Cape Cod Atlas of

Tidally Restricted Salt Marshes

Cape Cod, Massachusetts

Conducted & Prepared by

Cape Cod Commission

for the
Massachusetts
Wetlands Restoration Program

December, 2001

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The methodology, fieldwork, site descriptions, maps, and data summaries published in this Atlas were conducted, developed, and produced by the Cape Cod Commission. The background text of this Atlas was adapted in large part from the *Atlas of Tidal Restrictions on the South Shore of Massachusetts* (Metropolitan Area Planning Council, 2001) and from the *Atlas of Tidal Restrictions – Buzzards Bay Watershed* (Buzzards Bay Project National Estuary Program, 2000).

The Cape Cod Commission project staff that participated in the development and production of this atlas were Gail Hanley, Martha Hevenor, Stacey Justus (principal author and Project Manager), Van Morrill, Gary Prahm, and Steven Tucker. Special thanks are extended to Gail Hanley for her tireless and creative work in the design and production of this document.

The Commission project staff would like to thank the local officials and other regional specialists who took an interest in this work and took their time to meet, discuss, and review the specific findings of this Atlas. This Atlas would be neither complete nor accurate were it not for their assistance. For a complete list of individuals who assisted project staff in this effort please see Appendix E.

TABLE OF CONTENTS

TABLE OF CONTENTS

(continued)

Cape Cod Atlas of

Tidally Restricted Salt Marshes

Cape Cod, Massachusetts

PURPOSE AND GOALS

This study was undertaken to identify salt marsh systems impaired by the restriction of tidal flow along the coast of Cape Cod, Massachusetts. The scope of this project was limited to sites where salt marshes have been impacted by transportation related facilities such as roads, railroads, causeways, and footpaths. Additionally, infrastructure built to support the extensive cranberry farming operations on the Cape was also considered in this atlas. In some cases, dikes serving no transportation purpose were identified and included if they were found to be restricting tidal flow to a salt marsh.

The purpose of this Atlas is to identify, inventory, and present sites on Cape Cod that are tidally restrictive of salt marsh and may adversely impact upstream intertidal wetlands. The goals of this Atlas are:

- to provide valuable information about restricted coastal wetlands to coastal area planners, advocates, and decision makers;
- to increase public knowledge about tidal restrictions and their impacts;
- to provide a baseline upon which municipalities can identify restoration priorities; and
- to encourage and facilitate the restoration of tidally restricted coastal wetlands across Cape Cod.

The study area for this project encompasses the fifteen towns of Barnstable County, which includes Barnstable, Bourne, Brewster, Chatham, Dennis, Eastham, Falmouth, Harwich, Mashpee, Orleans, Provincetown, Sandwich, Truro, Wellfleet, and Yarmouth. Although these towns are located in the Cape Cod hydrologic basin, much of the Towns of Bourne and Falmouth are located in the Buzzards Bay Watershed. Refer to the *Atlas of Tidally Restricted Salt Marshes — Buzzards Bay Watershed, Massachusetts* (December 2000) for tidally restricted salt marsh sites that were previously identified in Bourne and Falmouth. This project did not identify any additional sites in Bourne that are outside of the Buzzards Bay Watershed, but did identify eight sites in Falmouth.

INFORMATION IN THIS ATLAS AND HOW TO USE IT

The Atlas contains the following information:

- Background information on tidal restrictions, issues to consider when planning a restoration project, and Massachusetts specific restoration programs and opportunities.
- Town maps showing the locations of tidal restrictions to salt marshes along the Cape Cod coastline.
- Charts for each town and its identified sites that provide site characteristics that are useful for prioritizing and planning future remediation projects.
- Detailed information on each identified tidally restricted salt marsh site.[1]

This Atlas was designed for use by municipalities, state and federal agencies, and other organizations and individuals seeking to prioritize, plan, and initiate salt marsh restoration projects. The information provided will be useful for identifying and targeting funds to those projects that best address specific community or regional restoration goals. In short, this Atlas gives people the ability to make informed decisions for salt marsh restoration.

