Essential Fish Habitat (EFH) is defined to include "those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." The Act requires the Councils to describe and identify the essential habitat for the managed species, minimize to the extent practicable adverse effects on EFH caused by fishing, and identify other actions to encourage the conservation and enhancement of EFH. As required by the Act, federal agencies must consult with NMFS on all actions or proposed actions authorized, funded, or undertaken that may adversely affect EFH. In return, NMFS must provide recommendations including measures to avoid, minimize, mitigate, or otherwise offset adverse effects on EFH resulting from the proposed actions. The New England Fishery Management Council (NEFMC) identifies and protects EFH for all species within the federal 200-mile limit off the coasts of Maine, New Hampshire, Massachusetts (including the project area), Rhode Island and Connecticut.

In compliance with Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (1996 amendments), the Herring River Restoration Committee (HRRC) and the National Park Service (NPS) is providing this assessment of the potential effects of restoring native tidal wetland habitat to large portions of the Herring River flood plain in and adjacent to Cape Cod National Seashore (the Seashore) on essential fish habitats.

## PROJECT BACKGROUND

The Herring River estuary is located in the towns of Wellfleet and Truro on Cape Cod, Massachusetts. The river, along with its flood plain, tributary streams, and associated estuarine habitats encompasses approximately 1,100 acres, with approximately 80 percent of the river's flood plain located within the boundary of the Seashore (Figure 1). The river itself extends from Wellfleet Harbor northeast for nearly 4 miles to Herring Pond in north Wellfleet. The dike at Chequessett Neck Road separates Wellfleet Harbor from the majority of the river. The dike consists of three 6-foot wide box culverts, each with an attached flow control structure. One culvert has an adjustable sluice gate that is currently set partially open at 2 feet and allows limited bi-directional tidal flow. The remaining two culverts have tidal flap gates, designed to permit flow only during the outgoing (ebbing) tide. In addition to the Herring River's upper, middle, and lower basins, the estuary is composed of other important sub-basins including Mill Creek, Duck Harbor, Lower and Upper Pole Dike Creek, and Lower and Upper Bound Brook (Figure 2).

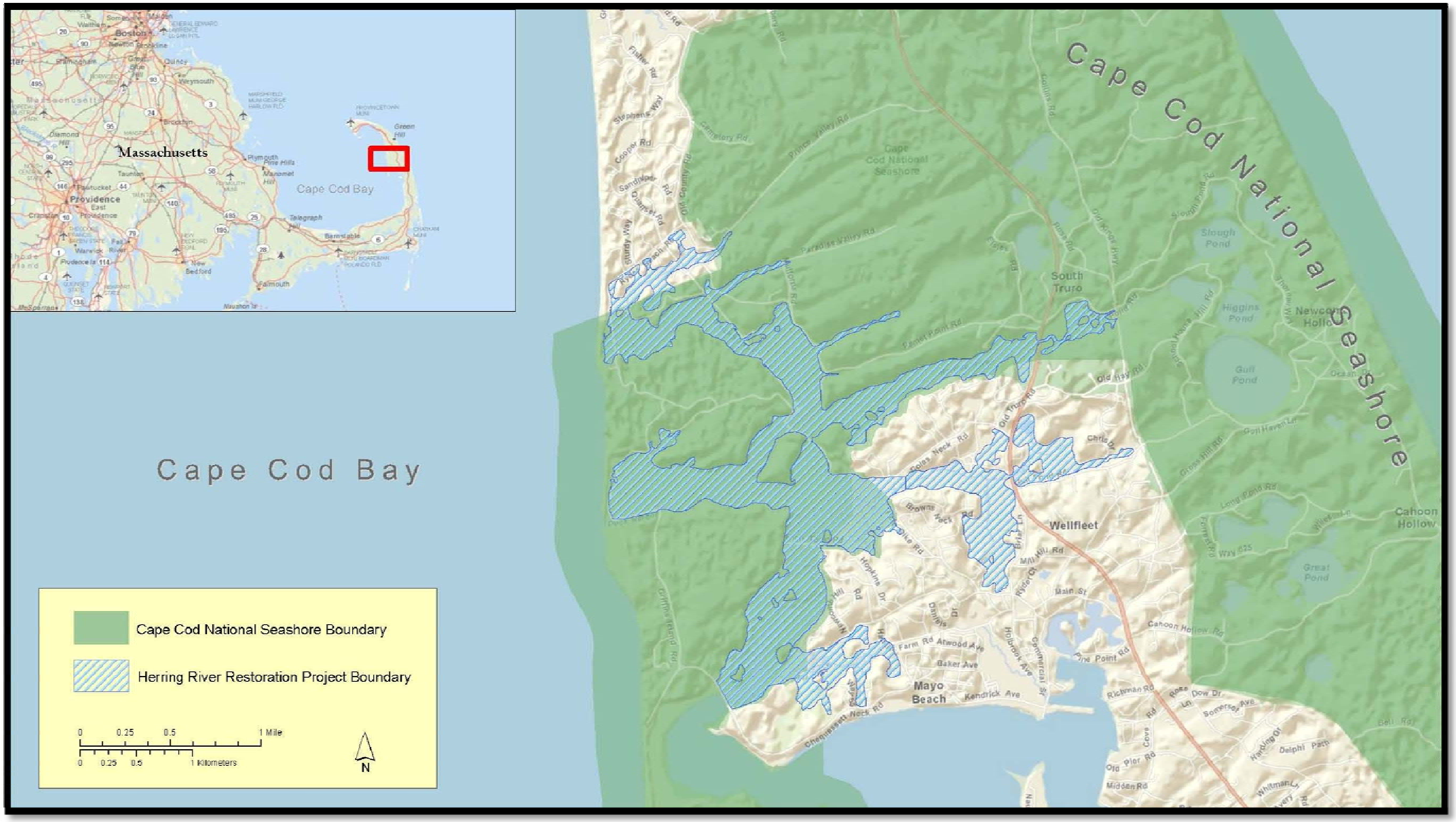


**FIGURE 1. HERRING RIVER RESTORATION PROJECT AREA**

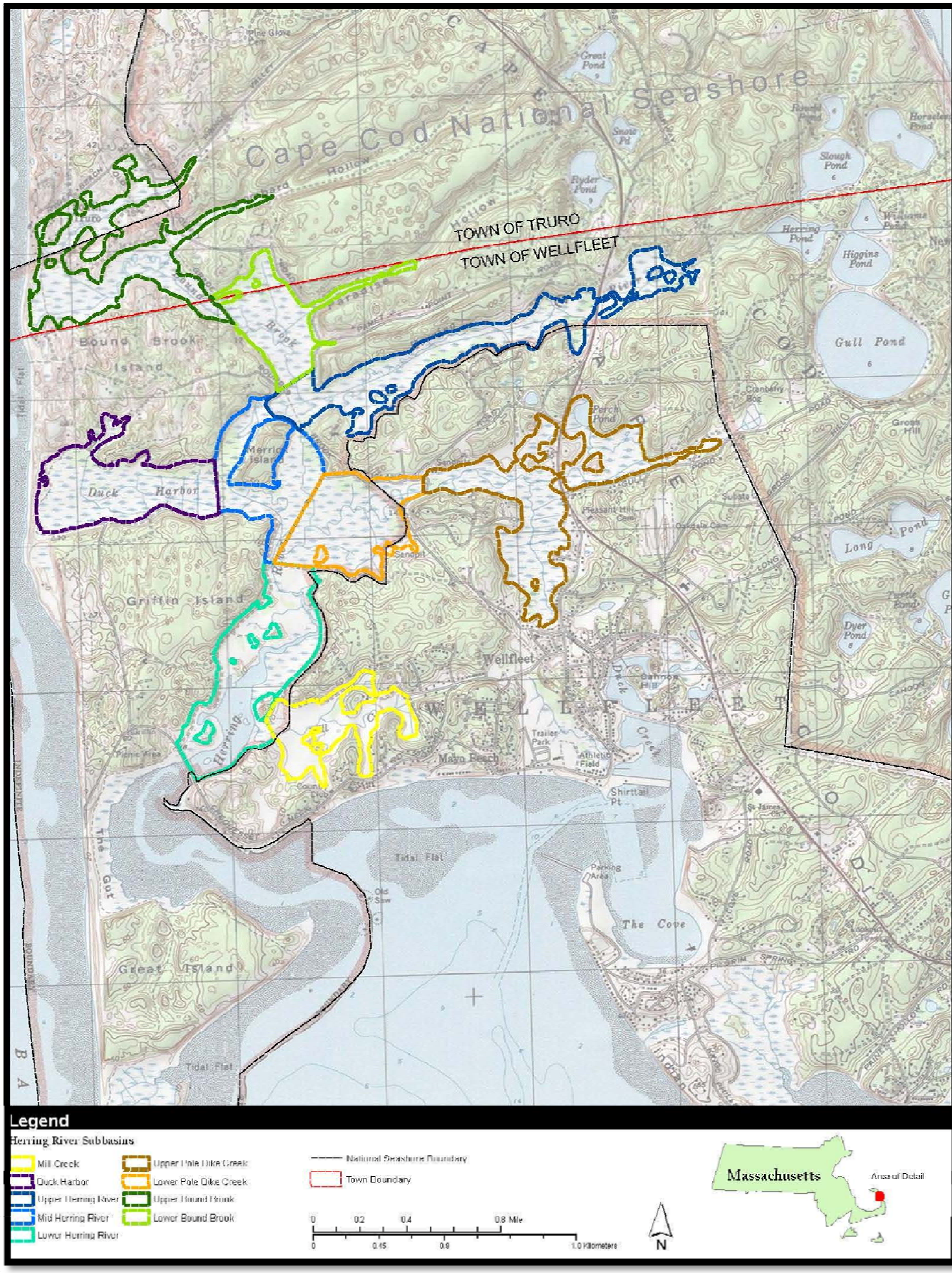


**FIGURE 2. HERRING RIVER SUB-BASINS**

Since the dike at Chequessett Neck Road was constructed in 1909, the river's wetland resources and natural ecosystem functions have been severely altered and damaged by 100 years of tidal restriction and salt marsh drainage. Adverse ecological effects include but are not limited to:

- Lack of tidal inflow and outflow – tidal range restriction. The Chequessett Neck Road Dike restricts the tidal range in the Herring River from more than 10 feet on the downstream, harbor side, to about 2 feet upstream of the dike. With the tidal restriction, seawater only reaches approximately 3,000 feet upstream of the dike. Under the original natural conditions, seawater reached upstream beyond present-day Route 6 and supported estuarine plants and animals throughout the flood plain.
- Loss of estuarine habitat. The original Herring River estuary included about 1,100 acres of salt marsh, intertidal flats, and open water habitats. The total estuarine habitat (sub-tidal and intertidal habitat) now totals about 70 acres and is confined to the Lower Herring River immediately upstream of the Chequessett Neck Road Dike.
- Degradation of water quality. The elimination of salt water input to the estuary and marsh dewatering has resulted in highly acidic waters which in the past has caused fish kills and causes the leaching of toxic metals, further degrading the water quality. The lack of tidal flushing has also resulted in low summertime dissolved oxygen levels.
- Impediments to fish passage and river herring migration. The Chequessett Neck Road Dike physically impedes fish passage and creates an artificially abrupt transition from seawater to fresh river water.
- Plant community changes, including loss of salt marsh vegetation and increase in non-native invasive species. Only about seven acres of salt marsh remain in the Herring River system. Much of the original Herring River wetlands have been converted from salt marsh to forest and shrublands dominated by opportunistic upland species. Large portions of the original sub-tidal and intertidal substrates between the dike and High Toss Road have been converted to monotypic stands of common reed (*Phragmites australis*).
- Elimination of natural sediment processes and salt marsh surface subsidence. Diking of the river has effectively blocked the transport of inorganic sediment from reaching the salt marshes in the Herring River basin, which along with other processes, has contributed to the severe historic and continuing subsidence in the Herring River's diked wetlands.

## PROJECT DESCRIPTION

The proposed project is to develop and implement actions for the restoration of self-sustaining coastal habitats in a large portion of the 1,100-acre Herring River estuary in the towns of Wellfleet and Truro, Massachusetts. Besides the dike, there are more than five miles of roadway, an abandoned railroad embankment, several tidally restrictive culverts and berms, channelized stream reaches, and acres of invasive, non-native vegetation that impact the Herring River flood plain. There are multiple options for addressing each of these issues. As a result of having multiple options to select from, the specific impacts of the project are unknown, so impacts are addressed in more general terms in this assessment. The major components and focus areas of the Herring River project include:

Chequessett Neck Road Dike: Reconstruction of the dike to allow greater tidal exchange is the primary element of the restoration project. Reconstruction of the dike would involve installing a 165-foot-wide series of culverts to allow passage of Wellfleet Harbor tides. The objective of the project, depending on the alternative selected through the National Environmental Policy Act

(NEPA) process, is to ultimately reach either a mean high spring tide of 4.8 feet and a 100-year storm driven tide of 6.0 feet in the Lower Herring River or alternatively a mean high spring tide of 5.6 feet and a 100-year storm driven tide of up to 7.5 feet. To achieve the desired tidal ranges the tide gates would be opened gradually and according to guidelines set forth in an adaptive management plan (see appendix A).

- Mill Creek Sub-basin: This sub-basin has a number of private properties that could be subject to flooding without protective measures. If the selected goal for the Lower Herring River through the NEPA process is achieving a mean high spring tide of 4.8 feet, then no dike construction at the mouth of Mill Creek would be needed, or would occur. However, if a mean high spring tide of 5.6 feet in Lower Herring River is the goal selected, then a dike would be constructed across the mouth of Mill Creek. The dike would either completely eliminate tidal influence to the sub-basin, or it would allow partially restored tidal flow to the sub-basin by using a combination tide gate at this location. In this instance, mean high water spring tides would be limited to a maximum of 4.7 feet and 100-year storm driven events would be limited to a maximum of 5.9 feet in Mill Creek.
- High Toss Road: Complete removal of the tidal restriction at High Toss Road is another major component of the project. The five-foot diameter circular culvert at High Toss Road would need to be removed or enlarged to maximize tidal circulation upstream. The roadway itself would be impacted by restored tidal exchange and could either be elevated or removed.
- Upper Pole Dike Creek Sub-basin: Under certain restoration scenarios and tidal conditions, flood protection measures might be required in Upper Pole Dike Creek sub-basin to protect low lying properties. Any significant flood impacts will be addressed on a property-specific basis or by restricting tide flow at Pole Dike Road with either the existing road culvert or a tide control gate.
- Pole Dike Creek, Old County, and Bound Brook Island Roads: Culverts under these low-lying roads could need to be enlarged if future monitoring shows the existing culverts are impeding tidal flows or altering other ecological processes. Preliminary engineering analyses show that approximately 8,000 linear feet of road surfaces would need to be elevated or relocated to remain passable during high tides.
- Management of Flood Plain Vegetation: Measures would be taken to remove woody shrubs and trees that die during transition to a more saline and/or wetter environment. Potential techniques include cutting, chipping, and burning.
- Restoration of Tidal Channel Structure and Marsh Surface Elevation: Measures would be taken to restore the natural configuration of tidal channels to maximize water circulation and promote elevation of subsided marsh surfaces. Potential actions to be taken include, but are not limited to, the following:
  - Dredging of accumulated sediment to establish a natural bottom of the Herring River channel at the appropriate depth to maximize ebb tide drainage.
  - Creation of small channels and ditches to improve tidal circulation.
  - Restoring natural channel sinuosity.
  - Removing lateral ditch dredge spoil berms and other anthropogenic material on the marsh surface to facilitate drainage of ponded water.
  - Applying thin layers of dredged material to build up subsided marsh surfaces.

- Chequessett Yacht and Country Club (CYCC): Any action that allows tidal influence to be restored to Mill Creek under the Herring River project would allow salt water to inundate low portions of the CYCC golf course during most high tides unless action is taken to protect it from tidal flooding. Two options for addressing the impacts to the CYCC include elevating affected portions of the facility by providing necessary quantities of fill, regrading, and replanting the areas. Approximately 150,000 cubic yards of fill and 32 acres of disturbance for grading and site preparation would be required. The other option is to relocate the affected portions of the facility to upland locations currently owned by the CYCC. This would involve clearing, grading, and planting of new golf holes and a practice area.

### ADAPTIVE MANAGEMENT

Reintroduction of tidal influence to the Herring River estuary would be adaptively managed over a long-term, phased process that would take several years. Gradual opening of adjustable tide gates at the Chequessett Neck Road Dike would incrementally increase the tidal range in the river. This would allow monitoring of the system so that unexpected and/or undesirable responses could be detected and appropriate response actions taken. An Operations and Maintenance Plan will also be developed to ensure that the project's habitat restoration and flood protection goals are achieved.

### CONSTRUCTION METHODS AND TIMEFRAME

Standard construction methods and equipment would be used to construct the infrastructure needed to implement the components of the restoration project and would include additional activities such as bank excavation/stabilization, culvert replacement, vegetation clearing, dredging, and the use of temporary fill. Earth-moving equipment, graders, cranes, dump trucks, cement trucks, and other equipment would be operated and staged in project areas. Fill, armor stones, and other construction materials would also be staged in preparation for use. To the extent possible, previously disturbed areas would be used to stage equipment and materials; however, clearing of vegetation will be needed for some of the actual construction activities. For dike construction, the sites (Chequessett Neck Road Dike and/or Mill Creek) would be de-watered using coffer dams and pumps, or other common methods for dike construction, though provisions would be made to ensure that the existing level of fish passage would continue to occur during construction activities.

Preliminary engineering guidance suggests construction of the new dike at Chequessett Neck Road Dike would be expected to take approximately 12-18 months to complete. Elevation or changes to low-lying roads would take approximately 6-12 months to complete. At Mill Creek, if construction of a dike is required it would take approximately 6-12 months. It is likely that individual construction elements would be phased in over time and would not occur concurrently. Elevation construction of some of the roads that are in the more upstream reaches of the flood plain could be delayed or phased with the later incremental dike openings. All low-lying roads do not need to be elevated at the start of the incremental tidal restoration.

## ASSESSMENT OF IMPACTS TO ESSENTIAL FISH HABITATS

### PHYSICAL ENVIRONMENT

**Water Quality**—Long term, the proposed action would have beneficial impacts to water quality within the Herring River estuary. Restored tidal flushing would be expected to reduce acidification within the mid-portion of the Herring River where salt water would again saturate drained peat and increase the pH of porewater and surfaces waters (Portnoy and Giblin 1997). With restored salinities, aluminum and iron would no longer be leached from the soils to receiving waters in concentrations that stress aquatic life. Modeling also indicates that the project would reduce the system resident times upstream of High Toss Road by at least a factor of 25 (4,801 hours vs. 191 hours) (Woods Hole Group 2011). Regular tidal flushing of the Herring River estuary with well-oxygenated water from Wellfleet Harbor is expected to maintain dissolved oxygen (DO) concentrations above state water quality standards at all times, benefitting resident fish, diadromous fish and invertebrates.

During the restoration process some short-term adverse impacts on water quality would be expected to occur. Portnoy and Giblin (1997) demonstrated that renewed tidal flushing of acid sulfate soils would allow ammonium-nitrogen to be released into receiving waters, at least in the short term. While this would benefit growth of salt marsh vegetation in the restored marsh, if large volumes of sea water were introduced suddenly, abundant nutrient release and sulfide production could promote algal blooms both in the river and downstream into Wellfleet Harbor that could temporarily reduce DO levels. The gradual reintroduction of tidal exchange through the adaptive management process should allow ammonium-nitrogen to be slowly released; avoiding nitrogen loading that could contribute to algal blooms in receiving waters in Herring River. Increased concentrations of released nutrients would likely be short-lived (probably months) and not persist beyond an initial adjustment period. Wellfleet Harbor is open to Cape Cod Bay and well flushed. With small incremental increases in tidal exchange, informed by appropriate water quality monitoring under adaptive management, the release of nutrients from the estuary would likely be small and would not result in persistent algae blooms in Wellfleet Harbor.

There has likely been historical use of pesticides throughout the Herring River watershed. During restoration, sediment is expected to be mobilized within the estuary in response to increased volume of tidal exchange. Mobilized sediment is expected to mostly be transported upgradient onto the marsh surface and partially downgradient toward Wellfleet Harbor. Potential impacts on the aquatic ecosystem from chemicals bound to mobilized sediments will be assessed once background levels of pesticides have been determined by ongoing efforts of the Seashore.

**Sediment**—Over 100 years of diking on the Herring River likely has resulted in extensive siltation with the river channel. Restoring the estuary and allowing more tidal flow through the dike would mobile these sediments within the system as suspended load and suspended fines. Modeling indicates that coarser-grained sediment would be transported primarily as bedload along the bottom of the tidal channels. Some of the bedload transport from areas just upstream and downstream of the dike would be slightly seaward toward Wellfleet Harbor, whereas finer-grained suspended sediments would be transported upstream to settle out in the upper sub-basins of the Herring River. Very fine particles would remain in suspension and may be transported upstream into the Herring River or downstream toward the harbor, and eventually out into Cape Cod Bay. The degree and rate of sediment mobilization would largely be determined by the amount of tidal influence and rate of incremental opening of the tide gates that would occur under the adaptive management process. The tide gates would be used to manage water levels and flows minimize the potential of mobilizing and resuspending large volumes of sediment at once and to promote deposition of sediment upstream of the dike. An adaptive management process would be informed by appropriate monitoring, evaluating both upstream and downstream transport and deposition of sediment during the incremental dike opening process.

Sediment and soil could also be mobilized during the reconstruction of the Chequessett Neck Road Dike and other construction activities (e.g., roads, construction of Mill Creek Dike, etc.), potentially resulting in local increases in turbidity in the adjacent water bodies, causing short-term adverse impacts on water quality. However, construction related impacts are expected to be minimal as Best

Management Practices (BMPs) would be employed to minimize the amount of stormwater runoff, as well as control in-water sediment disturbance. Stormwater management plans would be employed to reduce runoff carrying sediment to the receiving waters during construction activities. BMPs would also be put into place to minimize potential fuel or hydraulic fluid leaks from equipment. Coffer dams would be used for in-water activities during the reconstruction of the Chequessett Neck Road Dike as well as construction of a new Mill Creek Dike, if that alternative is selected. During the construction of the coffer dams there would be some temporary increases in turbidity from disturbed sediments; however, this would have a relatively short duration. Once the coffer dams are in place, construction activities would then be conducted in "dry" conditions and would not impact turbidity levels in the surrounding waters.