The Cape Cod Commission's project staff strongly encourage municipal public works departments and other transportation officials to regularly consult this Atlas when evaluating projects that may involve tidal restrictions. Officials can often design road and bridge projects to reduce or eliminate these restrictions — with little or no increase in project costs, but with potentially significant environmental benefit. However, such benefits can only be realized when officials make a conscious effort to assess restriction information ahead of time and, when appropriate, incorporate restoration actions into project planning and design. This Atlas provides officials with the information needed to crosscheck pending transportation projects with known tidal restrictions and to identify potential salt marsh restoration opportunities. Transportation planners will also find this Atlas useful when evaluating long-range projects as part of the Regional Transportation Plan — projects (and hence restoration) that may be eligible for state and federal transportation funding.

BACKGROUND

Tidal Wetlands and the Effects of Tidal Restrictions

Tidal wetlands are among Massachusetts' most valuable natural resources. Often called the ocean's farmlands, these wetland systems create the foundation of a coastal food web that supports a large variety of coastal fish and bird species. They also provide vital nes-

[1] Although the Cape Cod Commission's project staff made considerable efforts to identify all tidally restricted salt marshes on Cape Cod, we recognize that some sites may have been overlooked. Our list, though extensive, should not be considered definitive.

ting and breeding habitats for migratory waterfowl along the Atlantic Flyway. Coastal wetlands serve as important nursery and spawning grounds for many commercially and recreationally important fish and shellfish species. They play a critical role in maintaining water quality. Additionally, tidal wetlands provide irreplaceable protection from the flooding associated with storm surges and other serious weather events—a serious risk to the environment and economy of Cape Cod. Tidal wetlands are arguably the most productive and valuable of all the state's natural systems.

Tidal wetlands are comprised of salt marshes and adjacent intertidal habitats (e.g. mud flats, sandy beaches, and rocky shores) that are found along tidal rivers and estuarine embayments. Ocean tides flood these areas daily, and for a few days each month, the moon's gravitational pull creates especially high "spring tides" that flood the upper limits of salt marsh. Plants growing in upper marsh areas are specially adapted to this monthly salt water flooding cycle and, therefore, are especially sensitive to any deviation in that cycle. Even minor restrictions of tidal flows can stress and eventually kill native upper marsh species. Restrictions actually eliminate salt-tolerant species indirectly, by reducing salinity and draining the peat, thereby increasing competition by non-salt-tolerant species.

Tidal restrictions cause hydrological changes that typically reduce the maximum elevations of tidal flooding and lower the water's salt concentration. These changes cause a major transformation in vegetation and alter the entire upstream salt marsh. Common Reed (*Phragmites australis)* and other invasive species that are more tolerant of brackish conditions often displace native salt marsh grasses and rushes, thereby reducing plant diversity and changing vegetative structure (from a low grassy meadow to a tall reedy thicket). This change in vegetation, in turn, causes a major shift in wildlife use, as once diverse native salt marsh creatures are replaced by fewer, more generalist species. In sum, most tidal restrictions — by altering hydrology and salinity — significantly harm upstream tidal ecosystems.

The loss and fragmentation of coastal wetlands that is caused by transportation infrastructure, tide gates, and other engineering structures, often reduce a wetlands system's capacity to store floodwaters and to protect inland ecosystems and properties from storm damage. Tidal restrictions sometimes exacerbate the damage caused by major coastal storms because they can impound storm water and thus increase the severity of flood events. Long-term restrictions cause wetland subsidence, setting the stage for even greater storm-surge damage when restrictions breach.

Restoration Approaches and Issues to Consider when Restoring Tidally Restricted Salt Marshes

The main objective of salt marsh restoration is to return — as closely as possible — a marsh's hydrology and chemistry to natural, pre-restriction conditions. In many cases, full restoration could be accomplished by removing the restrictive feature or by creating an opening sufficient to pass full tidal flows. For example, where tidal flow is reduced by undersized culverts (those that are too small to pass the full spring tide), simply installing new culverts that are correctly sized and positioned will generally be enough to restore tidal range and proper salinity. Unfortunately, many restrictions have been in place for so long that ecosystems have, through natural processes, adapted to anthropogenically altered site characteristics that have created conditions that make full tidal range restoration impractical. However, a significant level of restoration can still take

place at these sites. The controlled, or phased, reintroduction of seawater is likely to be part of a plan for salt marsh remediation. Each proposed salt marsh restoration project should be evaluated early on for potential adverse impacts.

In many areas across Cape Cod and all along the Massachusetts coastline people have developed low-lying property adjacent to salt marshes. In many of these locations restoring full tidal flow may not be possible, nor may it be necessary in order to achieve significant environmental benefit. Restoration projects can be designed to eliminate much, if not all, of the tidal restriction while simultaneously protecting adjacent property from flooding. Studying the tidal range to find the appropriate level of flow that will address both environmental needs and flooding concerns can do this. Part of a solution may lie in properly sizing and positioning culverts to enable only the desired flow to pass upstream.

Methods to achieve the desired upstream tidal range often include a protective device called a tide gate. When used and managed properly, tide gates can manage the flow of water through the restricted area. They can be designed to pass the normal tide range in both directions but to prevent entry of storm tides. Some gates can be completely closed prior to an expected storm tide, if necessary, to protect the upstream marsh and adjacent properties from flooding.

Salt Marsh Protection and Restoration in Massachusetts

➤ BACKGROUND

In 1963, the Commonwealth of Massachusetts legally acknowledged the important values of coastal wetlands by passing the "Jones Act"— the first state law of its kind protecting coastal wetlands from dredging, filling, and other impacts. Prior to 1963, many people dredged, filled, and completely destroyed vast areas of coastal wetlands for harbor improvements, transportation projects, and industrial, residential and commercial developments. A poignant example of this wholesale transformation is the city of Boston, a large portion of which was built upon historic coastal wetlands. The majority of Massachusetts' surviving salt marshes have been degraded by other human activities including minor filling, mosquito ditching, and restriction of tidal flow.

Since the recognition of salt marsh values in the 1960's, Massachusetts has strengthened and expanded its wetland protection laws. In 1972 the state enacted the Wetlands Protection Act that regulates the alteration of wetland areas by requiring local and state government review and approval of potentially damaging activities. While strict regulations under this law virtually prohibit direct adverse impacts to salt marshes, other indirect impacts (e.g. water pollution) are more difficult to control and continue to degrade these areas.

➤ THE MASSACHUSETTS WETLANDS RESTORATION PROGRAM

Laws and regulations have halted most salt marsh alterations, but until recently no mechanism existed to reverse the historic destruction and degradation of these vital natural resources. That void was filled in 1994 when the Secretary of the Executive Office of Environmental Affairs established the Massachusetts Wetlands Restoration Program (here-

after, MWRP) — the purpose of which is to help change the tide of past wetland losses to one of future net wetland gains.

Unlike mandatory wetland replication projects sometimes required under the Wetlands Protection Act, project sponsors voluntarily initiate MWRP's pro-active wetland restoration projects. Restoration projects usually address problems of water quality, water quantity, and wildlife and fisheries habitat in the surrounding watershed. To assist project sponsors, MWRP provides technical, procedural, and funding assistance on an as-needed basis throughout the duration of a restoration project.

➤ RESTORING SALT MARSH IN MASSACHUSETTS

Coastal salt marsh restoration planning and project implementation are among MWRP's top priorities. This Atlas — along with similar efforts covering the North Shore, South Shore, and Buzzards Bay — reflect that focus and will soon provide an inventory of tidal restrictions for the entire Massachusetts coast.