**Bathymetry/Water Depth**—Other impacts expected from the proposed project include changes to the bathymetry and morphology of the Herring River. Long term, as tidal flows are restored to the estuary and water velocities increase, erosion of the river banks and bed would be expected to occur, increasing both the width and depth of the restored tidal channels from just below the Chequessett Neck Road Dike upstream to the Middle Herring River and Lower Pole Dike Creek sub-basins.

**Estuarine Habitat**—Opening the tide gate structure at Chequessett Neck Road Dike to allow increases in the mean spring tide would provide long-term benefits by changing the Herring River estuary from a largely freshwater system to a largely tide-influenced system with saline water extending much farther upstream than under current conditions. Salinity values would range from approximately 15 to 30 parts per thousand (ppt) in the lower sub-basins (Lower Herring River, Mill Creek under alternatives where tidal flow is restored to this sub-basin, Middle Herring River, and Lower Pole Dike Creek), increasing the amount of estuarine habitat (sub-tidal and intertidal habitat) from the existing 70 acres confined to the Lower Herring River basin below High Toss Road to somewhere between approximately 790 acres to 885 acres, depending on the alternative selected through the NEPA process. Restored habitat would also include approximately 10.6 miles to 11.5 miles, depending on the alternative, of mainstem tidal creek. This is an increase from the existing 1.4 miles of estuarine tidal creek habitat currently confined to the Lower Herring River basin below High Toss Road.

Restored tidal flow and improved water quality would also beneficially impact three other important habitat types: salt marsh, submerged aquatic vegetation (SAV), and intertidal mudflats. Restored inter-tidal habitat subjected to higher salinity waters, generally 18 ppt and higher, would be expected to transition to salt marsh, greatly increasing the amount of this habitat type within the system from the 13 acres that currently exists in the Lower Herring River sub-basin. With the reintroduction of tides into the Herring River estuary, the occurrence and distribution of wideon grass (*Ruppia maritime*), an SAV which is currently found in the open waters of the Lower Herring River sub-basin, would likely increase in coverage and biomass in high salinity areas and experience a general migration towards brackish areas. Eelgrass (*Zostera marina*), another SAV, is currently not found in the Herring River upstream of the dike, but is found in small isolated patches downstream of the dike just north of Great Island. With the introduction of higher salinities and improved water quality, *Zostera* could become re-established in the Lower Herring River sub-basin. In addition to higher high tides, restoration would also result in lower low tides upstream of the dike, greatly increasing the amount of intertidal mudflat habitat.

## BIOLOGICAL ENVIRONMENT

**Prey species**—The abundance and/or distribution of prey species for fish for which EFH has been designated may be impacted by restoration of the Herring River estuary. As estuarine habitat increases upstream of the Chequessett Neck Road Dike so would the amount of spawning and nursery habitat for finfish prey species such as the mummichog (*Fundulus heteroclitus*), striped killifish (*Fundulus majalis*), Atlantic silversides (*Menidia menidia*) and other common tidal salt marsh species, as well as for macroinvertebrate species; greatly increasing their populations throughout the Herring River estuary. Movement of finfish prey species from downstream of the dike to upstream of the dike, and vice versa, would also be enhanced. During construction activities for the new dike(s) (Chequessett Neck Road and/or Mill Creek) and any other infrastructure improvements such as upstream culverts or road relocations, some short-term adverse impacts on prey species could occur in the vicinity of the construction. Finfish and macroinvertebrate prey species could be temporarily displaced from habitat due to construction noise and vibrations, and some mortality of sedentary and less mobile species through burial could occur. However, most fish species are highly mobile and would just avoid the areas. Once construction was completed, species would be expected to readily recolonize and use the affected area. Overall, the project would have long-term benefits to prey species and subsequently to EFH species that forage on them.

Anadromous species including alewife (*Alos pseudoharengus*), blueback herring (*Alosa aestivalis*), hickory shad (*Notemigonus chrysoleucas*), and white perch (*Morone Americana*), along with one catadromous species American eel (*Anguilla rostrata*) are found in the Herring River during spring and fall adult and juvenile migrations. Design of the new Chequessett Neck Road Dike would benefit all species of anadromous and catadromous fish through better fish passage. In addition to allowing more fish to move upstream, the new tide gates would reduce the direct mortality of emigrating juveniles and post-spawning adults. Improved water quality upstream of the High Toss Road would decrease the mortality of juvenile and post-spawning adult river herring as well as American eels. With increased salinity during spring high tides expanding into the upper reaches of Upper Herring River, the creek channels leading to the headwater ponds where river herring spawn would likely become free of the emergent and submergent freshwater aquatic plants that often choke and block the waterway. This would benefit juvenile river herring as they emigrate from the ponds and move down stream. The increased amount of estuarine habitat and tidal creeks would also increase the amount of nursery habitat for juvenile fish. Increased fish passage and estuarine nursery habitat would also increase the utilization of the Herring River estuary by white perch and hickory shad. Though total suspended sediments (TSS) from sediment mobilized during the initial increased flushing of the system could temporarily adversely impact adult and juvenile anadromous and catadromous species, small, incremental openings of the tides gates under adaptive management would help mitigate these temporary impacts. Construction of the coffer dam for construction of the dike(s) could temporarily increase TSS, adversely impacting anadromous and catadromous species; however, these impacts would be short-lived and coordinating with the Massachusetts Division of Marine Fisheries (MA DMF) and NMFS to appropriately time in-water construction activities would help to minimize any impacts. Additionally, measures would be taken to ensure the existing level of fish passage would continue to occur during all construction activities at the dike as well as at culverts upstream of the dike. Therefore, impacts to EFH species that prey on anadromous and catadromous species would not be significantly adversely impacted during the short-term and overall would experience long-term benefits from the likely increases in anadromous and catadromous species populations resulting from the restoration of the Herring River estuary.

Shellfish also serve as prey items for EFH species. Shellfish populations upstream of the Chequessett Neck Road Dike are very limited due to low salinity and the availability of suitable substrate. With increased salinity ranges upstream of the Chequessett Neck Road Dike resulting from the proposed project, oysters (*Crassostrea virginica*), which are rare upstream of the dike, could potentially recolonize areas where salinity values fall within their preferred range of 10 ppt to 30 ppt, especially if cultch is laid down. Hard clams (*Mercenaria mercenaria*), which are absent upstream of the dike, would likely be able to reestablish populations in tidal creek habitat upstream of the dike within its preferred salinity range of 15 ppt to 35 ppt. During the period in 1973 when increased salinity occurred upstream of the dike due to the disrepair of the dike, soft shelled clams (*Mya arenaria*) occurred along an approximately 0.5-acre area of sub-tidal sandy shoreline in the Lower Herring River sub-basin (Gaskell 1978), indicating that with restoration, the soft shelled clam would also likely be able to expand its population upstream of the dike. Other prey species such as blue mussels (*Mytilus edulis*) would also benefit and increase in population from restoration of the estuary.

With restoration, increased tidal flows would erode sediments in the existing tidal creeks upstream and downstream of the dike, both deepening and widening them. While a large portion of these sediments would likely be moved upstream in this flood-dominated system, some sediment would be transported and deposited downstream of the dike and in Wellfleet Harbor. Species such as hard clams and softshelled clams can move up and down in the sediment column and would not likely be adversely impacted by sedimentation or erosion. While they may become temporarily buried deeper than preferred, or exposed by erosion, they would move up or down in the sediment column to adjust to the new substrate. Oysters, however, are sedentary and would be susceptible to burial by excessive sedimentation. However, because of the generally finer grain size of the mobilized sediment in Herring River as compared to the current sediment in Wellfleet Harbor, these sediment accumulations would likely be temporary in nature. The accumulated sediment would be expected to eventually be redistributed by currents and waves in the harbor with the finest particles either flushed out into Cape Cod Bay, or transported into tidal estuaries surrounding the harbor. Small, incremental openings in the tide gates through adaptive management would also minimize the amount of sediment mobilized at once, reducing the likelihood that large amounts of sediment would be mobilized and deposited on shellfish downstream of the dike all at once.

Shellfish would be adversely impacted by construction activities as well, though most impacts would occur below the dike as currently few species occur upstream of the dike. During construction, direct mortality of shellfish (oysters and hardclams) in the vicinity of the dike would occur through burial or other in-water construction activities. However, using a coffer dam during construction, as well as employing BMPs as part of a stormwater management plan, would reduce the amount of sedimentation and result in only short-term adverse impacts. Consequently, no significant adverse impacts are expected to occur within shellfish populations in the Herring River estuary or Wellfleet Harbor, and overall, shellfish populations would see long-term benefits from the restoration of the estuary.

## Essential Fish Habitat Species

EFH-designated species and life history stages in the proposed project area were identified based on a list in the NOAA Guide to Essential Fish Habitat Designations in the Northeastern United States (NOAA 2011). The guide identifies the managed species and their life stages that have EFH in selected 10-minute by 10-minute squares of latitude and longitude (referred to as “blocks”). These designations were completed by the NEFMC and the Mid-Atlantic Fishery Management Council. The project area falls within Block 41507000 (Table 1 and Figure 3) and species with EFH designated in this block are presented in Table 2. Because this block encompasses both offshore and nearshore estuarine waters, specific habitat conditions may indicate that EFH does not exist for some of these species or life stages within the proposed project area.

**Table 1. Ten Minute Square Coordinate Designation Encompassing the Project Area**

| Block Number | North | East | South | West |
|---|---|---|---|---|
| 41507000 | 42° 00.0’N | 70° 00.0’W | 41° 50.0’N | 70° 10.0’W |

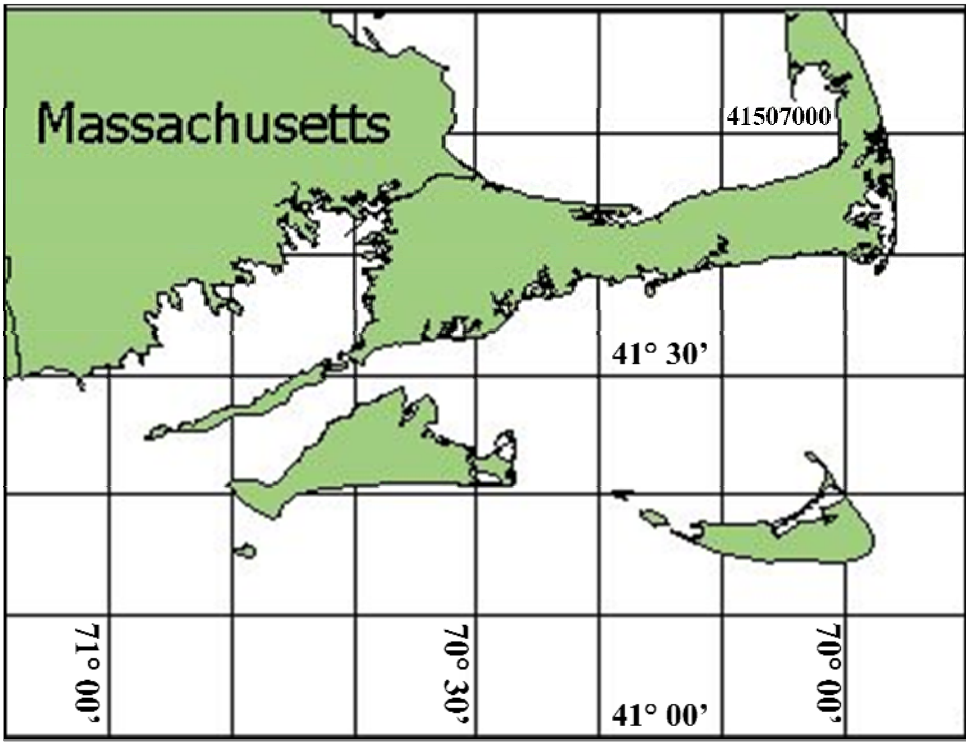


FIGURE 3. NMFS 10 × 10 MINUTE BLOCKS FOR EFH DESIGNATION

TABLE 2. SPECIES WITH IDENTIFIED EFH IN BLOCK NUMBER 4150700

| Species | Scientific Name | Eggs | Larvae | Juveniles | Adults |
|---|---|---|---|---|---|
| Atlantic cod | *Gadus morhua* | X | X | X | X |
| Haddock | *Melanogrammus aeglefinus* | X | X | | |
| Pollock | *Pollachiius virens* | | ⊗ | ⊗ | ⊗ |
| Whiting | *Merluccius bilinearis* | X | X | X | X |
| Red hake | *Urophycis chuss* | X | ⊗ | ⊗ | ⊗ |
| White hake | *Urophycis tenuis* | X | X | △⊗ | △⊗ |
| Winter flounder | *Pleuronectes americanus* | △⊗ | △⊗ | △⊗ | △⊗ |
| Yellowtail flounder | *Pleuronectes ferruginea* | X | X | X | X |
| Windowpane flounder | *Scopthalmus aquosus* | ⊗ | ⊗ | ⊗ | ⊗ |
| American plaice | *Hippoglossoides platessoides* | X | X | X | X |
| Ocean pout | *Macrozoarces americanus* | X | X | ⊗ | ⊗ |
| Atlantic halibut | *Hippoglossus hippoglossus* | X | X | X | X |
| Atlantic sea scallop | *Placopecten magellanicus* | X | X | X | X |
| Atlantic sea herring | *Clupea harengus* | X | X | X | X |
| Monkfish | *Lophius americanus* | X | X | X | |

| Species | Scientific Name | Eggs | Larvae | Juveniles | Adults |
|---|---|---|---|---|---|
| Bluefish | *Pomatomus saltatrix* | | | △⊗ | △⊗ |
| Long finned squid | *Loligo pealei* | n/a | n/a | X | X |
| Short finned squid | *Ilex illecebrosus* | n/a | n/a | X | X |
| Atlantic butterfish | *Peprilus triacanthus* | ⊗ | X | ⊗ | X |
| Atlantic mackerel | *Scombrer scombrus* | ⊗ | ⊗ | ⊗ | ⊗ |
| Summer flounder | *Paralicthys dentatus* | | | | △⊗ |
| Scup | *Stenotomus chrysops* | n/a | n/a | ⊗ | ⊗ |
| Black sea bass | *Centropristus striata* | n/a | | | X |
| Surf clam | *Spisula solidissima* | n/a | n/a | ⊗ | ⊗ |
| Ocean quahog | *Artica islandica* | n/a | n/a | | |
| Spiny dogfish | *Squalus acanthias* | n/a | n/a | ⊗ | ⊗ |
| Blue shark | *Prionace glauca* | | | | X |
| Bluefin tuna | *Thunnus thynnus* | | | X | X |

n/a This notation in the tables indicates some of the species either have no data available on the designated life stages, or those life stages are not present in the species' reproductive cycle.

X – indicates EFH for this life stage exists in Block Number 4150700

○ - indicates EFH for this life stage exists in Wellfleet Harbor

△ - indicates EFH for this life stage exists in Herring River

Unless otherwise cited, all of the EFH information below is from the Guide to Essential Fish Habitat Designations in the Northeastern United States (NOAA 2011).

## Atlantic Cod

**Eggs**—EFH for Atlantic cod eggs include waters around the perimeter of the Gulf of Maine, Georges Bank, and the eastern portion of the continental shelf off southern New England. Generally, Atlantic cod eggs can be found in water temperatures below 54 degrees (°) Fahrenheit (F), water depths less than 361 feet, and within a salinity range between 32 ppt and 33 ppt. Within the project area, eggs would only be found in Wellfleet Harbor in areas within the salinity range; however, based on best professional judgment, the MA DMF concludes that they are not present (Evans et al. 2011). Therefore, there would be no impact.

**Adults**—EFH for adult Atlantic cod include bottom habitats with a substrate of rocks, pebbles, or gravel in the Gulf of Maine, Georges Bank, southern New England, and the middle Atlantic south to Delaware Bay. They are also found across a wide range of oceanic salinities and in areas where generally water temperatures are below 50° F and depths range from 33 feet to 492 feet. Given the depths where cod are found, they would generally only be found in the deeper portions of Wellfleet Harbor; however, based on best professional judgment, the MA DMF concludes that they are not present (Evans et al. 2011). Therefore, there would be no impact.

Though EFH has been designated for both larvae and juvenile Atlantic cod, they are generally found in depths (minimum depth 98 feet and 82 feet respectively) that are greater than what is found in the project area; therefore, there would be no adverse impacts associated with the proposed projects.

## Haddock

Water depths for which EFH is designated for eggs and larvae exceeds those which occur in the project area (eggs: 164 feet to 295 feet; larvae: 98 feet to 295 feet; juveniles: 115 feet to 328 feet; adults: 131 feet to 492 feet). Therefore, no EFH exists in the project area.

## Pollock

**Larvae**—EFH for the larvae of pollock has been designated for the waters of the Gulf of Maine and Georges Bank. Generally the larvae are found in areas where the sea surface temperatures are less than 63° F and water depths range between 33 feet and 820 feet. Pollock larvae are often observed from September to July with peaks from December to February. Within the project area, larvae could be found in Wellfleet Harbor near the mouth where depths are deep enough. This area would not be impacted by restoration activities and would therefore not impact EFH for larvae.

**Juveniles**—For juvenile pollock, EFH has been designated for bottom habitats with aquatic vegetation or a substrate of sand, mud or rocks in the Gulf of Maine and Georges Bank. They are also generally found where water temperatures are less than 64° F, salinities range from 29 ppt to 32 ppt, and depths range from 0 feet to 820 feet. Within the project area, those areas in Wellfleet Harbor with salinities in the above range are designated as EFH. No impacts to Wellfleet Harbor would occur from restoration activities other than some small amount of sedimentation in areas close to the mouth of Herring River. While juvenile pollock are daytime sight feeders, turbidity levels in Wellfleet Harbor are not expected to increase much as a result of sediment mobilized during restoration. Small incremental openings of the tide gate structures would further reduce the impacts of turbidity reaching Wellfleet Harbor. Therefore, adverse impacts, if any, to EFH for juvenile pollock is anticipated to be minimal and short-term.

**Adults**—Bottom habitats in the Gulf of Maine and Georges Bank and hard bottom habitats (including artificial reefs) off southern New England and the middle Atlantic south to New Jersey are designed as EFH for adult pollock. Water temperatures below 57° F, salinities between 31 ppt and 34 ppt, and depths between 49 feet and 1,197 feet are also found in the EFH designations. Given the depth designations, only the deeper portions or Wellfleet Harbor are classified as EFH. For reasons described above for juveniles, impacts, if any, to EFH for adult pollock are anticipated to be minimal and short-term.

## Whiting

Water depths for which EFH is designated for all life stages of whiting exceeds those which occur in the project area (eggs: 164 feet to 492 feet; larvae: 164 feet to 427 feet; juveniles: 66 feet to 886 feet; adults: 98 feet to 1,066 feet). Therefore, no EFH exists in the project area.

## Red hake

**Eggs**—EFH for red hake eggs includes surface waters of the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the middle Atlantic south to Cape Hatteras and are most frequently seen during the months from May to November. Preferred conditions for red hake eggs include sea surface temperatures below 50° F along the inner continental shelf with salinities less than 25 ppt. Red Hake eggs are not likely to be found in Herring River or Wellfleet Harbor.

**Larvae**—EFH for red hake larvae includes surface waters of the Gulf of Maine, Georges Bank, the continental shelf off southern New England, and the middle Atlantic south to Cape Hatteras where water temperatures are below 66° F, depths are less than 656 feet, and salinities are greater than 0.5 ppt. They are most often observed during the months from May through December with peaks in September and October. Although EFH may encompass part of the project area, red hake likely do not occur in Herring River or Wellfleet Harbor. Therefore, no more than minimal impact on EFH for red hake larvae is anticipated as a result of the proposed project.

**Juveniles**—Red hake juveniles are found in bottom habitats with a substrate of shell fragments, including areas with an abundance of live scallops. Water temperatures below 61° F, depths less than 328 feet and a salinity range from 31 ppt to 33 ppt are preferred by red hake juveniles. Although EFH may encompass part of the project area in Wellfleet Harbor, red hake juveniles likely do not occur in the harbor and none were collected during the 1968-1969 survey by Curley et al. (1972). Therefore, no more than minimal impact on EFH for red hake juveniles is anticipated as a result of the proposed project.

**Adults**—Adult red hake are generally found in bottom habitats in depressions with a substrate of sand and mud; water temperatures below 54° F, and depths from 33 feet to 427 feet. They also have a preference for salinities in the range of 33 ppt to 34 ppt. Although EFH may encompass part of the project area in Wellfleet Harbor, adult red hake likely do not occur in the harbor and none were collected during the 1968-1969 survey by Curley et al. (1972). Therefore, no more than minimal impact on EFH for adult red hake is anticipated as a result of the proposed project.

### White hake

**Eggs**—EFH for white hake eggs includes surface waters of the Gulf of Maine, Georges Bank and southern New England, and are most often observed in August and September. During trawl surveys eggs were most often collected in water depths between 33 feet and 820 feet (Chang et al. 1999). Eggs are unlikely to be found in Herring River and Wellfleet Harbor.

**Larvae**—EFH for larvae is pelagic waters where temperatures are between 50° F and 64° F in water depths between 33 feet and 492 feet. They are unlikely to be found in inshore or nearshore waters (Chang et al. 1999), and therefore would not be found in Herring River or Wellfleet Harbor.

**Juveniles**—EFH is designated for two life stages of juveniles: the pelagic stage and the demersal stage. White hake juveniles in the pelagic stage are most often observed from May through September within pelagic waters. Demersal stage juveniles tend to occupy bottom habitats with seagrass beds or a substrate of mud or fine-grained sand. These juvenile stages are found in waters with temperatures between 46° F to 66° F and depths from 16 feet to 738 feet. Although EFH may encompass part of the project area, white hake juveniles were not collected in any surveys (Curley et al. 1972, Roman 1987, Raposa 1999 unpublished data, Gwilliam 2005 unpublished data) and likely do not occur in the harbor or Herring River. Therefore, no more than minimal impact on EFH for red hake juveniles is anticipated as a result of the proposed project.

**Adults**—EFH for white hake adults includes bottom habitats with a substrate of mud or fine-grained sand, as well as water temperatures of 41° F to 57° F and depths from 16 feet to 1,066 feet. Although EFH may encompass part of the project area, white hake adults were not collected in any surveys (Curley et al. 1972, Roman 1987, Raposa 1999 unpublished data, Gwilliam 2005 unpublished data) and likely do not occur in the harbor or Herring River. Therefore, no more than minimal impact on EFH for red hake juveniles is anticipated as a result of the proposed project.