Planning alone does not restore wetlands, and that is why MWRP provides considerable assistance to project sponsors for project implementation. MWRP works with municipalities, environmental groups, state and federal agencies, corporate partners, and other organizations to complete priority wetland restoration projects identified in these atlases. To receive support from MWRP, restoration projects must be sponsored through MWRP's GROWetlands (Groups Restoring Our Wetlands) program. MWRP helps GROWetlands sponsors develop goals, secure funding, draft work plans, build project teams, use restoration sites for education and outreach, and monitor restoration sites to ensure success. The level of assistance is commensurate with the level of need and the value of the project. See Appendix D for the GROWetlands Restoration Project Nomination Form.

METHODOLOGY

Identification of Potential Salt Marsh Restriction Sites

Potential salt marsh restrictions were initially identified using United States Geological Survey (USGS) topographic quadrangle maps (circa 1970s), aerial photography interpreted by the Cape Cod Commission's project staff, and input from various local officials and other knowledgeable people (see Appendix E). Specifically, the USGS topographic maps were studied to locate sites where tidal creeks or channels were crossed by built infrastructure, including roads, railroads, berms, cranberry bog berms, or dikes. In the early stages of the project the project staff used stereoscopes to interpret color infrared aerial photography taken by the James W. Sewall Company in 1999 (scale 1:25,000) to identify restricted sites. Common indicators of a salt marsh restriction that were visible by this method included:

- a significant change in vegetation from the seaward to upstream sides of the infrastructure;

- pooling water on one or both sides of the embankment suggesting uneven flow and the potential for scouring and/or erosion; and,
- bridges with short spans that "pinch" the waterway.

CCC staff also used the MA Department of Environmental Protection's (DEP) statewide wetlands data layer to identify and delineate potentially restricted salt marshes. This geographic information system (GIS) data layer was developed by DEP's Wetlands Conservation Program (WCP) through the photointerpretation of stereo, 1:12,000 scale, color-infrared aerial photography and was generated at 1:5,000 scale. The wetlands data layer delineates wetland boundaries and types and was viewed by CCC staff using ArcView 3.0 GIS software.

In the early stages of this project, CCC staff determined that for identifying tidally restricted wetlands, analysis of the DEP wetlands data layer provided more comprehensive and reliable results than in-house photointerpretation and, therefore, suspended in-house photointerpretation in favor of the GIS data produced by WCP experts.

Project staff surveyed the coastline of Cape Cod and examined each tidal river, channel, creek, and inlet to locate sites where infrastructure crossed tidal waters and isolated wetlands. Three wetland types were considered during this process — salt marsh (SM), inland freshwater shallow marsh (M), and inland freshwater shrub swamp (SS). MWRP staff determined that these three wetland types have the greatest potential to be affected by tidal restrictions and, should those restrictions be removed, have the potential to revert to healthy salt marsh. Therefore, sites were considered potential salt marsh restrictions if the WCP GIS data layer displayed **both** of the following conditions (considered the Basic Rule for Inclusion):

Basic Rule for Inclusion

1. SM delineated as contiguous to the seaward side of the crossing infrastructure and/or SM delineated upstream of the crossing infrastructure; and

2. SM, M, or SS delineated as contiguous to each other and to the upstream side of the infrastructure.[2]

The project staff made some exceptions to the Basic Rule for Inclusion. Where SM, SS, or M was delineated at some distance upstream of the infrastructure crossing rather than just being *contiguous* to it staff erred on the side of inclusion and would identify it as a potential salt marsh restriction site. Often topographic conditions involved an area of dune or upland through which a tidal channel ran before reaching a low-lying wetland area where SM, SS, or M again took hold. Similarly, isolated patches of SM, SS, or M that occurred well upstream of the infrastructure crossing site often fringed open water. A good example of this situation occurs in the finger ponds along Falmouth's south shore.

[2] These delineated parcels are considered the upstream affected area and are referred to as such in the town-by-town inventories of salt marsh restriction sites.

Field Investigation of Potential Salt Marsh Restriction Sites and Final Site Selection

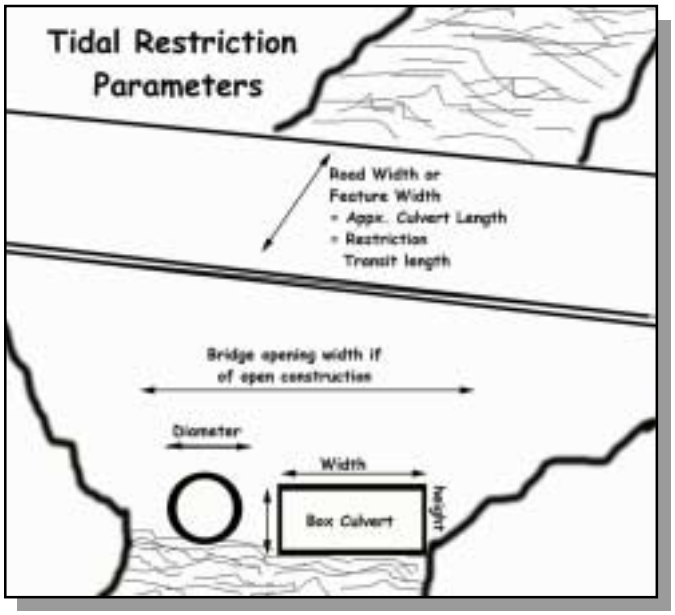
Project staff field-checked all identified potential salt marsh restriction sites to visually qualify the existence of restrictions and to collect information about crossing structures and affected salt marsh and wetland areas. Field reconnaissance generally was limited to tidal restriction sites with public access. Staff recorded field data on a Salt Marsh Restriction Field Inspection Sheet (attached as Appendix A).

Photographs were taken with a digital camera at each site in order to document existing conditions and to show the range in conditions among restricting structures. In order to accurately locate each restriction a hand-held Global Positioning System (GPS) receiver was used. The horizontal accuracy of the position recorded is 7 to 15 meters (21 to 45 feet). See Appendix C for a list of the latitude and longitude recorded at each selected salt marsh restriction site.

➤ THE FIELD INSPECTION SHEET (FIS)

Basic information about each site was recorded including the street and affected water body name, any landmarks helpful to locate the site, and a list of other sites seaward or upstream of it. Site parameters were measured (or estimated where necessary) in the field. Figure 1 presents a generalized view of a culvert tidal restriction and shows where certain measurements were taken.[3]

Figure 1



[3] Buzzards Bay Project National Estuary Program, 2000, p.7, Figure 6.

Both the seaward and upstream channel widths were estimated (or measured where accessible). Width measurements or estimates were taken a short distance from the culvert opening in order to account for unnatural widening adjacent to the culvert opening that is typically associated with restricted flow. It is common to find a pool of water collecting near the culvert or pipe opening, or a bridge's abutments, along with a scoured riverbed and eroded banks—conditions referred to as "pooling water" and "scour pools." In these cases, channel widths were estimated at a spot along the channel at a reasonable distance from the crossing itself where the channel appeared to return to its natural, free-flowing size.

➤ Restriction Classification Scheme[4]

The channel estimates were used in the Restriction Classification Scheme (RCS), a method of using both quantitative and physical indicators to determine the presence of a restriction and its relative severity. Two ratios are part of the RCS and help to identify whether an infrastructure crossing is restrictive. The *crossing ratio* is the ratio of the stream or channel width to the diameter or width of the culvert/pipe/bridge. The *pooling to erosion ratio* is based on the evidence of flow restriction compared with the severity of erosion. On the FIS this scheme rates each site on a scale of one to five. A lower score correlates to conditions that more closely resemble natural stream, or free-flowing, conditions. Similarly, a rating of five correlates to conditions that appear severely restricted.