## Winter flounder

**Eggs**—Winter flounder eggs are found in bottom habitats with a substrate of sand, muddy sand, mud, and gravel on Georges Bank, the inshore areas of the Gulf of Maine, southern New England, and the middle Atlantic south to Delaware Bay. They generally tend to occur in waters with temperatures less than 50° F, water depths less than 16 feet, and salinities between 10 ppt and 30 ppt. Eggs are often observed from February to June. Herring River and Wellfleet Harbor likely provide EFH for this species. Winter flounder are rare upstream of the Chequessett Neck Road Dike, so any impact from construction activities or sedimentation to EFH for winter flounder eggs would be minimal upstream of the dike. Downstream of the dike and in Wellfleet Harbor, eggs could be impacted through burial during construction of the dike and through sedimentation processes. However, much of the sedimentation in Wellfleet Harbor would likely occur in proximity to the mouth of Herring River and would be minimized by small incremental openings in the tide gates through adaptive management. Coordination with MA DMF and NMFS for appropriate in-water construction time periods and periods when the tide gates would be incrementally opened would also help to mitigate impacts to EFH for winter flounder eggs. With these measures, any impact to EFH for eggs is anticipated to be minimal and temporary. Over the long-term, restoration of Herring River estuary would provide better fish passage and dramatically increase the amount of estuarine habitat upstream of the dike, providing better access to areas upstream of the dike, as well as more spawning habitat and EFH for eggs.

**Larvae**—Winter flounder larvae are found in pelagic and bottom waters of Georges Bank and the inshore areas of the Gulf of Maine, where sea surface temperatures are less than 59° F, depths are less than 20 feet, and salinities are between 4 ppt and 30 ppt. Winter flounder larvae are often observed from March to July. EFH for the larvae of this species is likely found in Herring River and Wellfleet Harbor, though currently the occurrence of winter flounder upstream of the dike is rare. While increased turbidity during construction activities could impact EFH for larvae, impacts would be temporary in nature and localized, with areas of impact mostly just downstream of the Chequessett Neck Road Dike. Turbidity is not expected to increase very much in Wellfleet Harbor as a result of the project and would be minimized by the small incremental openings of the tide gates under adaptive management. Coordination with MA DMF and NMFS for appropriate in-water construction timeframes and periods when the tide gates would be incrementally opened would also help to minimize any potential impacts to EFH. In the long-term, the project would increase the amount of estuarine habitat upstream of the dike, providing beneficial impacts to EFH for larvae.

**Juveniles**—EFH is designated for two stages of winter flounder juveniles have been identified. Winter flounder young-of-the-year occupy bottom habitats with a substrate of mud or fine grained sand, within waters where the temperature is below 82° F, depths are from 0.3 feet to 33 feet, and salinities ranging between 5 ppt and 33 ppt. The second juvenile stage of winter flounder is the Age 1-plus juvenile found in inshore areas in waters with temperatures below 77° F, depths from 3 feet to 164 feet, and salinities between 10 ppt to 30 ppt. Winter flounder were collected during the surveys in 1968-1969 and 1984 and 2005, with the majority of them being juveniles and found downstream of the Chequessett Neck Road Dike (Curley et al. 1972, Roman 1987, Gwilliam 2005 unpublished data); therefore, Herring River and Wellfleet Harbor likely provide EFH for juvenile winter flounder. Juvenile winter flounder are mobile and would likely be temporarily displaced from construction activity, avoiding direct impacts such as mortality. During construction of the Chequessett Neck Road Dike measures will be taken to ensure that existing levels of fish passage continue, allowing winter flounder to access suitable habitat upstream of the dike. Localized increases in turbidity from in-water construction activities and sediment mobilization during restoration may affect feeding success. It may also restrict habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality. However individuals are mobile and would likely flee the area to neighboring waters where feeding and other impacts will be less problematic. Therefore, no more than minimal impact to juvenile flounder EFH is anticipated. During restoration, increased fish passage at the dike would allow greater access to areas upstream of the dike, and estuarine habitat upstream of the dike would expand and increase the quality of EFH for juveniles, providing long-term beneficial impacts.

**Adults**—Adult winter flounder occur in bottom habitats including estuaries with a substrate of mud, sand, and gravel, with water temperatures below 77° F depths, from 3 feet to 328 feet, and salinities between 15 ppt and 33 ppt. Spawning winter flounder adults are found in waters with temperatures below 59° F, depths less than 20 feet (except on Georges Bank where they spawn as deep as 262 feet), and salinities between 5.5 ppt and 36 ppt. Spawning occurs in January through May, with an optimal temperature being 38° F to 42° F and optimal salinity 11 ppt to 33 ppt. Adults have been collected in the project area, and the Herring River and Wellfleet Harbor likely provide EFH for adult and spawning adult winter flounder. Impacts would be similar to those described above for juveniles, resulting in minimal short-term adverse impacts and long-term beneficial impacts to EFH for adult winter flounder.

## Yellowtail flounder

Yellowtail flounder are rare in most estuaries and rivers in the North Atlantic, although they are common in the Sheepscot River and Casco Bay and abundant in Boston Harbor (Johnson et al. 1999). Given the depth preferences for eggs (98 feet to 295 feet), larvae (33 feet to 295 feet), juveniles (66 feet to 164 feet) and adults (66 feet to 164 feet), Herring River and Wellfleet Harbor do not provide EFH for any life stage of yellowtail flounder.

## Windowpane flounder

**Eggs**—EFH designated for windowpane flounder eggs includes surface waters around the perimeter of the Gulf of Maine, on Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras with temperatures ranging between 43° F and 68° F and water depths less than 230 feet. Although EFH may encompass part of the project area windowpane flounder eggs likely do not occur in Wellfleet Harbor or Herring River. Therefore, no more than minimal impact on EFH for windowpane flounder eggs is anticipated as a result of the proposed project.

**Larvae**—EFH for windowpane flounder larvae includes pelagic waters around the perimeter of the Gulf of Maine, on Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras with temperatures less than 68° F and water depths less than 230 feet. Although EFH may encompass part of the project area in Wellfleet Harbor, windowpane flounder larvae likely do not occur in harbor. Therefore, no more than minimal impact on EFH for windowpane flounder larvae is anticipated as a result of the proposed project.

**Juveniles**—EFH for juveniles includes bottom habitats around the perimeter of the Gulf of Maine, on Georges Bank, southern New England, and the middle Atlantic south to Cape Hatteras with substrates consisting of mud or fine-grained sand. Juveniles are common from June through October at temperatures below 77° F, depths from 3 feet to 328 feet, and salinities between 5.5 ppt to 36 ppt. Juvenile windowpane flounder were sampled at all stations except in Herring River downstream of the dike by Curley et al. (1972). They were also not sampled in Herring River in 1984, 1999, or 2005 (Roman 1987, Raposa 1999 unpublished data, Gwilliam 2005 unpublished data); therefore it is likely that only Wellfleet Harbor provides EFH for juveniles. Turbidity levels in Wellfleet Harbor are not expected to increase much as a result of in-water construction or sediment mobilization processes associated with restoration of Herring River; therefore, adverse impacts to feeding habits/success in juveniles is expected to be minimal and temporary. Other impacts that can be caused by increased turbidity such as restricted habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality would also be expected to be minimal and temporary. With the project resulting in increased fish passage at Chequessett Neck Road dike and increased estuarine habitat upstream of the dike, EFH for juvenile window pane flounder would likely expand to areas upstream of the dike, resulting in long-term benefits.

**Adults**—For adult windowpane flounder EFH is designated as bottom habitats with a substrate of mud or fine-grained sand in the Gulf of Maine, Georges Bank, southern New England, and the middle Atlantic south to the Virginia-North Carolina border. Water temperatures are generally below 80° F, water depths generally range from 3 feet to 246 feet, and salinities range from 5.5 ppt to 36 ppt. Wellfleet Harbor likely provides EFH for adult windowpane flounder. Impacts to EFH for adult windowpane flounder would be similar to those for juvenile window pane flounder discussed above and result in long-term benefits by expanding potential EFH upstream of the Chequessett Neck Road dike.

## American plaice

Water depths designated as EFH for American plaice eggs (98 feet to 295 feet), larvae (98 feet to 427 feet), juveniles (148 feet to 492 feet) and adults (148 feet to 574) are greater than what exist in Herring River and Wellfleet Harbor. Therefore, EFH for this species does not exist within the project area.

## Ocean pout

**Eggs**—EFH consists of bottom habitats in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Delaware Bay. Due to low fecundity, relatively few eggs (< 4200) are laid in gelatinous masses, generally in hard bottom sheltered nests, holes, or crevices where they are guarded by either female or both parents. Additionally, water temperatures are generally below 50° F, depths are generally less than 164 feet, and salinities range from 32 ppt to 34 ppt. Given the habitat requirements, it is not expected that eggs would occur in the project area.

**Larvae**—For larvae, EFH consists of bottom habitats in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Delaware Bay that remains in close proximity to the hard bottom nesting areas. Where larvae are found, water temperatures are generally below 50° F, depths are less than 164 feet, and salinities are greater than 25 ppt. Given the bottom habitats, no EFH is found within the project area.

**Juveniles**—EFH for juveniles consists of bottom habitats, often smooth bottom near rocks or algae in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Delaware Bay where water temperatures are below 57° F, depths less than 262 feet, and salinities are greater than 25 ppt. Although EFH may encompass part of the project area in Wellfleet Harbor, ocean pout juveniles likely do not occur in the harbor and none were collected in the surveys conducted in the harbor in 1968-1969 or 1984 (Curley et al. 1972, Roman 1987). Therefore, no more than minimal impact on EFH for ocean pout juveniles is anticipated as a result of the proposed project.

**Adults**—Bottom habitats for adult EFH occur in the Gulf of Maine, Georges Bank, southern New England and the middle Atlantic south to Delaware Bay where the substrate is sand, gravel, or a rough bottom, but are rarely found over mud (Steimle et al. 1999). Additionally, the following conditions exist where ocean pout adults are found: water temperatures below 59° F, depths less than 361 feet, and a salinity range from 32 ppt to 34 ppt. Although EFH may encompass part of the project area in Wellfleet Harbor, ocean pout adults likely do not occur in the harbor and none were collected in the surveys conducted in the harbor in 1968-1969 or 1984 (Curley et al. 1972, Roman 1987). Therefore, no more than minimal impact on EFH for ocean pout adults is anticipated as a result of the proposed project.

## Atlantic halibut

**Eggs and Larvae**—Atlantic halibut spawn offshore (Cargnelli et al. 1999) Atlantic halibut eggs are generally observed between late fall and early spring, in waters with temperatures between 39° F and 45° F, depths less than 2,297 feet, and salinities less than 35 ppt. EFH for larvae is the surface water of the gulf of Main and Georges Bank where salinities are between 30 ppt and 35 ppt. Because Atlantic halibut spawn offshore, it is unlikely that eggs or larvae would be found within the project area.

**Juveniles**—Juvenile halibut tend to emigrate from nursery areas between 3 and 4 years of age. They prefer sand and coarse sediment in the Gulf of Main and Georges Bank where depths range from 66 feet to 197 feet and water temperatures are above 36° F. There is no EFH for juveniles in the project area as preferred depths are greater than found in Wellfleet Harbor.

**Adults**—Adult Atlantic halibut, as well as spawning adults tend to occupy waters with temperatures below 56° F, depths from 328 feet to 2,296 feet, and salinities between 30.4 ppt and 35.3 ppt. Due to preferred depths, no EFH exists within the project area.

## Atlantic sea scallops

Sea scallops are an offshore species inhabiting water depths typically ranging from 59 feet to 361 feet, but may also occur in waters as shallow as seven feet in estuaries and embayments along the Maine coast and in Canada. In southern areas, scallops are primarily found at depths between 148 feet to 246 feet, and are less common in shallower water (82 feet to 148 feet) due to high temperature (Hart and Chute 2004). Because they are an offshore species, there is no EFH for them in the project area.

## Atlantic sea herring

Although juvenile Atlantic herring were sampled during the 1968-1969 survey in Wellfleet Harbor (Curley et al. 1972), water depths for which EFH is designated for all life stages exceeds those which occur in the project area (eggs: 66 feet to 262 feet; larvae: 164 feet to 295 feet; juveniles: 49 feet to 443 feet; adults: 66 feet to 427 feet). Therefore, no EFH exists in the project area.

## Monkfish

Water depths for which EFH is designated for all life stages of monkfish exceeds those which occur in the project area (eggs: 49 feet to 3,281 feet; larvae: 82 feet to 3,281 feet; juveniles: 82 feet to 656 feet; adults: 82 feet to 656 feet). Therefore, no EFH exists in the project area.

## Bluefish

**Eggs and Larvae**—Eggs and larvae are generally not collected in estuarine waters, thus there is no EFH designation inshore for these life stages.

**Juveniles and Adults**—EFH for juveniles and adults is all major estuaries between Penobscot Bay, Maine and St. Johns River, Florida. In North Atlantic estuaries, juvenile and adult bluefish generally occur from June through October in the "mixing" (0.5 ppt to 25 ppt) and "seawater" (> 25 ppt) zones. Therefore, Herring River and Wellfleet Harbor serve as EFH for juvenile and adult bluefish. They were sampled downstream of the dike in 1984 (Roman 1987) and in Wellfleet Harbor in 1968-1969 (Curley et al. 1972). Localized increases in turbidity associated with in-water construction activities and sediment mobilization processes during restoration could affect feeding success. It may also restrict habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality. However, these impacts would be localized and temporary. Juveniles and adults would are highly mobile and also likely flee impacted areas to surrounding waters where feeding and other impacts are less problematic. Therefore, any short-term adverse impact is anticipated to be minimal. However, the restoration project would have long-term beneficial impacts on EFH for juvenile and adult bluefish as the project would result increased fish passage at Chequessett Neck Road Dike, providing greater access to the increased amount of estuarine habitat and prey species populations resulting from the project.

## Long finned squid

There is no EFH for long finned squid in the project area as EFH for pre-recruits and recruits is pelagic waters found over the continental shelf (from the coast out to the limits of the Exclusion Economic Zone (EEZ)), for the Gulf of Maine through Cape Hatteras, North Carolina.

## Short finned squid

There is no EFH for short finned squid in the project area as EFH for pre-recruits and recruits is pelagic waters found over the continental shelf (from the coast out to the limits of the EEZ), for the Gulf of Maine through Cape Hatteras, North.

## Atlantic butterfish

**Eggs**—Inshore, EFH for eggs is the "mixing" (0.5 ppt to 25 ppt) and/or "seawater" (25 ppt) portions of all the estuaries where butterfish eggs are "common," "abundant," or "highly abundant" on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia according to the Estuarine Living Marine Resources (ELMR) database (NOAA 2010). Butterfish eggs pelagic and are generally collected from shore to 6,000 ft and temperatures between 52° F and 63° F, though they have been collected from temperatures up to 73° F (Cross et al. 1999). For the seawater portions of Cape Cod Bay, eggs are common during the months of July to September (NOAA 2010); therefore, they could potentially be present in the seawater portions of Wellfleet Harbor. However, the harbor is on the upper end of the temperature range during those months. Butterfish eggs are not present in the mixing portion of Cape Cod Bay estuaries (NOAA 2010). Turbidity in Wellfleet Harbor resulting from the restoration of Herring River is not expected to increase much, and would only be temporary in nature. Therefore, any impact to EFH for eggs is expected to be minimal and short-term.

**Larvae**—Inshore, EFH is designated as the "mixing" (0.5 ppt to 25 ppt) and/or "seawater" (> 25 ppt) portion of all the estuaries where Atlantic mackerel eggs are "common," "abundant," or "highly abundant” on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia according to the ELMR database. Larvae are generally found from 33 feet to 6,000 feet in areas where water temperatures range from 48° F to 66° F. For the seawater portions of Cape Cod Bay, butterfish larvae are rare, and they are not present in the mixing portion of the estuaries; therefore there is no EFH in the project area (NOAA 2010).

**Juveniles**—Inshore, EFH is designated as the “mixing” (0.5 ppt to 25 ppt) and/or “seawater” (> 25 ppt) portion of all the estuaries where Atlantic mackerel eggs are “common,” “abundant,” or “highly abundant” on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia according to the ELMR database. Juvenile fish are generally found in depths between 33 feet and 1,200 feet in areas where water temperatures range from 37° F to 82° F. For Cape Cod Bay, juveniles are common in both the seawater and mixing portions of its estuaries (NOAA 2010); therefore, while butterfish juveniles were not collected during the surveys conducted in 1968-1969 (Curley et al. 1972) or 1984 (Roman 1987), they could potentially occur in Wellfleet Harbor. Depths are too shallow for Herring River. Feeding success in juveniles could be impacted by increased turbidity. However, turbidity in Wellfleet Harbor resulting from the restoration of Herring River is not expected to increase much, and would only be temporary in nature. Other impacts that can be caused by increased turbidity such as restricted habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality would also be expected to be minimal and temporary. Juveniles are highly mobile and would also likely flee any impacted areas to surrounding waters where feeding and other impacts would be less problematic. Therefore, any impact to EFH for juvenile butterfish is expected to be minimal and short-term.

**Adults**—Inshore, EFH is designated as the “mixing” (0.5 ppt to 25 ppt) and/or “seawater” (> 25 ppt) portion of all the estuaries where Atlantic mackerel eggs are “common,” “abundant,” or “highly abundant” on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia according to the ELMR database. Adult butterfish are generally found in depths between 33 feet and 1,200 feet in areas where water temperatures range from 37° F to 82° F. For Cape Cod Bay, adults are common in both the seawater and mixing portions of its estuaries (NOAA 2010). Therefore, while adult butterfish were not collected during the surveys conducted in 1968-1969 (Curley et al. 1972) or 1984 (Roman 1987), they could potentially occur in Wellfleet Harbor. The depths are too shallow in Herring River for EFH. Impacts to EFH for adult butterfish would be the same as described above for juveniles and are expected to be minimal and short-term.

## Atlantic mackerel

**Eggs**—Inshore, EFH is designated as the “mixing” (0.5 ppt to 25 ppt) and/or “seawater” (> 25 ppt) portions of all the estuaries where Atlantic mackerel eggs are “common,” “abundant,” or “highly abundant” on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia according to the ELMR database. Generally, Atlantic mackerel eggs are collected from shore to 50 ft and temperatures between 41° F and 73° F. Eggs are common in the mixing portion of the estuaries and abundant to highly abundant in the seawater portion of the estuaries May through August (NOAA 2010). Therefore, they could be present in Wellfleet Harbor. Turbidity in Wellfleet Harbor resulting from the restoration of Herring River is not expected to increase much, and would only be temporary in nature. Therefore, any impact to EFH for eggs is expected to be minimal and short-term.

**Larvae**—Inshore, EFH is designated as the “mixing” (0.5 ppt to 25 ppt) and/or “seawater” (> 25 ppt) portions of all the estuaries where Atlantic mackerel larvae are "common," "abundant," or "highly abundant" on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia according to the ELMR database. Generally, Atlantic mackerel larvae are collected in depths between 33 feet and 425 feet and temperatures between 43° F and 72° F. In Cape Cod Bay, larvae are common in the mixing portion of estuaries and common to highly abundant in the seawater portion May through August (NOAA 2010); therefore, larvae could be found in the deeper portions of Wellfleet Harbor. Turbidity in Wellfleet Harbor resulting from the restoration of Herring River is not expected to increase much, and would only be temporary in nature. Therefore, any impact to EFH for eggs is expected to be minimal and short-term.

**Juveniles**—Inshore, EFH is designated as the “mixing” (0.5 ppt to 25 ppt) and/or “seawater” (> 25 ppt) portions of all the estuaries where juvenile Atlantic mackerel are "common," "abundant," or "highly abundant" on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia according to the ELMR database. Generally, juvenile Atlantic mackerel are collected from shore to 1,050 feet and temperatures between 39° F and 72° F. In Cape Cod Bay, juveniles are common in the mixing portion of estuaries May through October and common to abundant in the seawater portion May through November (NOAA 2010). Juvenile mackerel were collected in Wellfleet Harbor in the 1968-1969 survey (Curley et al. 1972) and one was collected in Herring River downstream of the dike during the 1984 survey (Roman 1987). EFH exists in the project area. Feeding success in juveniles could be impacted by increased turbidity. However, turbidity in Wellfleet Harbor resulting from the restoration of Herring River is not expected to increase much, and would only be temporary in nature. Other impacts that can be caused by increased turbidity such as restricted habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality would also be expected to be minimal and temporary. Juveniles are highly mobile and would also likely flee any impacted areas downstream of the dike and in Wellfleet Harbor to surrounding waters where feeding and other impacts would be less problematic. Therefore, any impact to EFH for juvenile Atlantic mackerel is expected to be minimal and short-term. Long-term benefits to EFH for juvenile Atlantic mackerel are expected from the increased populations of prey species resulting from the restoration of Herring River estuary.

**Adults**—Inshore, EFH is designated for the “mixing” (0.5 ppt to 25 ppt) and/or “seawater” (> 25 ppt) portions of all the estuaries where adult Atlantic mackerel are "common," "abundant," or "highly abundant" on the Atlantic coast, from Passamaquoddy Bay, Maine to James River, Virginia according to the ELMR database. Generally, adult Atlantic mackerel are collected from shore to 1,250 feet and temperatures between 39° F and 61° F. In Cape Cod Bay, adult mackerel are common in the mixing portion of estuaries during May through August and common to abundant in the seawater portion of estuaries from May through November (NOAA 2010). Adult mackerel could potentially occur in Wellfleet Harbor during the fall when temperatures fall below 60° F, otherwise water temperatures are too warm in the harbor and Herring River for adult mackerel. Feeding success in adults could be impacted by increased turbidity. However, turbidity in Wellfleet Harbor resulting from the restoration of Herring River is not expected to increase much, and would only be temporary in nature. Other impacts that can be caused by increased turbidity such as restricted habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality would also be expected to be minimal and temporary. Adults are highly mobile and would also likely flee any impacted areas downstream of the dike and in Wellfleet Harbor to surrounding waters where feeding and other impacts would be less problematic. Therefore, any impact to EFH for adult Atlantic mackerel is expected to be minimal and short-term. Long-term benefits to EFH for adult Atlantic mackerel are expected from the increased populations of prey species resulting from the restoration of the Herring River estuary.

## Summer flounder

No EFH is designated for eggs, larvae or juveniles in Cape Cod Bay and its estuaries.

**Adults**—Inshore, EFH for adult summer flounder is designated for the “mixing” (0.5 ppt to 25 ppt) and/or “seawater” (> 25 ppt) portions of all the estuaries where adult summer flounder are “common,” "abundant," or "highly abundant” according to the ELMR database. Generally, summer flounder inhabit shallow coastal and estuarine waters during warmer months and move offshore on the outer continental shelf at depths of 500 feet in colder month. The ELMR database does not provide any data for summer flounder in Cape Cod Bay (NOAA 2011). Though no summer flounder were collected during the 1968-1969 and 1984 surveys (Curley et al. 1972, Roman 1987), given the species preference for shallow coastal and estuarine habitats during the warmer months, and the fact that MA DMF considers the shoal waters of Cape Cod Bay and the region east and south of Cape Cod, including all estuaries, bays and harbors thereof, as critically important habitat (Packer et al. 1999) summer flounder could potentially be found in Wellfleet Harbor and possibly Herring River; therefore these areas should be considered as EFH for this species. Feeding success in adults could be impacted by increased turbidity. However, turbidity in Wellfleet Harbor resulting from the restoration of Herring River is not expected to increase much, and would only be temporary in nature. Turbidity in Herring River would be localized and temporary in nature as well. Other impacts that can be caused by increased turbidity such as restricted habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality would also be expected to be minimal and temporary. Adults are highly mobile and would also likely flee any impacted areas to surrounding waters where feeding and other impacts would be less problematic. Therefore, any impact to EFH for adult summer flounder is expected to be minimal and short-term. Long-term benefits to EFH for adult summer flounder are expected from the increased populations of prey species resulting from the restoration of Herring River estuary. Increased fish passage at Chequessett Neck Road Dike and increased estuarine habitat upstream of the dike would also increase the amount of EFH available to adult summer flounder.

## Scup

**Juveniles**—Inshore, EFH is designated as the estuaries where scup are identified as being common, abundant, or highly abundant in the ELMR database for the "mixing"(0.5 ppt to 25 ppt) and "seawater"(>25 ppt) salinity zones. In general during the summer and spring, juvenile scup are found in estuaries and bays between Virginia and Massachusetts, in association with various sands, mud, mussel and eelgrass bed type substrates, in water temperatures greater than 45° F and salinities greater than 15 ppt. In Cape Cod Bay, juvenile scup are common in the mixing and seawater portion of estuaries during July through September (NOAA 2010) and scup were collected in Wellfleet Harbor by Curley et al. (1972). Feeding success in juveniles could be impacted by increased turbidity. However, turbidity in Wellfleet Harbor resulting from the restoration of Herring River is not expected to increase much, and would only be temporary in nature. Other impacts that can be caused by increased turbidity such as restricted habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality would also be expected to be minimal and temporary. Juveniles are highly mobile and would also likely flee any impacted areas to surrounding waters where feeding and other impacts would be less problematic. Therefore, any impact to EFH for juvenile scup is expected to be minimal and short-term. Long-term benefits to EFH for juvenile scup are expected to occur. Restoration of Herring River would increase salinity levels upstream of the Chequessett Neck Road Dike and would increase fish passage at the dike as well. This would potentially expand suitable habitat for scup to access. Restoration of Herring River estuary would also increase populations of prey species for scup, providing long-term benefits to EFH for juvenile scup.

**Adults**—Inshore, EFH is designated as the estuaries where scup were identified as being common, abundant, or highly abundant in the ELMR database for the "mixing"(0.5 ppt to 25 ppt) and "seawater"(>25 ppt) salinity zones. Generally, wintering adults (November through April) are usually offshore, south of New York to North Carolina, in waters above 45° F. In Cape Cod Bay, adult scup are common in the seawater portion of estuaries from June through September (NOAA 2010) and scup were collected in Wellfleet Harbor by Curley et al. (1972). Impacts to EFH for adult scup from the proposed project would be the same as those described above for juvenile scup.

## Black sea bass

**Adults**—Inshore, EFH is designated for the estuaries where adult black sea bass were identified as being common, abundant, or highly abundant in the ELMR database for the "mixing" (0.5 ppt to 25 ppt) and/or "seawater" (> 25 ppt) portions. Black sea bass are generally found in estuaries from May through October. Wintering adults (November through April) are generally offshore, south of New York to North Carolina. Temperatures above 43° F appear to be the minimum requirements. Structured habitats (natural and man-made), sand and shell are usually the substrate preference. Black sea bass are uncommon in the cooler waters north of Cape Cod (Drohan et al. 2007) and the ELMR database does not provide distribution information for areas of Cape Cod Bay. Therefore, there is no EFH for this species in the project area.

## Surf clam

**Juveniles/adults**—EFH for surf clam juveniles and adults is designated throughout the substrate, to a depth of three feet below the water/sediment interface, within federal waters from the eastern edge of Georges Bank and the Gulf of Maine throughout the Atlantic EEZ. Surf clams generally occur from the beach zone to a depth of about 200 feet, but beyond about 125 feet abundance is low. They also only occur in salinities greater than 28 ppt (Cargnelli et al. 1999). The higher salinity areas of Wellfleet Harbor could serve as EFH for this species. Though some sedimentation is expected to occur in Wellfleet Harbor in the vicinity of the mouth of Herring River, it would be minimized by small incremental openings in the tide gates under adaptive management. Surf clams are able to move up and down in the substrate; therefore, it is not anticipated that they would be affected by any sedimentation that would occur. Thus, any impact to surf clams is anticipated to be minimal and short-term.

## Ocean quahog

No EFH is designated for any life stage of ocean quahog in Cape Cod Bay and its estuaries.

## Spiny dogfish

**Juveniles**—Inshore, EFH is the "seawater" (>25 ppt) portions of the estuaries where dogfish are common or abundant on the Atlantic coast, from Passamaquoddy Bay, Maine to Cape Cod Bay, Massachusetts. Generally, juvenile dogfish are found at depths of 33 feet to 1,280 feet in water temperatures ranging between 37° F and 82° F. Though no spiny dogfish have been collected in the project area (Curley et al. 1972, Roman 1987), they could potentially be found in the deeper portions of Wellfleet Harbor. Feeding success in juveniles could be impacted by increased turbidity. However, turbidity in Wellfleet Harbor resulting from the restoration of Herring River is not expected to increase much, and would only be temporary in nature. Other impacts that can be caused by increased turbidity such as restricted habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality would also be expected to be minimal and temporary. Juveniles are highly mobile and would also likely flee any impacted areas to surrounding waters where feeding and other impacts would be less problematic. Therefore, any impact to EFH for juvenile spiny dogfish is expected to be minimal and short-term.

**Adults**—Inshore, EFH is the "seawater" (.25 ppt) portions of the estuaries where dogfish are common or abundant on the Atlantic coast, from Passamaquoddy Bay, Maine to Cape Cod Bay, Massachusetts. Generally, adult dogfish are found at depths of 33 feet to 1,476 feet in water temperatures ranging between 37° F and 82° F. Though no spiny dogfish have been collected in the project area (Curley et al. 1972, Roman 1987), they could potentially be found in the deeper portions of Wellfleet Harbor. Impacts to EFH for adult spiny dogfish would be similar to those for juvenile spiny dogfish discussed above and are expected to be minimal and short-term.

### Blue shark

**Adults**—The blue shark is a pelagic species that inhabits clear, deep, blue waters, usually in temperatures of 50° F to 68° F, at depths greater than 590 feet. EFH is designated in localized areas in the Atlantic off Florida and Georgia, and from South Carolina to the Gulf of Maine. Based on the mapping for this species, there is no EFH for adult blue sharks in the project area (NOAA 2009).

### Bluefin tuna

**Juveniles/Subadults**—EFH juvenile/subadult bluefin tuna consists of all inshore and pelagic waters warmer than 53.6° F off the Gulf of Maine and Cape Cod Bay, from Cape Ann, MA (~42.75 N) east to 69.75 W (including waters of the Great South Channel west of 69.75 W), continuing south to and including Nantucket Shoals at 70.5 W to off Cape Hatteras, NC (approximately 35.5 N), in pelagic surface waters warmer than 53.6° F, between the 82 and 328 foot isobaths. No EFH exists in the estuarine waters of Wellfleet Harbor and Herring River.

**Adults**—Adult bluefin tuna are found from Newfoundland to Brazil, but have EFH for adults in pelagic waters of the Gulf of Maine from the 164 foot isobath to the EEZ boundary, including the Great South Channel, then south of Georges Bank to 39 N from the 164 foot isobath to the EEZ boundary. No EFH exists in the estuarine waters of Wellfleet Harbor and Herring River.

## CUMULATIVE EFFECTS

Cumulative impacts are those resulting from the incremental impact of the proposed action when added to other past, present, and reasonably foreseeable future actions. Other projects and plans in the area with the potential to beneficially affect EFH include the Town of Wellfleet Comprehensive Wastewater Management Plan, the Mayo Creek and East Harbor salt marsh restoration projects, and oyster spawning experiments in Wellfleet Harbor. Wellfleet's wastewater management plan would improve water quality in the project area waters by reducing the potential for nutrient loading and domestic sewage contamination of local surface waters, improving the habitat for estuarine fish and macroinvertebrate species as well as shellfish. The May Creek and East Harbor restoration projects, similar to the Herring River restoration project, would improve and increase the amount of habitat available for all aquatic species. The oyster spawning experiments in Wellfleet Harbor could directly enhance the local population of oysters and provide additional spat that could settle in restored areas of Herring River. The oysters used in the experiments could also potentially improve the overall local water quality by filtering nitrogen out of the water; improving habitat conditions for all aquatic species.

Recurrent dredging of the federal navigation channel between the Town Pier and Wellfleet Harbor, which has occurred four times since 1971, has the potential to adversely affect EFH through temporary disturbance, decreases in local water quality, sedimentation and direct mortality. Although these effects are temporary, they recur with each dredging event, resulting in long-term, intermittent impacts. Mobile species, both fish and macroinvertebrates, would temporarily move out of the area while the dredging occurs; returning once the activities are over. This would temporarily impact both prey species as well as EFH species, but once the dredging is over, species would readily return. Dredging delivers sediment to the water column and increases turbidity. Fine sediments would likely be transported out of Wellfleet Harbor on ebbing tides while coarser sediments could settle to the bottom within the harbor. Increased turbidity can adversely impact aquatic species, including shellfish, and sedimentation can adversely affect shellfish through burial. While feeding for species with designated EFH would be impacted, these species would likely flee the impacted areas to surrounding waters where feeding is less problematic, resulting in minimal adverse impacts that would be temporary in nature. Dredging would also result in the direct mortality of some benthic species that are not mobile enough to move out of the area; again impacting feeding resources for species with designated EFH. However, once dredging activities cease, species would quickly recolonize the affected area.

Overall, the proposed action when combined with the projects in the vicinity of the proposed action would have long-term beneficial impacts on EFH, as any adverse impacts would be temporary and localized in nature and would not result in a cumulative impact that was significant.

## CONCLUSIONS

Long-term, the proposed restoration of the Herring River estuary is expected to provide numerous benefits to EFH for species occurring in the area, including improved quality and quantity of EFH. Through increased tidal flow and flushing rates water quality upstream of the Chequessett Neck Road Dike as well as upstream of High Toss Road would improve. Salinity values would increase throughout much of the system with values ranging from 15 ppt to 30 ppt in most of the lower sub-basins, increasing the amount of estuarine habitat (sub-tidal and intertidal habitat) by approximately 790 acres to 885 acres, depending on the alternative selected through the NEPA process. This new estuarine habitat in turn would result in an increase in the population of prey species, including finfish, macroinvertebrates and shellfish, which species with EFH feed on. Fish passage at the Chequessett Neck Road dike would also increase, decreasing potential mortality rates for anadromous and catadromous species and increasing access to estuarine habitat upstream of the dike for both prey species and species for which EFH is designated.

Although some adverse impacts to species with designated EFH would occur, they are expected to be minimal and short-term in nature. During construction activities less mobile prey species would likely be buried or directly killed during in-water construction activities. Sediment disturbance would increase turbidity in the surrounding waters, adversely impacting the feeding behaviors of species with EFH, as well as other species. It may also restrict habitat use and function through greater expenditure of energy, gill tissue damage and associated respiratory impacts, lowered oxygen levels, and mortality. However, this would be temporary and localized and species would likely flee to neighboring waters where feeding and other impacts are less problematic. As tidal flows increase with restoration, sediments would be mobilized, and though most would be transported upstream onto the marsh system, some would be transported downstream of the dike and into Wellfleet Harbor, with coarser sediments settling out and finer sediments likely flushing out to Cape Cod Bay. However, with small incremental openings in the tide gates under adaptive management, impacts would be minimized and benthic species would be expected to recolonize areas readily.

## ACRONYMS

| | |
|---|---|
| BMPs | Best Management Practices |
| CYCC | Chequessett Yacht and Country Club |

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|---|---|
| DO | dissolved oxygen |
| EFH | Essential Fish Habitat |
| MA DMF | Massachusetts Division of Marine Fisheries |
| NEPA | National Environmental Policy Act |
| NEFMC | New England Fishery Management Council |
| NMFS | National Oceanic and Atmospheric Administration National Marine Fisheries Service |
| ppt | parts per thousand |
| TSS | total suspended solids |

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Woods Hole Group

2011 Hydrodynamic Modeling for the Herring River Restoration Project.

# APPENDIX G: STATEMENT OF FINDINGS FOR WETLANDS AND FLOOD PLAINS

# STATEMENT OF FINDINGS FOR WETLANDS AND FLOOD PLAINS

# HERRING RIVER RESTORATION PROJECT

# STATEMENT OF FINDINGS
# WETLANDS and FLOOD PLAINS

## For the Herring River Restoration Project
## Cape Cod National Seashore, Massachusetts

June 2012

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| Recommended: | ______________________ | __________ |
| | Superintendent | Date |
| | Cape Cod National Seashore | |
| Certification of | | |
| Technical Adequacy and | | |
| Servicewide Consistency: | ______________________ | __________ |
| | Chief | Date |
| | NPS Water Resources Division | |
| Approved: | ______________________ | __________ |
| | Regional Director | Date |
| | Northeast Region | |

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# INTRODUCTION

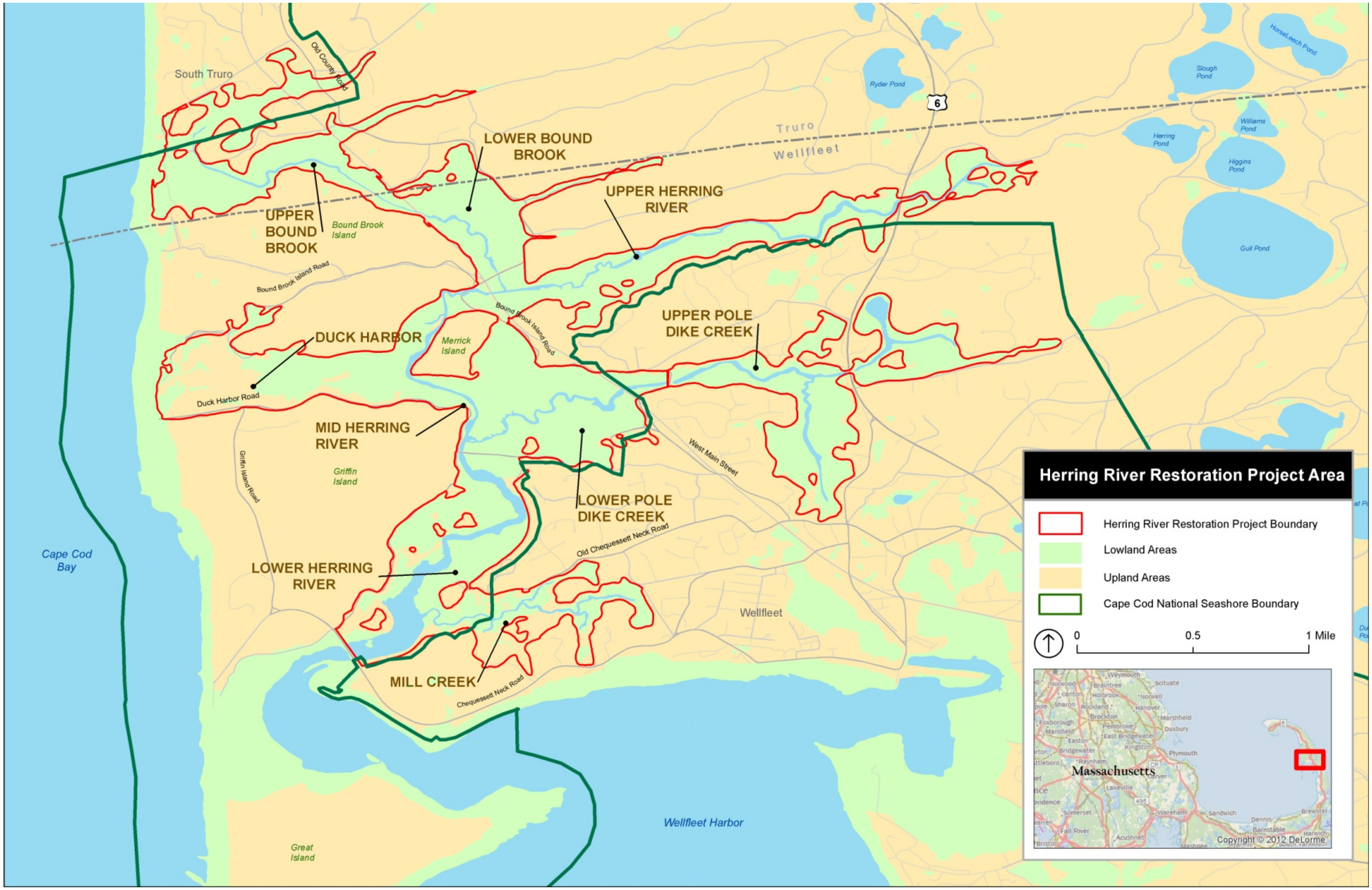
In accordance with the National Environmental Policy Act (NEPA) and the Massachusetts Environmental Policy Act (MEPA), the Herring River Restoration Committee (HRRC) and the National Park Service (NPS) have prepared and made available to the public a joint draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for the project to restore the Herring River flood plain in and adjacent to Cape Cod National Seashore (the Seashore).

In addition to complying with NEPA and MEPA requirements, NPS Director's Order 77-1 and Procedural Manual 77-1 provide guidance regarding NPS policies and procedures for wetland protection. The purpose of this Director's Order is to establish NPS policies, requirements, and standards for implementing Executive Order (EO) 11990: Protection of Wetlands (42 Fed. Reg. 26961), which was issued by President Carter in 1977 "…to avoid to the extent possible the long and short term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative...."

Consistent with this order, the NPS has adopted a goal of "no net loss of wetlands." Additionally, the NPS will strive to achieve a longer-term goal of a net gain of wetlands Servicewide. When proposing new development or other new activities, plans, or programs located in or otherwise have the potential to result in adverse impacts on wetlands, the NPS will avoid adverse wetland impacts to the extent practicable, minimize impacts that cannot be avoided, and compensate for remaining unavoidable adverse wetland impacts via restoration of degraded wetlands.

EO 11988: Floodplain Management, also enacted by then President Jimmy Carter in 1977, requires the NPS and other federal agencies to avoid to the extent possible the short- and long-term adverse impacts associated with the occupancy and modification of flood plains and to avoid direct and indirect support of flood plain development wherever there is a practicable alternative. Under the EO, each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health, and welfare, and to restore and preserve the natural and beneficial values served by floodplains (EO 11988). NPS Director's Order 77-2 Floodplain Management and Procedural Manual 77-2 provide NPS policies and procedures for complying with EO 11988.

The proposed project is intended to restore native tidal wetland habitat to large portions of the 1,100-acre Herring River flood plain (figure 1) by re-establishing tidal exchange in the river basin and its connected sub-basins. While the ecological goal is to restore the full natural tidal range in as much of the Herring River flood plain as practicable, tidal flooding in certain areas must be controlled to protect existing land uses. Where these considerations are relevant, the goal is to balance tidal restoration objectives with flood control by allowing the highest tide range practicable while also ensuring flood proofing and protection of vulnerable properties. As a result, flood plain functions would be altered from their current condition and adjacent landowners may be subject to a change in flood regimen of the Herring River.




Source: The Louis Berger Group, Inc., 2012.

**FIGURE 1: PARK VICINITY MAP AND HERRING RIVER RESTORATION AREA**

Increased tidal exchange would be achieved by reconstruction of the Chequessett Neck Road Dike (figure 2), which separates the former Herring River estuary from the marine waters of Wellfleet Harbor and Cape Cod Bay, and the construction of a new dike to control tidal inflows into the Mill Creek sub-basin of the project area. Tidal exchange would be increased incrementally, over time, using an adaptive management approach over several years to achieve desired conditions for native salt marsh habitats.

Source: NPS, 2011.