Ideally, infrastructure crossing a tidal creek or channel would be constructed larger than the creek's average width to allow for flood tides and storm surges to flood adjacent marshes.[5] The field assessment team found that on Cape Cod, tidal crossings seldom met this description.

➤ Visual Indicators of a Restriction

At each site the presence or absence of visual indicators of a restriction were recorded. Visual indicators of a restriction can be seen relating to the structure, vegetation, or waterway. Another good indicator of reduced tidal range is wetland subsidence, determined by comparing elevation of similar vegetation communities on different sides of a restriction. Although measuring subsidence is beyond the scope of this project it should be considered as a future assessment step. Indicators used in this study are listed below. The degree to which these visual indicators occurred was rated on the following scale:[6]

1 = dominant/major
2 = significant
3 = minor

[4] This method was adopted from the Parker River Clean Water Association's *Tidal Crossing Handbook* (Purinton and Mountain, 1996).
[5] Parker River Clean Water Association, 1997, pp 18-19.
[6] While this categorical rating was subjective, the Commission staff project manager was present at each field assessment conducted for this Atlas in order to provide continuity and consistency when evaluating different sites.

Indicators visible in the structure:

- the seaward culvert opening submerged at mean high tide
- culvert invert problem
- a clogged culvert
- water pooling on either side of the crossing infrastructure

A culvert invert problem observed in Sandwich, at site SA-11 – the pipe is sited high in the bank; too high to pass the full tidal range.

Indicators related to the vegetation:

- a significant change in vegetation from the seaward to upstream side of the infrastructure (the presence of *Phragmites australis* upstream but not seaward of the site was the most obvious indicator)
- the presence and extent of *Phragmites* or cattails was noted

Dominant Phragmites observed growing upstream of restriction site HA-4 in Harwich.

Indicators visible in the marsh and waterway:

- scouring near an opening of the pipe, culvert, or bridge abutments
- erosion of the waterway's banks that appears to be due to detained tidal flow (rather than roadway runoff)
- marsh slumping
- vegetation die back/die off
- ponded water on the marsh surface

Severe vegetation die off observed in Barnstable, at site BA-2.

An example of a major scour pool and vegetation die off observed in Brewster at site BR-2.

Marsh slumping and vegetation die off observed in Sandwich, at site SA-10.

Major erosion observed in Yarmouth, at site YA-4.

➤ Final Site Selection versus Determination as a Non-tidally Restricted Site

On-site observation of one or more visual indicator at each preliminary salt marsh restriction site was considered evidence of a tidal restriction. However, the degree of their occurrence played the decisive role in determining whether a site was ultimately included in this Atlas as tidally restrictive of salt marsh. The RCS was also considered along with the absence or presence of visual indicators. For example, an observed combination of the following three conditions may have led the field staff to determine that a site was *not* restrictive of salt marsh: 1) the presence of minor scour pools; 2) no observed change in vegetation; and 3) a low ranking on the Restriction Classification Scheme. However, the presence of structural engineering features at many sites makes the RCS rating particularly important. For example scouring, and particularly erosion, may not be visible if a channel's banks are armored with rock walls. This would make it necessary to refer to the RCS. If the RCS rating was high (indicating that the site did not resemble natural, free-flowing conditions) then the lack of visible erosion and scour may not be useful in the characterization of a site. Similarly, a site may have exhibited major or significant erosion while the RCS rating was low (meaning that conditions resembled natural, free-flowing conditions). Such a case would have alerted the project staff to the likelihood of other causes of the erosion such as storm water run-off directed to the site.

Project staff used their judgement, information provided by local officials and others, and a combination of all information collected on the FIS to determine if a site should be characterized as restrictive or non-tidally restrictive of salt marsh. Occasionally, fieldwork led the project staff to conclude that, although a particular site met the Basic Rule for Inclusion as a potential salt marsh restriction site, present conditions observed indicated that the site was not tidally restrictive of salt marsh. For a complete list of these sites and the reasons why they were excluded see Appendix B.