**FIGURE 2: CHEQUESSETT NECK ROAD DIKE**

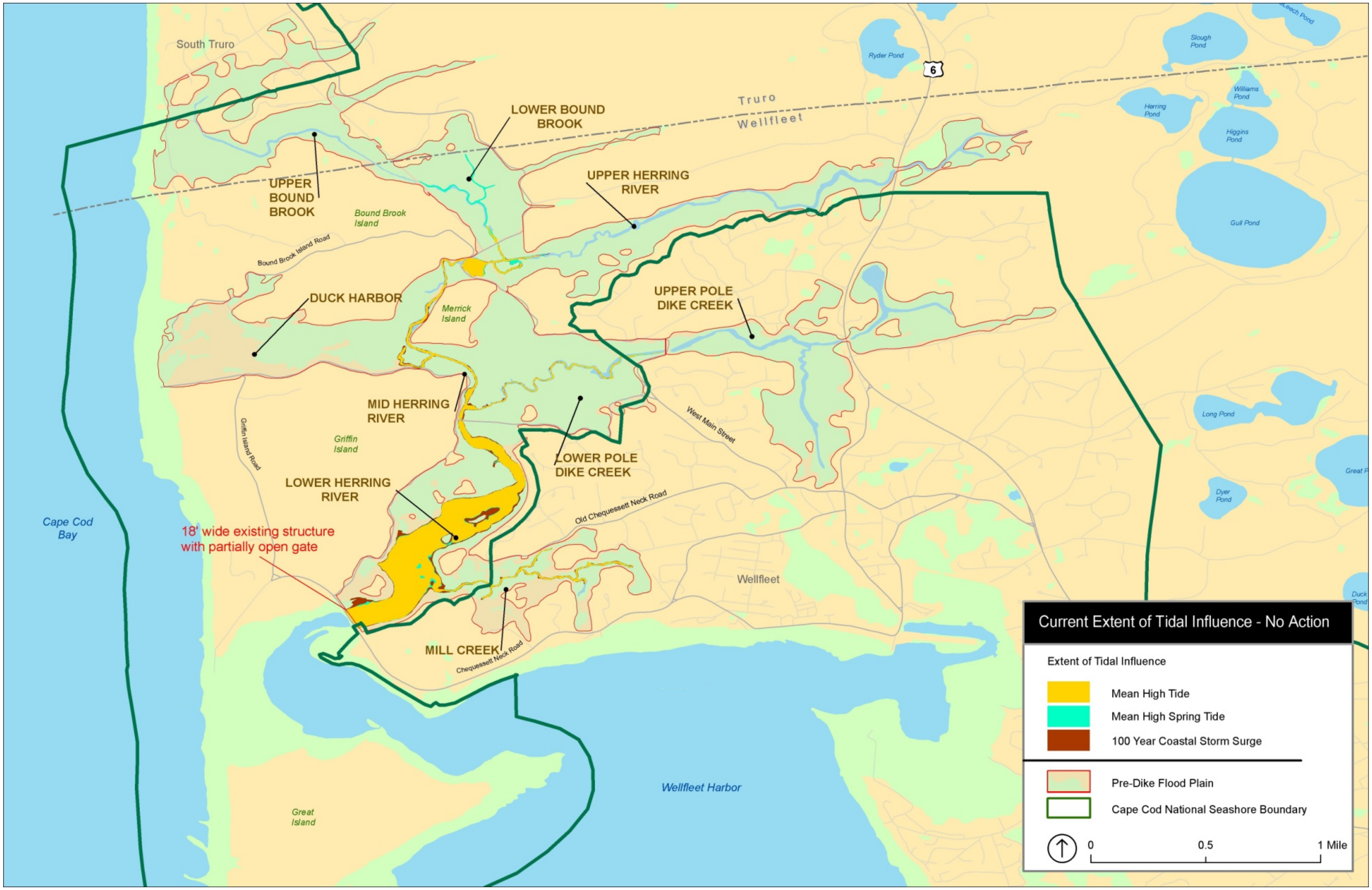
The proposed project would result in long-term wetland and flood plain impacts resulting from the transition of up to approximately 900 acres of man-made freshwater wetlands to native, salt marsh tidal wetlands. This would be achieved by construction of a new, tide-controlling dike that would allow tidal exchange while protecting the Herring River from flooding storm surge. Limited, short-term adverse effects to wetlands and flood plains would also occur as a result of construction activities, active management of vegetation during the adaptive management phase, and grading or other activities needed to ensure that both tidal inflows and drainage are adequate to achieve the desired future conditions.

This combined Wetlands and Floodplains Statement of Findings addresses both the long-term changes to natural processes and short-term construction and implementation impacts of the restoration project. It also identifies mitigation measures designed so that the proposed project is in compliance with NPS wetland and flood plain management procedures.

# PROJECT BACKGROUND

Historically, the Herring River estuary and flood plain was the largest tidal river and estuary complex on the Outer Cape and included about 1,100 acres of salt marsh, intertidal flats, and open-water habitats (HRTC 2007). In 1909, the Town of Wellfleet constructed the Chequessett Neck Road Dike (figure 2) at the mouth of the Herring River to reduce the presence of salt marsh mosquitoes. The dike restricted tides in the Herring River from approximately 10 feet on the downstream harbor side to about 2 feet upstream of the dike (figure 3).

By the mid-1930s, the Herring River, now flowing with freshwater, was channelized and straightened. Between 1929 and 1933, developers associated with the Chequessett Yacht and Country Club (CYCC) constructed a nine-hole golf course in the adjoining Mill Creek flood plain. Several homes have also been built at low elevations in the flood plain.




Source: The Louis Berger Group, Inc., 2012.

**FIGURE 3. CURRENT LEVEL OF TIDAL INUNDATION IN THE HERRING RIVER FLOOD PLAIN**

By the 1960s, the dike tide gates had rusted open, increasing tidal range and salinity in the lower Herring River. This caused periodic flooding of the CYCC golf course and other private properties. In 1973, the Town of Wellfleet required that the dike be repaired to accommodate anadromous fish passage. As a result, the Massachusetts Department of Public Works rebuilt the dike in 1974 (HRTC 2007). Following reconstruction, tide height monitoring showed that the new tide gate opening was too small to achieve the required tide heights. In 1977, control of the dike was transferred to the Massachusetts Department of Environmental Protection (MassDEP) so that increased tidal flow could be attained in the interest of restoration (HRTC 2007).

In 1980, a large die-off of American eel (*Anguilla rostrata*) and other fish drew attention to the poor water quality in the Herring River. The Massachusetts Division of Marine Fisheries and NPS identified the cause of the fish kill as high acidity and aluminum toxicity resulting from diking and marsh drainage (Soukup and Portnoy 1986). The tide gate opening was increased to 20 inches in 1983. That year, Seashore scientists documented summertime dissolved oxygen depletions and river herring (*Alosa* spp.) kills for the first time (Portnoy 1991). The NPS then implemented measures to protect river herring by blocking their emigration from upstream ponds to prevent the fish from entering anoxic waters (HRTC 2007).

Concerns about flooding of private properties and increased mosquito populations prevented the town from opening the tide gate further. NPS mosquito breeding research conducted from 1981 to 1984 found that mosquitoes, *Aedes cantator* and *Ae. canadensis,* were breeding abundantly in the Herring River. However, estuarine fish, important mosquito predators, could not access breeding areas because of low tidal range, low salinity, and high acidity (Portnoy 1984). In 1984, the town increased the sluice gate opening to 24 inches, where it has since remained (HRTC 2007).

In 1985, the Massachusetts Division of Marine Fisheries classified shellfish beds in the river mouth as "prohibited" due to fecal coliform contamination. In 2003, water quality problems caused MassDEP to list Herring River as "impaired" under the federal Clean Water Act Section 303(d) for low pH and high metal concentrations. More recently, NPS researchers identified bacterial contamination as another result of restricted tidal flow and reduced salinity (Portnoy and Allen 2006).

Concentrations of nitrogen and phosphorus in the sediments of Herring River have remained high. Although there is no documentation of specific anthropogenic or natural inputs, potential sources of excessive nutrients in the watershed include agriculture, fertilized lawns, CYCC golf course, the nearby Coles Neck landfill, leaking septic systems, animal waste, and atmospheric deposition. The lack of tidal flushing has allowed nutrients to accumulate in the Herring River. In a normally functioning estuary, nutrients would be diluted and flushed out of the system with each tide cycle.

In addition, pesticides have likely been used throughout the Herring River watershed, including long-term use for mosquito control. Pesticide concentrations (dichloro-diphenyl-trichloroethane (DDT) and dieldrin) measured in the Herring River sediments downstream of the dike in 1969 (Curley et al. 1972) were found to be elevated, exceeding National Oceanic and Atmospheric Administration (NOAA) guideline values (Buchman 2008). However, samples analyzed for organics (including pesticides) from the Wellfleet Harbor by Hyland and Costa (1995) did not exceed NOAA guideline values. Quinn et al. (2001) analyzed the upper 2 cm of the marsh sediments at four stations upstream and downstream of the Chequessett Neck Road Dike for polychlorinated biphenyls (PCBs), DDT, total petroleum hydrocarbons (TPH), and polycyclic aromatic hydrocarbons (PAHs). PAHs were found to be below NOAA's effects range low (ERL) guideline values while PCBs and DDT were found to be above NOAA's ERL guidelines.

Because tidal restrictions radically affect the process of sedimentation on the salt marsh, much of the diked Herring River flood plain has subsided up to three feet (Portnoy and Giblin 1997a). Coastal marshes must increase in elevation at a rate equal to or greater than the rate of sea-level rise in order to persist. This increase in elevation (accretion) depends on several processes, including transport of sediment and its deposition onto the marsh surface during high tides. This sediment transport must occur to promote the growth of salt marsh vegetation and gradually increase the elevation of the marsh surface. Diking has effectively blocked sediment from reaching the Herring River flood plain. In addition, drainage has increased the rate of organic peat decomposition by aerating the sediment and caused sediment pore spaces to collapse. These processes have contributed to severe historic and continuing subsidence in the Herring River's diked wetlands.

## STUDY AREA

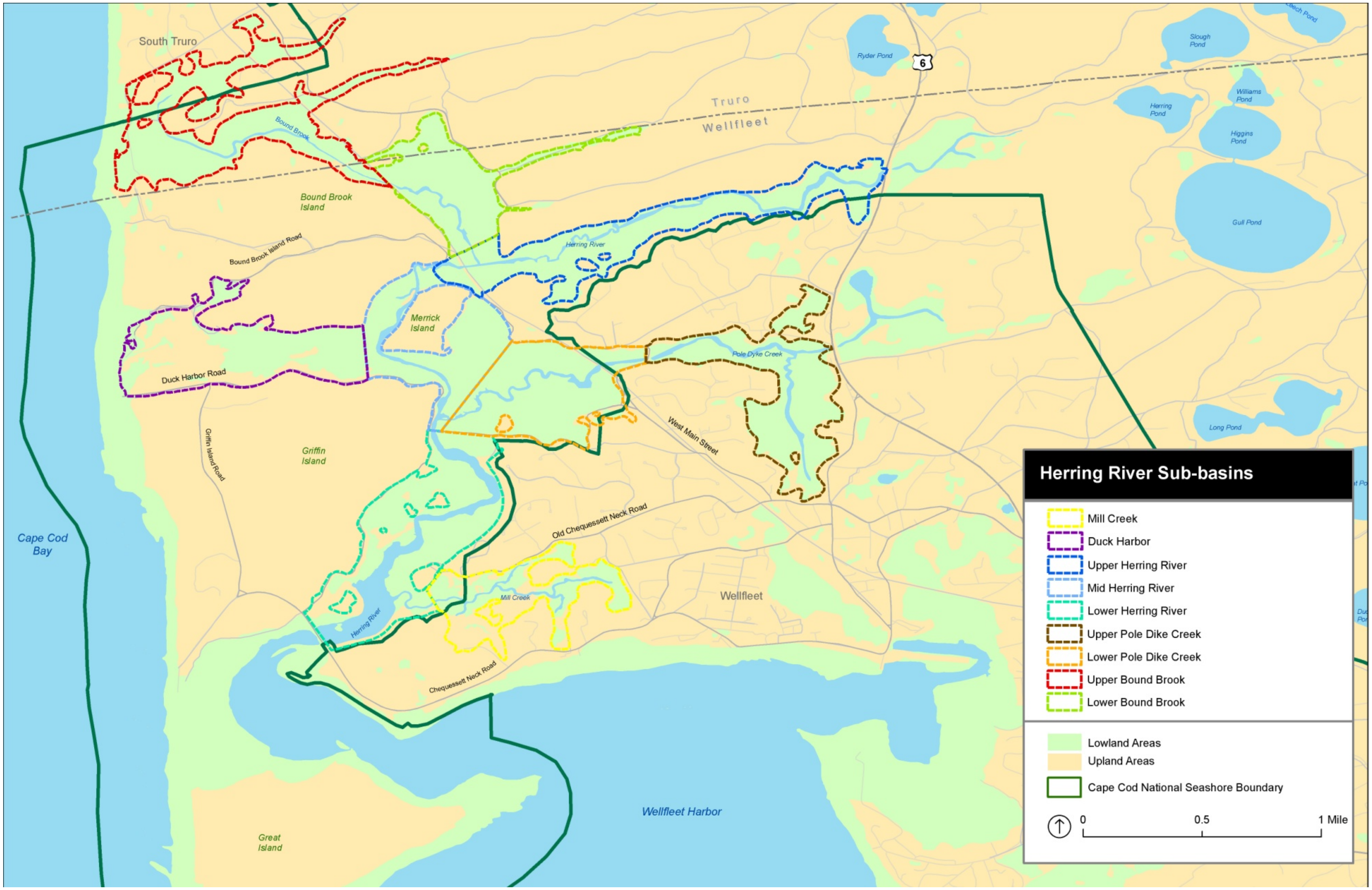
The geographic study area for this Statement of Findings is the Herring River estuary on Massachusetts' Cape Cod. The majority of the river's flood plain (approximately 80 percent) is within the boundary of Cape Cod National Seashore. The river itself extends from Wellfleet Harbor northeast for just under four miles to Herring Pond in north Wellfleet. The river system, generally defined by the landward limit of the historic flood plain of the river and its tributaries, encompasses approximately 1,100 acres.

In addition to the Herring River's upper, middle, and lower basins, the restoration project area is composed of important stream sub-basins (table 1 and figure 4). Each basin is distinct physically, chemically, and biologically, because of its elevation and distance from the Herring River and Wellfleet Harbor. Therefore, tidal restoration will influence each basin to a different degree.

**TABLE 1. DESCRIPTION OF SUB-BASINS WITHIN HERRING RIVER RESTORATION AREA**

| Sub-Basin Name | Location and Acreage | Current Vegetation Type(s) |
|---|---|---|
| **Herring River Basin** | Approximately 396 acres are divided into three separate hydrologic units: Lower Herring River, Mid Herring River, and Upper Herring River. | The only remaining salt marsh in the Herring River system, approximately seven acres in size, is located just upstream of the dike in the Lower Herring River. The remaining sub-basin is dominated by non-native common reed (*Phragmites australis*) and freshwater wetland and upland species. |
| **Mill Creek** | This 80-acre sub-basin forms the southeastern portion of the project area, lying just upstream and east of the Chequessett Neck Road Dike. | *Phragmites* marsh and disturbed wooded wetland habitat cover much of the Mill Creek sub-basin. In the 100 years since the Herring River Dike was constructed, the CYCC and several private residences have been developed in the Mill Creek flood plain. |
| **Pole Dike Creek** | This sub-basin forms the east central portion of the project area, encompasses approximately 288 acres, and consists of two hydrologic units: Lower Pole Dike Creek and Upper Pole Dike Creek. | The sub-basin is dominated by mixed freshwater marsh. Private properties have been more intensely developed around the Upper Pole Dike Creek wetlands than in other Herring River sub-basins. |
| **Duck Harbor** | This 131-acre sub-basin basin extends west from the main stem of the Herring River to the Duck Harbor barrier beach.<br>Today, Duck Harbor is separated from Cape Cod Bay by a vegetated duneline. Historic maps show a tidal channel connecting it to the bay as recently as 1848 (Tyler 1922). | Dry deciduous woodlands are typical in the eastern portion, while freshwater wetland shrubs dominate in the lower, wetter, western portion, except where the basin rises up to the barrier beach. |

| Sub-Basin Name | Location and Acreage | Current Vegetation Type(s) |
|---|---|---|
| **Bound Brook** | This 234-acre wetland extends to the north and west of Herring River above Old County Road. Consists of two hydrologic units: Lower Bound Brook and Upper Bound Brook.<br>Today, Bound Brook is separated from Cape Cod Bay by a vegetated duneline. In the past, Bound Brook Basin was likely an estuary with a tidal connection to Cape Cod Bay. | Due to generally low elevations, the peat has remained saturated, albeit fresh, and the dominant vegetation is wetland shrubs and cattail. |




Source: The Louis Berger Group, Inc., 2012.

**FIGURE 4: HERRING RIVER SUB-BASIN MAP**

## DESCRIPTION OF WETLANDS WITHIN THE PROJECT AREA

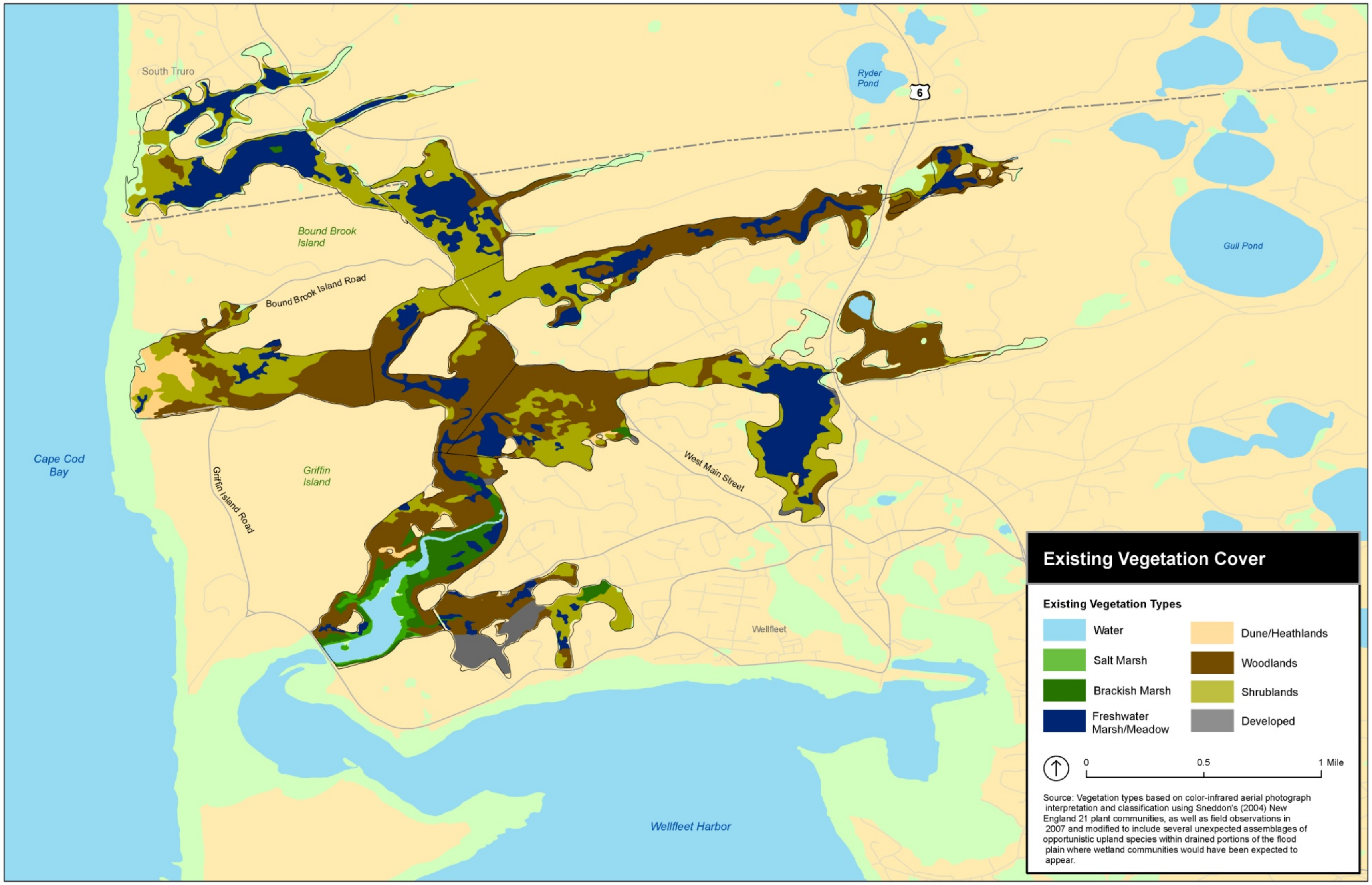
In order to achieve compliance with EO 11990, parks are directed to use the "Classification of Wetlands and Deepwater Habitats of the United States" (FWS/OBS-79/31; Cowardin et al. 1979) as the standard for defining, classifying, and inventorying wetlands. As a former extensive tidal marsh, the project area is currently comprised primarily of Palustrine (freshwater) wetlands with a smaller amount of remnant Estuarine (saltwater) in the lower sub-basins. Estuarine systems are those in which salinities during the period of average annual low flow exceeds 0.5 ppt (Cowardin et al. 1979). The project area also includes smaller areas of natural dune overwash onto former wetlands and developed areas (primarily golf course fairways on hydric soil).

Reduced salinity and marsh drainage have had a gradual but dramatic impact on the species composition of the Herring River salt marsh plant communities. Salt marsh plants, including salt marsh cordgrass (*Spartina alterniflora*), salt meadow cordgrass (*S. patens*), and salt meadow rush (*Juncus gerardii*) were denied their competitive edge over freshwater wetland species, such as cattail (*Typha* spp.). Cattail-dominated plant communities gradually replaced salt marsh vegetation. By the 1960s, continued drainage allowed upland grasses, forbs, and trees to replace cattails (Portnoy and Soukup 1982). Black cherry (*Prunus serotina*) and pitch pine (*Pinus rigida*) are now dominant in areas that were once naturally occurring salt marsh habitats. By the 1970s, much of the original Herring River was forest and shrublands dominated by opportunistic upland species (Portnoy and Soukup 1982). Concurrently, large portions of the original sub-tidal and intertidal substrates between the dike and High Toss Road had converted to monotypic stands of common reed (*Phragmites australis*).

No formal wetland delineation has been undertaken for the project area. However, the Seashore has vegetation cover type mapping for the project area. Table 2 and Figure 5 summarize existing vegetation types and classifications in the Herring River restoration area.

**TABLE 2: EXISTING VEGETATION COVER TYPES WITHIN THE HERRING RIVER FLOOD PLAIN**

| Existing Cover Type | Existing Acreage | Cowardin Classification |
|---|---|---|
| Salt Marsh | 13 | E2EM1 |
| Brackish Marsh | 40 | E2EM1 |
| Freshwater Marsh/Meadow | 222 | PEM |
| Shrublands | 299 | PSS |
| Woodlands | 403 | PFO |
| Dune/Heathland | 20 | Upland |
| Developed | 21 | PEM |
| **Total Area** | **1,018-** | |




Source: The Louis Berger Group, Inc., 2012.

**FIGURE 5: CURRENT VEGETATION COMMUNITIES IN THE HERRING RIVER FLOOD PLAIN**

### *Wetland Functional Assessment*

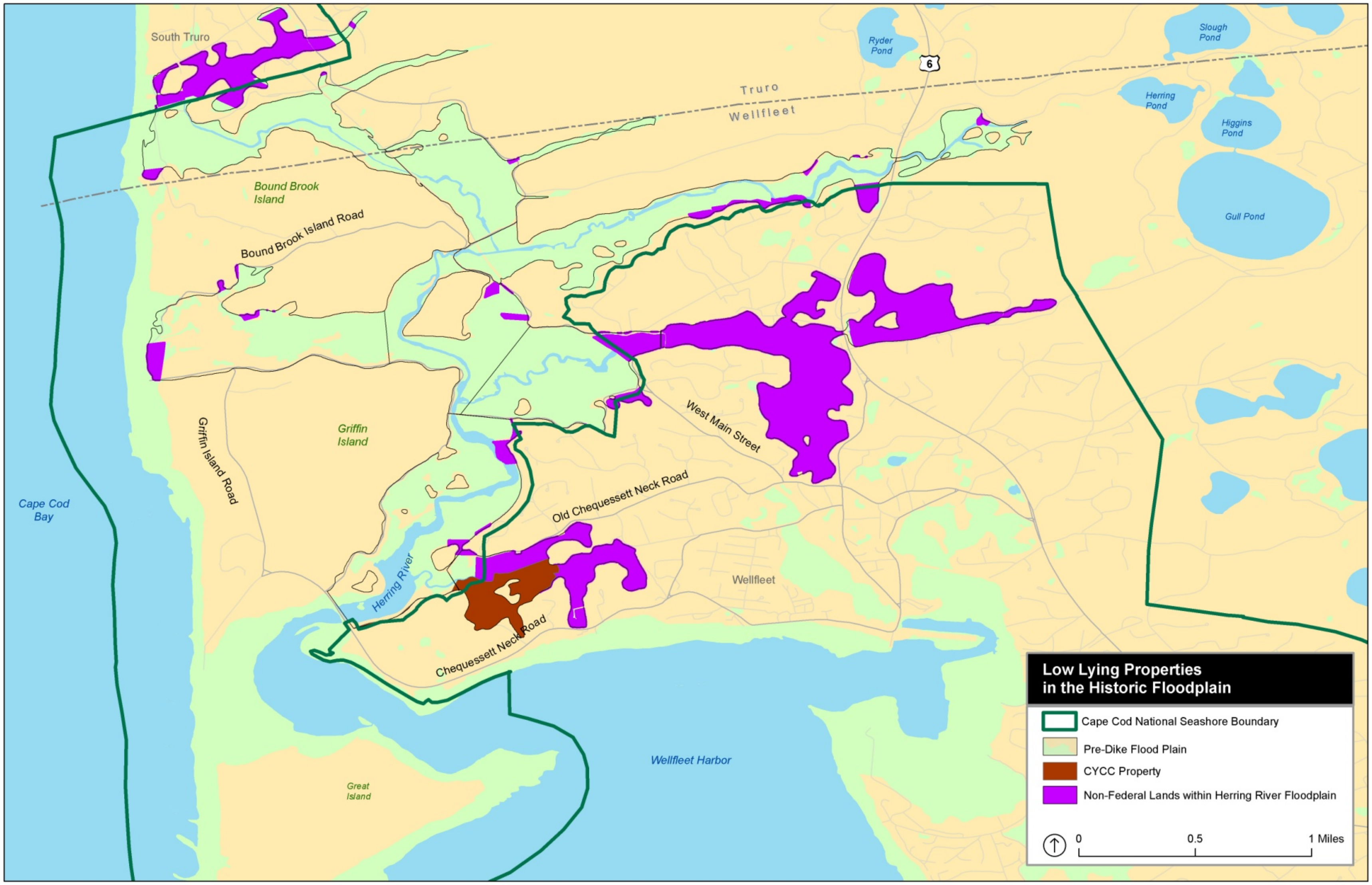
The United States Army Corps of Engineers (USACE) New England Division method for assessing wetland functions and values (The Highway Methodology Workbook Supplement, Wetland Functions and Values - a Descriptive Approach, USACE NED, 1999) considers many wetland functions and values as part of a Section 404 permit application. A functional assessment of the Herring River wetland complex up gradient of the Chequessett Neck Road Dike was conducted. A comparison of wetland functions and values under current conditions and following restoration implementation is provided under the impacts section.

## DESCRIPTION OF FLOOD PLAINS WITHIN THE PROJECT AREA

The presence of the Chequessett Neck Road Dike has dramatically reduced flood plain functions in the project area. While the normal tidal range in Wellfleet Harbor just seaward of the dike is nine feet, the existing tidal range in the Herring River above the dike is only about two feet. As a result, seawater only reaches approximately 3,000 feet upstream of the dike. As a result, the project area has not been exposed to extreme high water events generally associated with northeaster (cold center cyclones) winter storms or other flood events as it would have been in a dike-free condition.

By eliminating flooding, the diking and drainage of the Herring River flood plain has allowed land uses and development of the former salt marsh and adjacent areas which would not be permitted today without regulatory oversight. Several dozen of these properties could potentially be affected by restored tidal exchange to some degree. The largest of these is the CYCC. Most of the other potentially affected properties are residential parcels within the Mill Creek and Upper Pole Dike Creek sub-basins.

A number of properties lie in the historic Herring River flood plain and may be affected by higher tide levels resulting from the restoration project. The area of the historic flood plain is approximately 1,100 acres. A total of 368 properties lie partially or fully within Herring River flood plain. These properties include private and municipal parcels; parcels owned by non-profit organizations; non-federal conservation land parcels; residential and commercial parcels (Town of Wellfleet 2009). In total, these parcels cover approximately 354 acres of land within the Herring River flood plain. Figure 6 identifies both NPS and non-NPS parcels within the flood plain.




Source: The Louis Berger Group, Inc., 2012.

**FIGURE 6: LOW-LYING PROPERTIES IN THE HISTORIC HERRING RIVER FLOOD PLAIN**

## USE OF HYDRODYNAMIC MODELING TO DESCRIBE EXISTING CONDITIONS AND EXPECTED CHANGES

The Woods Hole Group developed a hydrodynamic model simulating the complexities of the Herring River system (WHG 2012). The model allows for the evaluation of specific questions regarding potential change to surface water elevations, flow velocities, salinity changes, and sediment processes in the estuary. Specifically, the numerical modeling has been used to evaluate the goals of the proposed project. Some of the modeling objectives include:

- Prediction of restored water surface elevations and salinities;
- Estimation of hydroperiod and wetting/drying of marsh surfaces;
- Assessment of potential change in the velocities and sedimentation patterns in the project area; and
- Assessment of impacts to low-lying properties and infrastructure.

Information regarding and results of the modeling process can be found in appendix C to the draft EIS/EIR (WHG 2012).

## RANGE OF ALTERNATIVES ANALYZED

### *Alternative A: No Action – Retain Existing Tidal Control Structure at Chequessett Neck*

Under alternative A, no action means that the existing 18-foot-wide structure composed of two flap gates and an adjustable tide gate would remain in place (shown in figure 2). Although no physical changes would be made, it is important to emphasize that "no action" is not a steady state. Physical factors acting on the dike will continue and the tide gates will entail maintenance costs during the next several years. Additionally, ecological conditions with the Herring River would continue to be affected by tidal restriction.

### *Alternative B: New Tidal Control Structure at Chequessett Neck – No Dike at Mill Creek*

Under Alternative B, a 165-foot-wide series of culverts would be installed in the Chequessett Neck Road Dike to allow passage of Wellfleet Harbor tides (common to all action alternatives). The tide gates would be opened gradually and according to guidelines set forth in the Adaptive management plan with an objective to ultimately reach a mean high spring tide of 4.8[1] feet and 100-year storm driven tide of 6.0 feet in the Lower Herring River. These elevations reflect the maximum restoration possible without installing a secondary tidal control structure at Mill Creek and are based on the feasibility of addressing flood impacts within the Mill Creek sub-basin. Hydrodynamic modeling has demonstrated that a vertical tide gate opening of approximately three feet across the 165-foot culvert structure would result in this tidal regime. Tides in the upstream sub-basins would be lower because of natural tide attenuation.

This alternative would not require the construction of a dike at Mill Creek. Flood-proofing actions undertaken for the CYCC golf course and other low-lying properties would be designed to accommodate

[1] All tidal elevations cited are referenced to the North American Vertical Datum of 1988 (NAVD88), which in Wellfleet Harbor is approximately 0.3 feet above mean sea level and 5.2 feet above mean low water.

100-year storm driven tidal flooding up to 5.9 feet within the Mill Creek sub-basin and 5.3 feet in the Upper Pole Dike Creek sub-basin. The exact final maximum high tide elevations would be determined through the adaptive management process, but would not exceed these elevations.

Alternative B would also forego the ability to pursue higher inundation levels in the estuary as part of an adaptive management process. This would limit both horizontal effects (restored acreage) and vertical effects (restored elevation of the salt marsh surface) of tidal restoration.

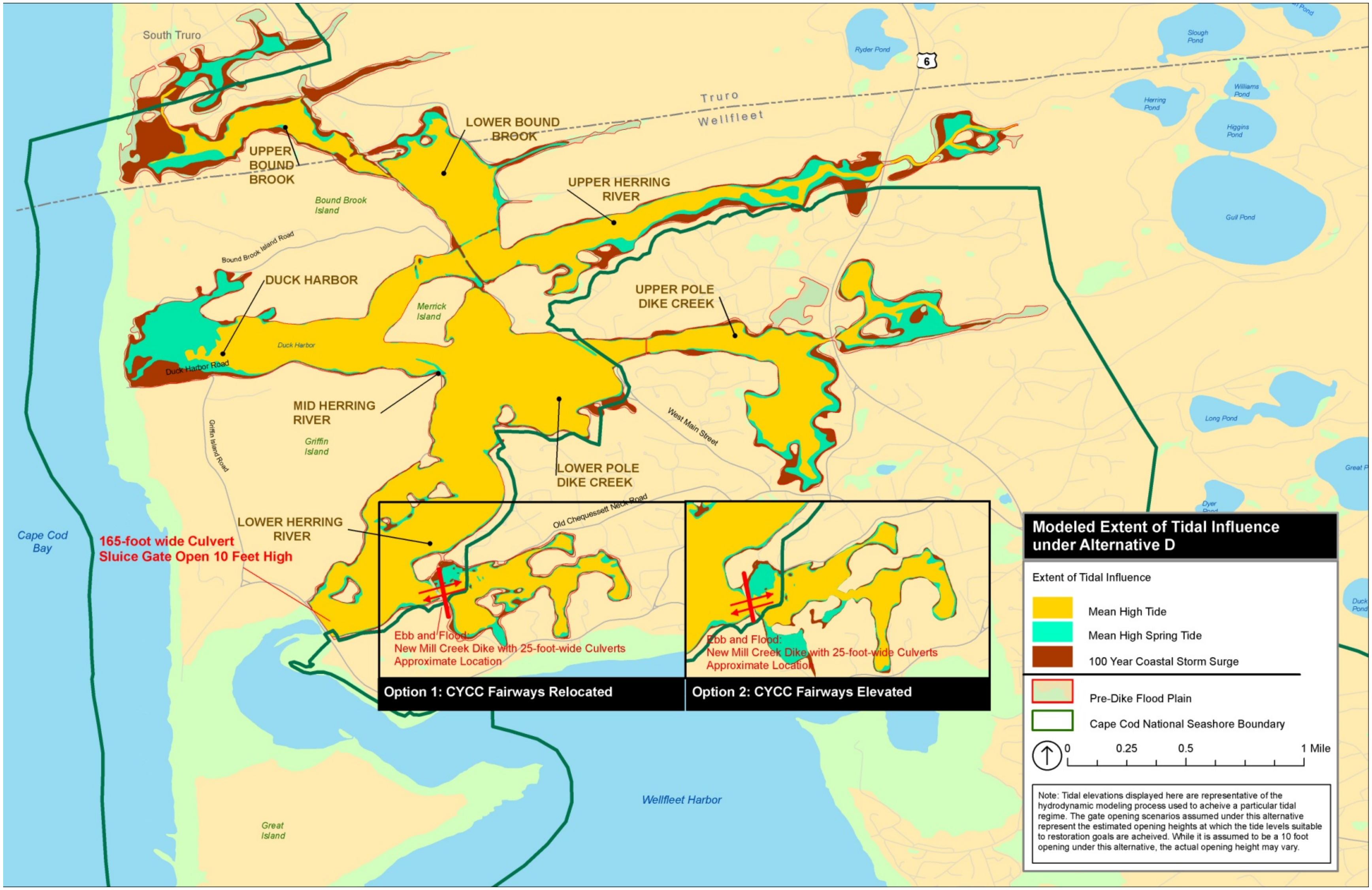
### *Alternative C: New Tidal Control Structure at Chequessett Neck – Dike at Mill Creek that Excludes Tidal Flow*

Similar to the other action alternatives, tide gates at a rebuilt Chequessett Neck Road Dike would be opened gradually and in accordance to guidelines set forth in the Adaptive management plan. The objective for alternative C would be to fully open the gates to allow mean high water spring tides up to 5.6 feet and 100-year storm driven tides up to 7.5 feet in the Lower Herring River. These elevations reflect the maximum restoration feasible for most of the Herring River flood plain. A tidal exclusion dike would need to be constructed at the mouth of Mill Creek. Tides in the upstream sub-basins would be lower because of natural tide attenuation. Mitigation actions undertaken throughout the remainder of the Herring River estuary would be designed to accommodate flooding up to these maximum tidal elevations.

## PROPOSED ACTION

### *Alternative D, the Preferred Alternative: New Tidal Control Structure at Chequessett Neck – Dike at Mill Creek that Partially Restores Tidal Flow*

Tide elevations in the project area would reflect the maximum restoration possible for the majority of the Herring River flood plain (see table 3). The Chequessett Neck Road Dike would be reconstructed with a 165-foot tide gate opening that would be opened gradually and according to guidelines set forth in the adaptive management plan. The objective of alternative D is to fully open the gates to allow mean high water spring tides up to 5.6 feet and 100-year storm driven tides up to 7.5 feet in the Lower Herring River (see figure 7). Tides in the upstream sub-basins would be lower because of natural tide attenuation. With the exception of Mill Creek, mitigation measures undertaken throughout the estuary would be designed to accommodate flooding up to these maximum tidal elevations. Two options are possible under alternative D; Mill Creek option 1 would relocate portions of multiple low-lying golf holes to upland areas currently owned by the CYCC or, Mill Creek option 2 which would elevate the affected areas in place by filling and regrading. A new dike at the mouth of Mill Creek would be constructed to partially restore tidal flow to the sub-basin. Tidal flows would be *controlled* at this location using a combination tide gate to ensure mean high water spring tides to a maximum of 4.7 feet and 100-year storm driven events to a maximum of 5.9 feet in Mill Creek. Flood-proofing measures would be required for Mill Creek (e.g., golf course and private dwelling flood-proofing and well relocation). Alternative D, with Mill Creek option 2, which elevates the fairways and practice area at the CYCC, is the preferred alternative.




Source: The Louis Berger Group, Inc., 2012.

**FIGURE 7. EXTENT OF TIDAL INUNDATION UNDER THE PREFERRED ALTERNATIVE FOR RESTORATION OF THE HERRING RIVER FLOOD PLAIN**

## *Incremental Tidal Restoration and Adaptive Management*

Reintroduction of tidal exchange would occur in phases over several years. Gradual opening of adjustable sluice gates would incrementally increase the tidal range and allow for monitoring so that unexpected and/or undesirable responses could be detected and appropriate response actions taken. Details of this process are described in appendix A.

The increased tidal exchange between the Herring River estuary and Wellfleet Harbor would change many characteristics of the flood plain. One of the most noticeable and desirable changes would be to the composition of plant communities. There would be a transition from one set of plant community types to another as changes occur to environmental parameters, such as tidal inundation, tide frequency, soil saturation, and most notably salinity. Management of flood plain vegetation would have the following objectives:

- Encourage re-establishment of *Spartina*-dominant marsh;
- Remove woody debris that might impede fish passage; and
- Remove large trees that will eventually die, topple and leave holes on the wetland surface where mosquitoes might breed.

Vegetation management activities would consist of cutting of the vegetation and processing and removal of the biomass that has been cut. Cutting would be accomplished with tools such as hand-held loppers, chain saws, mowers, brush hogs, or larger, wheeled or treaded machines that cut and chip. Removal would be accomplished by the sale of cut hardwood, removal of wood chips, and burning brush and branches.

## *Low-lying Roads and Culverts*

Several segments of Pole Dike, Bound Brook Island, and Old County Roads where they cross the main Herring River and tributary streams are vulnerable to high tide flooding under the proposed restoration (ENSR 2007). To prevent this, road surfaces and culverts would need to be elevated or relocated. Preliminary engineering analysis shows that approximately 8,000 linear feet of road should be elevated to a minimum grade of 5.5 feet. Elevating these roads would also require widening the road bases and increasing culvert sizes. A second option for these road segments would be to relocate the alignment onto a nearby former railroad right-of-way. Preliminary engineering analysis shows this to be feasible with lower costs. Additional engineering studies and traffic analyses are needed to fully evaluate both of these options (CLE 2011).

## *Restoration of Tidal Channel and Marsh Surface Elevation*

Several actions would be necessary to reverse other alterations of the system's topography, bathymetry, and drainage capacity. Diking and drainage have caused subsidence of the former salt marsh by up to three feet, reaches of the river have been channelized and straightened, mosquito ditches have been created, and spoil berms have been left along creek banks (HRTC 2007). These factors could limit or delay progress toward meeting the project objectives by inhibiting circulation of salt water, preventing recolonization of salt marsh vegetation, ponding fresh water, and expanding nuisance mosquito breeding habitat.

Several supplementary habitat management actions would be considered to address these issues. These actions and the conditions under which they would be employed are described and analyzed in detail in appendix A. In summary, potential actions include but are not limited to:

- Dredging of accumulated sediment to establish a natural bottom of the Herring River channel at the appropriate depth to maximize ebb tide drainage;

- Creation of small channels and ditches to improve tidal circulation;
- Restoring natural channel sinuosity;
- Removing lateral ditch dredge spoil berms and other anthropogenic material on the marsh surface to facilitate drainage of ponded water; and
- Applying a thin layer of dredged material to build up subsided marsh surfaces.

# IMPACTS TO WETLANDS

## *Long-Term Impacts to Wetland Habitat and Vegetation*

Restoration of the Herring River flood plain would result in the widespread change from degraded primarily freshwater (Palustrine) wetlands to Estuarine sub-tidal and inter-tidal habitats. Restored inter-tidal habitat subjected to higher salinity waters, generally 18 parts per thousand and higher, is expected to transition to salt marsh (E2EM1). However, lower salinities would likely occur on the periphery of the project area and in the upper reaches of many sub-basins where brackish (also E2EM1) and freshwater plants (Palustrine marsh, shrub swamp and forested wetland) are expected to persist. While changes in higher salinity areas are relatively clear and predictable, vegetation changes in restored inter-tidal areas with lower salinity are less certain and difficult to quantify.

To evaluate the changes in vegetation resulting from each of the action alternatives, the modeled areal extent of the mean high water spring tide was used to estimate the total area of restored inter-tidal habitat. The area of existing vegetation cover types affected up to the mean high water spring tide line for each alternative are summarized in table 3. In addition, a relatively small area of wetland-to-upland transitional habitat along the periphery of the mean high water spring tide line would be affected by AHW (the highest tide within a given year). Some vegetation change would be expected in these areas depending on the species present and the exact frequency and duration of tidal influence. The area encompassing the predicted limits of the mean high water spring tide line is greatest for alternative D option 1 (approximately 84 percent). This decreases to approximately 75 percent under alternative B option 2.

**TABLE 3: AREA OF EXISTING WETLAND HABITAT AND VEGETATION COVER TYPES AFFECTED BY MEAN HIGH WATER SPRING TIDE FOR EACH ACTION ALTERNATIVE**

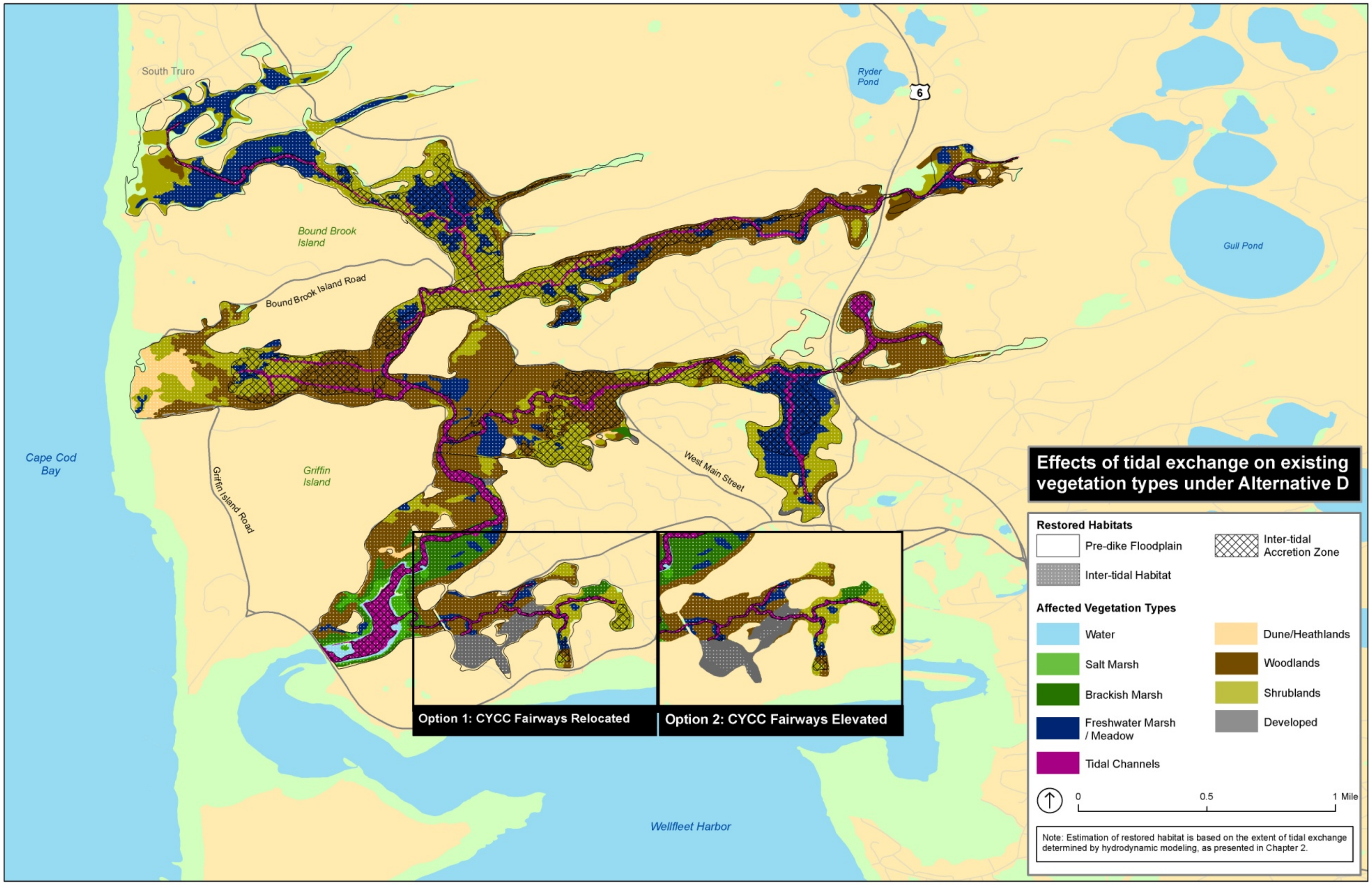
| Existing Cover Type | Existing Acreage | Estimated Acreage | | | | |
|---|---|---|---|---|---|---|
| | | Alt B Option 1 | Alt B Option 2 | Alt C | Alt D Option 1 | Alt D Option 2 |
| Open Water | 29 | 29 | 29 | 29 | 29 | 29 |
| Salt Marsh | 13 | 13 | 13 | 13 | 13 | 13 |
| Brackish Marsh | 40 | 39 | 39 | 37 | 40 | 40 |
| Freshwater Marsh/ Meadow | 222 | 176 | 178 | 189 | 194 | 196 |
| Shrublands | 299 | 203 | 204 | 217 | 231 | 232 |
| Woodlands | 403 | 314 | 314 | 321 | 342 | 342 |
| Dune/ Heathland | 20 | 6 | 6 | 14 | 14 | 14 |
| Developed | 21 | 17 | 7 | 0 | 17 | 7 |
| Total Area | 1047 | 797 | 790 | 820 | 880 | 873 |

[1] The extent of vegetation changes within sub-basins with limited tidal frequency and duration and lower salinities are less certain and difficult to quantify.

The majority of the project-wide restoration of inter-tidal habitat would occur within freshwater marsh/meadow, shrublands and woodlands. Approximately 79 to 88 percent of the existing 222 acres of freshwater marsh/meadow, 68 to 78 percent of the existing 299 acres of shrublands, and 78 to 85 percent of the existing 403 acres of woodlands would be encompassed by the predicted mean high water spring tide line. Lesser amounts of tidal habitat restoration would occur within brackish marsh, dune/heathlands, and developed lands. An increase in amount of developed lands encompassed by the predicted mean high water spring tide line from seven acres for alternative D, option 2 (elevation) to 17 acres for alternative D, option 1 (relocation) is primarily the result of the proposed raising of low-lying portions of the CYCC golf course with the preferred alternative. Habitat conditions would improve within the existing 42 acres of salt marsh or open water within the Lower Herring River sub-basin.

Under all of the action alternatives, there would be extensive vegetation change within the lower Herring River sub-basins. Over the long term, mean high spring tides with relatively high salinity levels would affect the existing freshwater and brackish marsh, woodland, and shrubland plant communities that have replaced the historic salt marsh habitats (see figure 7). This area would largely be restored to low and high salt marsh vegetative communities but would also include sub-tidal and inter-tidal channel habitats. The lowest of these areas would lie below mean low water if the current topography remains unchanged. However, sediment transport modeling indicates that these severely subsided areas are expected to receive large volumes of sediment as higher tides are incrementally restored. In the long term, these areas are anticipated to accrete and support salt marsh vegetation as the marsh surface reaches equilibrium with a restored tidal regime. A smaller portion of transitional habitat along the periphery of the sub-basins would be affected by annual high water. Some vegetation change would be expected in these areas depending on the species present and the exact frequency and duration of tidal influence.

Vegetation changes in the upper sub-basins would be limited in comparison to the lower sub-basins. Although most of these areas are thought to have been historically dominated by salt marsh vegetation, the relatively low mean high spring tidal elevations achieved by all the alternatives would not allow salt water to regularly propagate into these basins and salinity levels within both the channel and on the marsh surface are predicted to remain low (see figure 7). Although no salt marsh or brackish species likely would colonize the marsh surface under these conditions, pulses of tidally forced freshwater would favor the displacement of upland woodland species with vegetation more characteristic of a Palustrine wetland. The transitional habitat (extending up to annual high water) along the periphery of these upper basins would be expected to experience less habitat change as compared to the lower basins. Figure 8 and Table 4 summarize the anticipated wetland changes based upon the predicted extent of Mean High Water Spring.




Source: The Louis Berger Group, Inc., 2012.

**FIGURE 8: RESTORED INTERTIDAL HABITAT COMPARED TO CURRENT VEGETATION COMMUNITIES IN THE HERRING RIVER FLOOD PLAIN**

### TABLE 4: ANTICIPATED VEGETATION CHANGE BY HERRING RIVER SUB-BASIN

| Sub-basin | Summary of Vegetation Change | Summary of Changes in Wetland Type |
|---|---|---|
| Lower Herring River | There would be extensive vegetation change within the Lower Herring River sub-basin. Over the long term, tidal waters with salinity levels consistently in the mid-20s and higher would affect existing freshwater and brackish marsh (much of this area is dominated by Phragmites), woodland, and shrubland plant communities, which would be replaced by low and high salt marsh communities. | 149 to 154 of the 162 acres in this sub-basin would transition to tidal marsh (E2EM1) over the long term. |
| Mill Creek | Salinity levels would consistently reach the mid-20s ppt and low and high salt marsh vegetation would eventually replace existing brackish marsh, freshwater marsh, shrubland, and woodland. | 53 to 60 of the 72 acres in this sub-basin would transition to salt marsh (E2EM1) over the long term, depending on the flood mitigation strategy employed at the CYCC golf course. Alternative C would not impact existing vegetation within this subbasin. |
| Mid Herring River | Within the Mid Herring River sub-basin, vegetation changes would be significant under any of the action alternatives. Most of the change would occur within existing woodlands. Salinity levels would reach the mid-20 ppt range in, and within close proximity to, tidal channels, where existing woodlands and, to a lesser degree, shrublands and freshwater marsh, would be restored to low and high salt marsh. | 85 to 87 of the 89 acres in this sub-basin would transition to salt marsh (E2EM1) over the long term. |
| Upper Herring River | Vegetation changes in the Upper Herring River would be limited compared to the lower sub-basins. Salinity levels in tidal channels could reach as high as 17 ppt and 14 ppt in portions of the marsh surface. Generally, higher salinities would occur closer to the channels and diminish landward. Uncertainty about salinity modeling in the upper sub-basins makes specific projections about vegetation change difficult. | 104 to 113 of the 147 acres in this sub-basin would transition to salt marsh (E2EM1) over the long term. |
| Duck Harbor | Within the Duck Harbor sub-basin, vegetation changes would be extensive. Most of the change would occur within existing shrublands and woodlands. Salinity levels would reach the mid 20-ppt range in and within close proximity to tidal channels, where existing vegetated habitats would be restored to low and high salt marsh. | 81 to 107 of the 129 acres in this sub-basin would transition to salt marsh (E2EM1) over the long term. |
| Lower Pole Dike Creek | There would be extensive vegetation change within the Lower Pole Dike Creek sub-basin. Over the long term, tidal waters with salinity levels consistently in the mid-20s and higher would affect existing freshwater marsh, woodland, and shrubland communities, which would be replaced by low and high salt marsh communities. | 104 to 105 of the 109 acres in this sub-basin would transition to salt marsh (E2EM1) over the long term. |

**TABLE 4: ANTICIPATED VEGETATION CHANGE BY HERRING RIVER SUB-BASIN**

| Sub-basin | Summary of Vegetation Change | Summary of Changes in Wetland Type |
|---|---|---|
| Upper Pole Dike Creek | Vegetation changes in the Upper Pole Dike Creek sub-basin would be limited compared to the lower sub-basins. Salinity levels in tidal channels could reach as high as 12 ppt and 20 ppt in portions of the marsh surface. Uncertainty about salinity modeling in these upper sub-basins make specific projections about vegetation change difficult Generally, the salinity levels predicted by the model would not be high enough or occur consistently enough to support extensive salt marsh plant communities, although some salt marsh plants could appear proximate to the channels or portions of the marsh surface. | 108 to 125 of the 146 acres in this sub-basin would transition to (E2EM1) salt marsh over the long term. |
| Lower Bound Brook | Within the Lower Bound Brook sub-basin, vegetation changes would be extensive under any of the action alternatives. Most of the change would occur within existing shrublands. Salinity levels would reach the mid 20-ppt range in and within close proximity to tidal channels, where existing shrublands and, to a lesser degree, woodlands and freshwater marsh, would be restored to low and high salt marsh. | 67 to 71 of the 80 acres in this sub-basin would transition to (E2EM1) salt marsh over the long term. |
| Upper Bound Brook | Vegetation changes in the Upper Bound Brook would be limited compared to the lower sub-basins. Salinity levels in tidal channels could reach as high as 15 ppt. Uncertainty about salinity modeling in these upper sub-basins make specific projections about vegetation change difficult. Generally, the salinity levels predicted by the model would not be high enough or occur consistently enough to support extensive salt marsh plant communities, although some salt marsh plants could appear adjacent to and in close proximity of the channels. | 39 to 56 of the 113 acres in this sub-basin would transition to (E2EM1) salt marsh over the long term. |

## *Potential Changes in the Distribution of Phragmites*

Intermediate salinity levels, between approximately five ppt and 18 ppt, could make some areas suitable for non-native common reed (*Phragmites australis*), particularly in the Bound Brook and the Upper Herring River sub-basins. Herbicide application would likely be used to reduce coverage of Phragmites prior to tidal restoration. As tidal exchange is restored, monitoring would be conducted to track vegetation change throughout the system. If Phragmites is observed to be expanding its range or colonizing new areas, management actions, including herbicide application, mechanical control, or hydrological (increased inundation and salinity) alterations could be implemented to limit or control its spread.

## *Woody Vegetation on the Flood Plain*

Mortality of approximately 700 acres of shrubland/woodland vegetation is anticipated. Large volumes of standing dead and fallen woody debris may be undesirable because it could obstruct formation of tidal channels and delay the establishment of marsh grasses by decreasing seed dispersal and germination. Options for woody vegetation management include removal through cutting, chipping, and/or burning as well as processing the cut biomass (harvest for firewood or wood chips and burning brush and branches). A future vegetation management program would require the concurrence of landowners (both private and public) as well as regulatory agencies. The types of mechanized equipment allowed in the project area and time-of-year restrictions will be defined based on early findings of the adaptive management plan.

## *Impacts to Water and Sediment Quality*

Restored tidal flushing is expected to reduce acidification, nutrient and fecal coliform concentrations and increase levels of dissolved oxygen in much of the project area. Tidal inundation would decrease the rate of aerobic decomposition and acid production within the soil while the pH of porewater and surface water would increase (Portnoy and Giblin 1997a). With restored salinities, aluminum and iron could no longer be leached from the soil in concentrations that stress aquatic life.

Tidewater residence times upstream of High Toss Road would be reduced by at least a factor of 25 (from 4,801 hours under current conditions to 191 hours after restoration flows are established) (see table 5). Regular tidal flushing of the Herring River estuary with well-oxygenated water from Wellfleet Harbor is expected to maintain dissolved oxygen concentrations above state water quality standards at all times. Adequate dissolved oxygen concentrations are expected to benefit migratory diadromous fish as well as resident fish and invertebrates.

**TABLE 5: MODEL CALCULATED SYSTEM RESIDENCE TIMES* OF THE HERRING RIVER ESTUARY**

| Basin /Sub-basin | Alternatives | Residence Time (hrs) | Improved Flushing over Existing Conditions |
|---|---|---|---|
| Mill Creek with Wellfleet Harbor | No Action | 12,553 | |
| | D** | 424 | 97% |
| Sub-Basins above High Toss Road with Wellfleet Harbor | No Action | 4,801 | |
| | D** | 144 | 97% |

Source; Woods Hole Group, 2011.

* System residence time is a measure of tidal exchange from a given sub-basin with Wellfleet Harbor

** Residence Times are identical for alternatives C and D; however, alternative C does not include tidal flushing in Mill Creek which would result in change from existing conditions.

During restoration, a tidal channel system would likely be re-established. Sediment would be mobilized in response to the increased volume of tidal exchange. Mobilized sediment is expected to mostly be transported upgradient onto the marsh surface and partially downgradient toward Wellfleet Harbor. Potential impacts on the aquatic ecosystem from chemicals bound to mobilized sediments will be assessed once background levels of pesticide have been determined by ongoing efforts of the Seashore.

Fecal coliform concentrations would be substantially reduced. Flushing rates would be increased (residence time would be decreased) (see table 5). Additionally, the survival time of fecal coliform bacteria would be reduced by higher salinity (e.g., Bordalo et al. 2002) as well as by higher dissolved oxygen and lower water temperature. Greatly reduced fecal coliform concentrations within Herring River and Wellfleet Harbor would likely allow for the removal of the river from the 303(d) list for impairment of pathogens increasing the potential for additional areas of shellfish beds to be reopened for harvesting.

# IMPACTS TO WETLAND FUNCTIONS AND VALUES

As mentioned above, the USACE New England Division method for assessing wetland functions and values considers eight wetland functions and five wetland values.  A comparison of the functions and vales provided by the Herring River wetland complex up gradient of the Chequessett Neck Road Dike is discussed below.

## *Floodflow Alteration (Storage/Desynchronization)*

Wetlands can be important in the storage and desynchronization of floodwaters, protecting downstream resources from flood damage. Wetlands high in the watershed with constricted outlets or closed basins are generally important in capturing and detaining floodwaters. Other wetland characteristics that contribute to flood storage and desynchronization include broad flood plains and plant communities consisting of low, dense vegetation. Under existing conditions, broad, relatively flat local topography, large size, presence of ponded water, contiguous/branched channels, well vegetated flood plains, and numerous constricted outlets all contribute to the wetland complex's ability to retain floodwaters higher in the watershed. These physical characteristics would remain relatively unchanged under the action alternatives.

During coastal flooding events, any newly constructed dikes would continue to provide flood protection by meeting the Federal Emergency Management Agency's (FEMA) and other applicable agency requirements for construction and height (including necessary freeboard). As a result, the project area would be protected from extreme coastal floods. However with increased regular tidal exchange comes the opportunity to provide this function during some lesser storm events.

## *Fish and Shellfish Habitat (Aquatic Diversity / Abundance)*

Large wetlands contiguous to a large, perennial stream or waterbody capable of supporting large fish and/or shellfish populations are important in providing Aquatic Diversity/Abundance. There are several factors that affect this function under existing conditions including water quality impairments and numerous barriers which limit fish movement. The restored estuarine waters and salt marsh would provide substantially more spawning and nursery habitat for both resident and transient fish species as well as for estuarine macroinvertebrates, greatly increasing their abundance and use of the estuary over existing conditions. The new dike at Chequessett Neck Road would provide improved fish passage for all fish including anadromous and catadromous species. Such changes coupled with improved water quality and access to the head waters of the river would likely enhance the river's herring run size and allow for the possible reintroduction of sea-run brook trout into the Herring River estuary. With increased salinity upstream of the dike, habitat for shellfish would also be enhanced.

## *Sediment / Toxicant Retention (Pollutant Attenuation)*

Typically wetland systems with permeable soils that detain storm and flood waters and promote percolation reduce runoff rates sufficiently to allow sediments and adsorbed toxicants to settle from the water column. Diffuse channels, deep pools, and dense low vegetation are wetland characteristics that may also contribute to this process by slowing water velocities. While these characteristics are generally present under existing conditions, the waters associated with the wetland system have a number of water quality impairments. As mentioned above, restored tidal flushing is expected to reduce acidification, reduce nutrient and fecal coliform concentrations, and increase levels of dissolved oxygen in much of the project area. Tidal inundation is also expected to decrease the rate of aerobic decomposition and acid production within the soil which in the past has led to fish kills attributed to high acidity and aluminum toxicity.

The long-term water and sediment quality changes resulting from tidal restoration in the Herring River are generally positive and integral to achieving the ecological objectives of the proposed project. However, several potentially adverse effects on water and sediment quality are possible and, as such, will be components of a long-term monitoring program. Components included in the long-term monitoring program include but are not limited to:

- Continued low dissolved oxygen concentrations – Summertime dissolved oxygen levels could remain low in ponded areas until a tidal channel system becomes established. Targeted excavation of silted-in channels could be used to increase circulation and promote low-tide drainage.
- Temporary excessive release of nutrients – Renewed tidal flushing of acid sulfate soils would allow ammonium-nitrogen to be released into receiving waters in the short term (Portnoy and Giblin 1997a). Gradual reintroduction of tidal exchange is expected to allow ammonium-nitrogen to be slowly released (Portnoy 1999). Increased nutrient concentrations would likely be short-lived. Wellfleet Harbor is open to Cape Cod Bay and well-flushed, limiting the potential effects of temporary increases in nutrient loading.
- Elevated fecal coliform concentrations – Elevated bacteria concentrations could persist in upstream reaches of the system, particularly after rainstorms. Increasing salinity and flushing will reduce bacteria survival time and density prior to discharge into Wellfleet Harbor. Fecal coliform will continue to be monitored during the restoration process, particularly after rainstorms.

## *Nutrient Removal / Retention / Transformation (Pollutant Attenuation)*

Wetlands can serve as a filter for the removal or detention of nutrients carried in surface water flows. Many wetland plants respond to high nutrient concentrations with accelerated uptake rates. Some nutrients are assimilated in plant material while others are trapped in organic sediments in wetlands by chemical, physical, and biotic actions. Typically wetlands designated as having nutrient removal functions are identified by the presence of large areas of open or ponded water with dense emergent vegetation, meandering streams with slow water velocities, and contiguous/branched channels. While these characteristics are generally present under existing conditions, the waters associated with the former Herring River estuary have a number of water quality impairments. Renewed tidal flushing of drained flood plain soils would allow nitrogen to be released into receiving waters in the short term. Over the long term, water and sediment quality changes resulting from tidal restoration in the Herring River are generally positive, integral to improving this wetland function, and the achievement of the ecological objectives of the proposed project.

## *Production Export (Nutrient)*

Production export is the production of organic material and its subsequent transport out of a wetland to downstream areas or to deeper waters within the basin. This organic material is then added to the food chain where it is eaten by fish and other aquatic organisms. Wetlands with dense vegetation dominated by non-persistent emergent vegetation are important in supplying downstream wetlands with organic material. Wetlands dominated by shallow marshes with a perennial stream flowing from them are most important in providing production export. Wetlands designated as having production export functions are classified by the presence of high densities and diversity of hydrophytic vegetation, abundant fish and wildlife, and downstream/downgradient evidence of export. Under existing conditions, the function of production export is limited by the Chequessett Neck Road Dike configuration.

## *Wildlife Habitat*

Factors that contribute to the provision of important wildlife habitat include large, undisturbed wetlands; the presence of shallow, permanent open water of good quality; proximity to undisturbed upland wildlife habitat; a high degree of interspersion of vegetation classes; a high degree of species and structural diversity within the vegetational community; high vegetation density; and the presence of wildlife food plants. Wetlands that are contiguous to other wetland areas may serve as travel or migratory corridors for wetland wildlife.

Even in its existing degraded state, the Herring River flood plain contains diverse habitats for a wide array of bird, mammal, reptile, and amphibian species. However, not undertaking the proposed project would result in the continued degradation of the Herring River estuary including continued encroachment of invasive plant species; loss of native plant communities and wildlife habitats; adverse impacts to water quality and associated effects to aquatic biota and associated water-dependent wildlife; and loss of natural wildlife habitat functions provided by the estuary.

Several high priority salt marsh- and tidal creek-dependent avian species are anticipated to benefit directly through restoration of nesting and/or foraging opportunities in the Herring River. Tidal restoration would also restore wetland and open-water habitats for resident and migratory waterfowl and shorebirds. Existing shrublands and woodlands dominated by upland vegetation, habitats widely used by generalist resident and migrating passerine species, would be reduced and replaced by tidally influenced brackish and freshwater marsh which would likely increase the amount and quality of habitat for wetland dependent avian species. Generalist populations would persist in the abundant uplands surrounding the project area and at the wetland/upland edge where some shrub thickets and relic tree stands would remain as suitable habitat after restoration.

Similarly, it is anticipated that adequate habitat elements (e.g., suitable food, cover, and den sites) would remain for most mammalian species as a result of tidal restoration. Initial restoration would result in gradual flooding of existing habitat and landward migration of many mammalian species. Affected species would likely readjust to the restored salt marsh system and shift their local range within and adjacent to the river and its flood plain. Eventual habitats for voles, mice, and other rodents would be dramatically expanded. As tidal restoration progresses, many mammals would continue to forage on the invertebrates, fish, and marsh vegetation and would continue to use surrounding wooded uplands for den sites and refugia. Increased tidal range and salinity coupled with restored marsh habitat may provide long-term benefits with improved water quality, more abundant and diverse prey species, and a more open, expansive habitat structure for mammals.

The Herring River flood plain also provides habitat for a variety of reptiles and amphibians such as snapping and spotted turtles and northern water snake. These species generally inhabit the freshwater areas upstream of High Toss Road but can also survive in brackish water and salt marsh habitats. Amphibians, such as green and wood frogs, Fowlers toad, and spotted salamander, generally are not present within high salinity portions of coastal environments and are more commonly found in the upper reaches of most sub-basins and in upland transitional habitats. Increases in tidal range and salinity associated with restoration may, in the short term, limit and disrupt reptile and amphibian breeding, foraging, and nesting in lower areas of the flood plain. However, these areas are less likely to be occupied initially and restoration will proceed at a gradual pace, allowing any affected populations to relocate to suitable habitat. In the long term, these populations are anticipated to shift and adjust their ranges with no significant declines in species diversity or abundance.

## *Uniqueness / Heritage / Listed Species*

The Uniqueness/Heritage function includes the consideration of science, the endangerment of the wetland, and the importance of the wetland in the context of its local and regional environment. The wetland may contain areas of archaeological, historical, or social significance or it may represent the last fragment of its wetland type in an urbanized or agricultural environment. The presence of relatively scarce wetland habitats or wetland species contributes to the Uniqueness/Heritage function provided by the wetland. Areas containing Estimated Habitats of Rare Wildlife (Estimated Habitat) or Priority Habitats of Rare Species (Priority Habitat) mapped by the Massachusetts Natural Heritage and Endangered Species Program (NHESP) and/or federally-protected species confer a higher value in this category.

The Herring River is the largest tidal river and estuary complex on the Outer Cape and for that reason alone it is considered to provide this function. The restoration project as a whole would substantially improve this function by returning this important coastal ecosystem to a self-sustaining estuarine flood plain. With regard to listed species habitat, the restoration of tidal flow would increase salinity and inundation, resulting in changes to vegetation and ultimately wildlife species and their habitats. Tidal marsh restoration would likely allow for the recolonization of the protected diamondback terrapin in the Herring River. Changes in vegetation types would reduce the value of the wetland system for species that rely on habitats that are less salt-tolerant protected species, such as the Northern harrier, eastern box turtle, and water willow stem borer.

Restoration of the Herring River estuary could impact pre-contact and post-contact archeological sites, primarily associated with construction activities, as well as any other ground-disturbing activities, including borrow or construction staging areas. Although there are no listed historic structures in the Herring River estuary, a dike was located across Mill Creek near the confluence with the Herring River likely as part of a historical gristmill. Some low-lying structures may need further evaluation for historic significance. The precise location and extent of effects to archaeological sites cannot be fully identified at this time, as the design process is still ongoing, and the locations of ground-disturbing activities are not yet finalized. As these locations and actions are identified, potential impacts to archaeological sites will be assessed and any effects would be resolved through implementation of the Programmatic Agreement under Section 106 of the National Historic Preservation Act of 1966.

## *Recreation (Consumptive / Non Consumptive)*

Wetlands designated as having recreational value are classified based on the suitability of the wetland and associated watercourses to provide opportunities such as hiking, canoeing, boating, fishing, and hunting, among others. Consumptive opportunities, such as fishing and hunting, consume or diminish the plants, animals, and/or other resources that are intrinsic to the wetland. Non consumptive opportunities do not diminish these resources of the wetland.

Numerous opportunities for public recreational activities, such as boating, fishing, and wildlife viewing, currently exist in the Herring River estuary. There are many recreational access points within the estuary, including parking areas, viewing locations, boat landings, and trailheads. Under the restoration project, this value would be enhanced through better access accommodations and improved habitat conditions. Both shellfishing and finfishing are important recreational activities throughout Wellfleet and outer Cape Cod and are an integral component of the region's natural and cultural history. Removal of the tidal restriction caused by the dike would dramatically improve habitat for the full range of fish species formerly found in the estuary and provide a corresponding improvement to the recreational fishery. Additionally, improvements to estuarine habitat and connectivity within Wellfleet Harbor would also improve the near shore fishery in Cape Cod Bay. The proposed project is anticipated to provide long-term benefits to shellfish populations and potentially provide increased opportunities for the harvesting of shellfish.

## LONG-TERM IMPACTS TO FLOOD PLAINS

Although the proposed project would restore much of the natural tidal exchange water levels in the Herring River flood plain, any newly constructed dikes would continue to provide flood protection by meeting FEMA and other applicable agency requirements for construction and height (including necessary freeboard). As a result, the project area would be protected from extreme floods. However, with increased regular tidal exchange comes an increase in inundation levels associated with unusual storms. Under the preferred alternative, a 100-year storm event would inundate up to an elevation of 7.5 feet in the Lower Herring River and 5.9 feet in the Mill Creek sub-basin. Water levels in the upstream sub-basins would be lower because of natural tide attenuation. Flood protection actions undertaken throughout the estuary would be designed to accommodate flooding up to these maximum tidal elevations.

### Chequessett Yacht and Country Club

All or portions of five CYCC fairways and the practice area would be impacted by tidal waters and require flood proofing. The preferred alternative would elevate the low lying golf holes and relocate the practice area to an upland site that would also serve as the borrow area for the fill needed to elevate the low-lying fairways. The current practice area would be restored to tidal wetland. This would result in filling 89,000 square feet (1.9 acres) that cannot be relocated due to its proximity to the clubhouse.

During flood proofing, use of the golf course would be interrupted, resulting in lost revenue to CYCC. After construction activities have been completed, the CYCC would have newer, improved golf holes, practice area, and appurtenances.

### Low-lying Residential Properties

Hydrodynamic modeling results, aerial photography, topographic and ground survey data, and property records were used to compile a list of private properties within the project area potentially affected by restoration activities. Of the 322 properties that may be contacted by elevated tidewaters, 169 would experience no affect; 145 would experience impacts to natural vegetation; 2 would experience impacts to cultivated landscapes; and 20 would experience structural impacts. Impacts to properties were categorized based on the frequency of tidal water reaching the property and the nature of the land or structures impacted, as summarized in table 6.

**TABLE 6: LOW LYING PROPERTIES AFFECTED BY RESTORATION OF THE HERRING RIVER**

| Impact Category | Number of Properties Affected | Description of Effect |
|---|---|---|
| No Affect | 169 | |
| Infrequent Effects on Natural Vegetation | 54 | Natural vegetation affected by tides, on average, one time per year or less frequently. Tidal influence would not be frequent enough to convert the vegetation type to salt or brackish marsh. |

| Impact Category | Number of Properties Affected | Description of Effect |
|---|---|---|
| Frequent Effects on Natural Vegetation | 8 | Natural vegetation affected by daily high tides or monthly high spring tides. This would stress and kill salt-intolerant species and convert the area to salt or brackish marsh. |
| Both Frequent and Infrequent Effects on Natural Vegetation | 83 | Parcels contain areas both above and below mean high spring tide. This would either temporarily or permanently stress salt-intolerant species to some extent. |
| Infrequent Effects on Cultivated Vegetation | 1 | Cultivated, landscaped vegetation affected, on average, one time per year or less frequently. Some species could be temporarily stressed, but would likely recover and persist. |
| Frequent Effects on Cultivated Vegetation | 0 | Cultivated, landscaped vegetation (affected by daily high tides or monthly high spring tides. This would occur frequently enough to stress and kill salt-intolerant species and convert the area to salt or brackish marsh. |
| Both Frequent and Infrequent Effects on Cultivated Vegetation | 1 | Parcels contain areas both above and below mean high spring tide. This would either temporarily or permanently stress salt-intolerant species to some extent. |
| Infrequent Effects on Structures | 9 | Buildings, driveways, private lanes, wells, and septic systems affected, on average, one time per year or less frequently. The potential for impacts would only occur during the highest predicted tide of the year or during coastal storm events. |
| Frequent Effects on Structures | 11 | Buildings, driveways, private lanes, wells, and septic systems affected, on average, by daily high tides or up to monthly high spring tides. |

The NPS and HRRC are working with individual landowners on a case-by-case basis to determine site-specific mitigation needs. However no specific measures have been identified at this time and therefore cannot be quantified. It is anticipated that some of these actions would include the construction of a small berm or wall to protect a specific residential parcel, adding fill to a low driveway or lawn, and relocating a well or septic system, among others. Implementation of any of these measures would occur with close consultation of the landowners and would be subject to the regulatory review strategy and the adaptive management plan.

## POTENTIAL SHORT-TERM ADVERSE IMPACTS TO WETLANDS AND FLOOD PLAINS

Implementation of the preferred alternative includes construction of two dikes to control tidal exchange in the Herring River flood plain, elevation or relocation of several road sections, installation of new culverts at road crossings in upstream project areas, and relocation or filling in place portions of the CYCC golf course. The various restoration actions included as components of restoration would result in short-term impacts and, in some cases, include a direct and permanent adverse impact to wetlands occurring within or adjacent to construction areas.

Construction activities would result in soil disturbance and loss of vegetative cover in the construction area. Heavy equipment may also be used in management of large wood debris during the adaptive management phase of the plan. This disturbance could lead to temporary adverse effects to water quality during stormwater runoff events. However, best management practices (BMPs) would be implemented to limit sediment movement and protect water quality. Areas of temporary disturbance, such as access roads and equipment and material staging areas, would be returned to natural grade and seeded with native vegetation.

Areas of disturbance that would persist after completion of the adaptive management phase include the areas occupied by (footprint of) infrastructure. As demonstrated in table 7, the expected footprint of the Chequessett Neck Road Dike, Mill Creek Dike, and road realignment actions (under alternative D) would result in up to 11 acres of long-term vegetation/wetland disturbance. This represents approximately one percent of the total restoration project area.

Secondary restoration actions are those needed to maximize the effects of restoring tidal flood beyond rebuilding the Chequessett Neck Road Dike and increasing tidal range. They include but are not limited to direct vegetation management, sediment management, channel improvements, and planting vegetation. Specific impacts associated with any of these actions cannot be quantified but are expected to include work within wetland areas to remove trees and shrubs, dredge and/or deposit sediment, excavate or fill channels, and other actions to maximize tidal circulation and hasten the recovery of native estuarine habitats. Some actions would include access for heavy equipment and similar wetland impacts. These activities would be similar to those of many regional mosquito control programs implementing Open Marsh Water Management or Integrated Mosquito Management in New England salt marshes.

Table 7 summarizes the anticipated acreage of short-term impacts anticipated from project actions.

**TABLE 7. TEMPORARY AND PERMANENT WETLAND AND FLOOD PLAIN DISTURBANCE RESULTING FROM THE HERRING RIVER RESTORATION PROJECT**

| Location | Short-term Disturbance | Long-term Disturbance | Note |
|---|---|---|---|
| Chequessett Neck Road Dike | Up to 2.4 acre construction foot print (coffer dam, dewatering) | Up to 800 linear feet permanent intertidal (E2UB/EM) and sub-tidal (E1UB) habitat loss, if dike crest elevated (estimate up to one acre) | Final design of dike would determine width at the dike base and the total acreage occupied by the structure |
| Mill Creek Dike | Up to 2.4 acre construction footprint (coffer dam, dewatering) | Up to 12,500 square feet (approximately 0.3 acres) permanent estuarine (E2EM1) and palustrine (PEM/ PSS) permanent wetland loss | Final design of dike would determine the total acreage occupied by the structure |
| High Toss Road | Approximately 20 feet width of disturbance along 1,000 foot length of causeway (0.5 acre) | Up to 13,000 square feet (approximately 0.3 acres) palustrine (PEM/ PSS) permanent wetland loss if elevated; Up to 12,000 square feet (approximately 0.28 acres) gain of restored estuarine (E2EM1) wetland if removed | Independent of alternatives |
| Pole Dike/Bound Brook Island Roads | Construction corridor of approximately 20 feet along 6,200 linear feet adjacent to vegetated wetlands (2.85 acres) | Up to 4,000 square feet (0.1 acre) palustrine (PEM/ PSS) permanent wetland loss to elevate above 100-year storm surge, 2,300 square feet (just over 0.05 acre) lost to elevate to annual high water | Independent of alternatives |

| Location | Short-term Disturbance | Long-term Disturbance | Note |
|---|---|---|---|
| CYCC Golf Course | | Elevation Option: 360,000 square feet (8.26 acres) wetland loss (most is existing maintained golf course-Palustrine wet meadow), ~5 acres potentially sensitive archeological resource disturbance<br>Relocation Option: 89,000 square feet (just over 2 acres) Palustrine wet meadow wetland loss (all is existing maintained golf course), ~30 acres potentially sensitive archeological resource disturbance | Applies to alternatives B and D |
| Residential Flood Proofing | To be determined with input from landowners but could include wetland fill for elevation, berms, or walls | | |
| Secondary Restoration Actions | Specific impacts cannot be identified or quantified at this time, but are expected to include work within wetland areas to remove trees and shrubs, dredge and/or deposit sediment, excavate or fill channels, and other actions to maximize tidal circulation and restoration benefits; would likely include access by heavy equipment for some restoration actions | | |
| **Total Disturbance Area** | Minimum of 8.15 acres of temporary vegetation/wetland disturbance plus that needed to implement vegetation management during adaptive management phase | Up to approximately 11 acres of long-term deep water and wetland disturbance for dike(s), road elevation or realignment, and culvert installation | |

The long-term water and sediment quality changes resulting from tidal restoration in the Herring River would generally be positive and are integral to achieving the ecological objectives of the proposed project. However, several potentially adverse effects to water and sediment quality are possible and as such will be included as components of a long-term monitoring program. Components included in the long-term monitoring program would include but not be limited to:

- Continued low dissolved oxygen concentrations – Summertime dissolved oxygen levels could remain low in ponded areas until a tidal channel system becomes established. Targeted excavation of silted-in channels could be used to increase circulation and promote low-tide drainage.
- Temporary excessive release of nutrients – Renewed tidal flushing of acid sulfate soils would allow ammonium-nitrogen to be released into receiving waters in the short term (Portnoy and Giblin 1997a). Gradual reintroduction of tidal exchange should allow ammonium-nitrogen to be slowly released (Portnoy 1999). The increase in nutrient concentrations would likely be of

relatively short duration. Wellfleet Harbor is open to Cape Cod Bay and well-flushed which limits the potential effects of temporary increases in nutrient loading.

- Increased turbidity – Sediment and soil could be mobilized during the reconstruction of the dike and in other areas of construction, potentially resulting in local increases in turbidity in adjacent water bodies. BMPs would be required and would include erosion control measures as well as maintenance of the current rate of tidal exchange through the dike.
- Elevated fecal coliform concentrations – Elevated bacteria concentrations could persist in upstream reaches of the system, especially after rainstorms. Increasing salinity and flushing will reduce bacteria survival time and density prior to discharge into Wellfleet Harbor. Fecal coliform would continue to be monitored during the restoration process, particularly after rainstorms.
- Porewater sulfide concentrations depress salt marsh plant colonization and growth – Flooding of the lowest organic sediments with seawater could result in elevated porewater sulfide, especially in areas with poor low-tide drainage. Porewater sulfide levels and salt marsh plant colonization will be monitored in these low areas. As part of the adaptive management plan, some channel excavation may be required to improve low-tide drainage and, consequently, peat aeration and sulfide oxidation.

# COMPLIANCE

## Compliance with Section 404 off the Clean Water Act and Section 10 of the Rivers and Harbors Act

Several components of the Herring River Restoration Project would include unavoidable impacts to wetlands under federal jurisdiction, primary by the discharge of fill into waters of the United States. These actions include but are not limited to the reconstruction of the Chequessett Neck Road Dike, potential construction of a dike at Mill Creek, work to elevate or otherwise flood-proof low-lying roadways, and potentially fill places in low-lying areas of the CYCC golf course. Given the nature and extent of these impacts to wetlands under USACE jurisdiction, it is anticipated that compliance under Section 404 and Section 10 would require the filing of an Individual Permit verses being eligible for review under a Massachusetts General Permit. A permit application for the discharge of dredged and/or fill material in waters of the United States is evaluated using the Environmental Policy Act’s (EPA) Section 404(b) (1) guidelines. These guidelines are designed to avoid unnecessary filling of waters and wetlands. For the guidelines to be satisfied:

- There must be no practicable alternatives available which would have less adverse impact on the aquatic ecosystem and which do not have other significant adverse environmental consequences;
- The activity must not violate federal or state water quality standards or threaten a federally-listed endangered species;
- There must be no significant degradation of water and wetlands; and
- All reasonable steps must be taken to minimize adverse effects to the aquatic environment.

Action undertaken to restore the Herring River estuary will comply with the requirements of Section 404 of the Clean Water Act, Section 404(b) (1) guidelines, and Section 10 of the Rivers and Harbors Act.

## Compliance with Section 401 off the Clean Water Act

Section 401 of the Federal Water Pollution Control Act of 1972 (Clean Water Act or CWA) requires that any applicant for a Section 404 (dredge and fill) permit also obtain a water quality certification from the state. The purpose of the certification is to confirm that the discharge of fill materials would comply with the state’s applicable water quality standards. Section 401 gives the authority to the states either to concur with USACE approval of a section 404 permit or to place special conditions on the approval, or deny the activity by not issuing a 401 certification. Compliance with Section 401 would be addressed through Massachusetts Regulation and Consultation and Water Quality Certification prior to the implementation of project construction.

## Compliance with the Coastal Zone Management Act of 1972, as amended

The Commonwealth of Massachusetts' Office of Coastal Zone Management implements the Coastal Zone Management Act (CZMA) through the Coastal Zone Management Policy Guide (October 2011) – the current official statement of the Massachusetts coastal program policies and legal authorities. Under the CZM program, all MEPA projects are reviewed for consistency with the management principles of CZM, which are intended as guidance for any activities proposed in the Coastal Zone. The overall goal of coastal zone management is to protect coastal resources from contamination or degradation, prevent the creation of coastal hazards, and maximize the public use and benefit of coastal areas. Compliance with the Massachusetts CZM will be achieved through review of this draft EIS/EIR chapter 5 (see section 5.3.5).

## CONCLUSION

### *Wetlands*

#### Long-Term Changes to Wetland Habitats

The project to restore the Herring River salt marsh habitats is consistent with the NPS policies and mandates to protect and improve wetland habitats in our nation's national park units as expressed in NPS Procedural Manual 77-1: Wetland Protection and under EO 11990: Protection of Wetlands. The proposed action would, over time, restore tidal inundation to up to 880 acres of degraded freshwater wetland habitats. This would be accomplished by construction of two new dikes – one at the main mouth of the Herring River and one at the Mill Creek sub-basin – and gradual increase of tidal elevations using an adaptive management approach (appendix A). Construction of these dikes, and other flood mitigation measures, would result in long-term loss of up to 11 acres of wetland habitat

Widespread change from degraded primarily freshwater (Palustrine) wetlands to Estuarine sub-tidal and inter-tidal habitats would be expected to occur over the several-year adaptive management period. Restored inter-tidal habitat subjected to higher salinity waters, generally 18 parts per thousand and higher, is expected to transition to salt marsh (E2EM1). The majority of the project-wide restoration of inter-tidal habitat would occur within freshwater marsh/meadow, shrublands and woodlands. Approximately 79 to 88 percent of the existing 222 acres of freshwater marsh/meadow, 68 to 78 percent of the existing 299 acres of shrublands, and 78 to 85 percent of the existing 403 acres of woodlands would be encompassed by the predicted mean high water spring tide line. Lesser amounts of tidal habitat restoration would occur within brackish marsh, dune/heathlands, and developed lands. An increase in amount of developed lands encompassed by the predicted mean high water spring tide line from seven acres for alternative D, option 2 (elevation) to 17 acres for alternative D, option 1 (relocation) is primarily the result of the proposed raising of low-lying portions of the CYCC golf course with the preferred alternative. Habitat conditions would improve within the existing 42 acres of salt marsh or open water within the Lower Herring River sub-basin. Lower salinities would likely occur on the periphery of the project area and in the upper reaches of many sub-basins where brackish (also E2EM1) and freshwater plants (Palustrine marsh, shrub swamp and forested wetland) are expected to persist.

The anticipated change from degraded primarily freshwater (Palustrine) wetlands to Estuarine sub-tidal and inter-tidal habitats preferred alternative (alternative D option 2) would include approximately 196 acres of freshwater marsh/meadow, 232 acres of shrublands, and 342 acres of woodlands. Habitat conditions would improve within the existing 42 acres of salt marsh or open water as well as 40 acres of brackish marsh and seven acres of CYCC fairways developed on wetland soils.

The construction of two new dikes – one at the main mouth of the Herring River and one at the Mill Creek sub-basin and other flood mitigation measures would result in long-term loss of up to 11 acres of wetland habitat. However, the increase in wetland function resulting from the restoration of 859 acres of degraded wetlands to estuarine intertidal emergent wetland (E2EM1) more than compensates for the 11 acres of wetland lost to infrastructure impacts that are necessary to implement the project and satisfy's the NPS no-net-loss policy with respect to no-net-loss of wetland functions as allowed for in NPS Procedural Manual 77-1: Wetland Protection).

**Short-Term Impacts of Construction and Adaptive Management**

Construction activities would result in soil disturbance and loss of vegetative cover in the construction area (see table 7, above). Heavy equipment may also be used in management of large wood debris during the adaptive management phase of the plan (appendix A). This disturbance could lead to temporary adverse effects to water quality during stormwater runoff events. However, best management practices (BMPs) would be implemented to limit sediment movement and protect water quality. Areas of temporary disturbance, such as access roads and equipment and material staging areas, would be returned to natural grade and seeded with native vegetation.

Areas of disturbance that would persist after completion of the adaptive management phase include the areas occupied by (footprint of) infrastructure. As demonstrated in table 7, the expected footprint of the Chequessett Neck Road Dike, Mill Creek Dike, and road realignment actions (under the preferred alternative) would result in up to 11 acres of long-term vegetation/wetland disturbance. This represents approximately one percent of the total restoration project area.

## *Floodplains*

**Long-Term Changes to Floodplain Functions**

The project to restore the Herring River salt marsh habitats is consistent with the NPS policies and mandates to protect floodplain functions in our nation's national park units as expressed in NPS Procedural Manual 77-2 Floodplain Management and EO 11988: Floodplain Management. The project would increase regular tidal inundation across approximately 90 percent of the former Herring River tidal estuary. In addition, storm surges would reach higher elevations (7.5 feet in the Lower Herring River than under current conditions (2.1 feet in the Lower Herring River), restoring a portion of historic flood plain function under extreme events. However, full inundation of the historic 100-year flood plain would not be practicable because of development within and adjacent to the historic flood plain flood.

Up to 368 adjacent properties may be contacted by elevated tidewaters; 177 would experience no affect to structure or landscape; 149 would experience impacts to natural vegetation; 22 would experience impacts to cultivated landscapes; and 20 would experience structural impacts. Impacts to properties were categorized based on the frequency of tidal water reaching the property and the nature of the land or structures impacted. The NPS and HRRC are working with individual landowners on a case-by-case basis to determine site-specific mitigation needs.

**Short-Term Impacts of Construction and Adaptive Management**

Construction activities would result in soil disturbance and loss of vegetative cover in the construction area (see table 7, above). Heavy equipment may also be used in management of large wood debris during the adaptive management phase of the plan (appendix A). This disturbance could lead to temporary adverse effects to water quality during stormwater runoff events. However, best management practices (BMPs) would be implemented to limit sediment movement and protect water quality. Areas of temporary disturbance, such as access roads and equipment and material staging areas, would be returned to natural grade and seeded with native vegetation.

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