SITE CHARACTERISTICS

This Atlas does not prioritize for remediation the sites identified as tidal restrictions. Rather, it compiles and presents baseline information about each site in order to foster site prioritization by others. A comprehensive chart with nine site characteristics is provided for each town, containing the following information for each site:[7]

Upstream Affected Wetland Area

Project staff ascertained the size (based in acres) of the affected wetland area upstream of the infrastructure that causes the restriction by querying the data associated with the WCP GIS data layer. If a given coastal wetland is restricted by a linear series of structures, all affected upstream areas are summed. (Refer to the methodology section of this Atlas to understand how upstream affected area is identified.)

[7] The project staff consulted several appropriate local officials and other knowledgeable people in each town in order to compile this information. See Appendix E for a list of those contacted.

The chart provides two numbers in this column. First is the upstream affected saltmarsh area only. Second is the sum total acreage of the upstream affected salt marsh, shrub swamp, and shallow marsh. Presented along with each site description is a GIS-based image with the upstream affected wetland area highlighted.

Contiguous Open Space

Based on town open space maps, other appropriate maps, or local knowledge it is noted whether the upstream affected area is contiguous to or within designated open space — either publicly owned (municipal, state, or federal) or privately owned by a conservation organization.

Shellfish Resource Areas

Project staff determined whether a site is located within or contiguous to a known shellfish resource area, or whether the waterway involved flows over a known shellfish resource area. Restoration of these sites may help restore or improve shellfish resources.

Anadromous Fish Pathways

Some of the tidal restriction sites are located on waterways that serve as important anadromous fish runs. Restoration of these sites may result in fish habitat improvements.

Engineered Flood Structures

Some of the identified tidal restrictions are caused by man-made flood control structures such as tide gates or water-control stoplogs. Modification of these structures or their operation and maintenance plans could in some cases significantly improve salt marsh health without jeopardizing human property or safety.

Areas of Critical Environmental Concern (ACEC)

Several of the sites discussed in this Atlas are located within one of the eight designated Cape Cod ACECs including Herring River, Bourne Back River, Pocasset River, Waquoit Bay, Sandy Neck/Barnstable Harbor, Pleasant Bay, Inner Cape Cod Bay, and Wellfleet Harbor.

Priority Habitat of Rare Species (PH) or Estimated Habitat of Rare Wildlife (WH)

The Massachusetts Division of Fisheries & Wildlife Natural Heritage & Endangered Species Program's *Massachusetts Natural Heritage Atlas, 2000-2001 Edition*, was used to determine if the upstream affected area of any site includes identified PH or WH.

Upstream Benefits

In cases where a series of tidal restrictions are found along a waterway, restoration of downstream sites might produce additional upstream benefits by enabling, or in some cases necessitating, restoration of upstream sites. If a site has a companion upstream site that is also included in this Atlas it is indicated here.

Site Ownership

Ownership of the crossing infrastructure that is the cause of the salt marsh restriction was determined as either public or private. This will be useful information when remediation is considered. Generally, private ownership of the site could mean additional funding and permitting obstacles.

TOWN INVENTORIES OF SALT MARSH RESTRICTION SITES

One-hundred and fourteen (114) sites were identified by the Commission's project staff as sites where infrastructure crosses tidal creeks or channels and causes the restriction of salt marsh on Cape Cod. Of those 114, nine (9) sites are located on a town line, for which two communities share maintenance responsibility and/or ownership. The sites are distributed as follows:

- Barnstable – 19 (3 shared)
- Brewster – 7 (2 shared)
- Bourne – 0
- Chatham – 7 (2 shared)
- Dennis – 13 (2 shared)
- Eastham – 9 (1 shared)
- Falmouth – 8
- Harwich – 9 (2 shared)
- Mashpee – 6 (1 shared)
- Orleans – 7 (2 shared)
- Provincetown – 1
- Sandwich – 13 (1 shared)
- Truro – 7
- Wellfleet – 6
- Yarmouth – 11 (2 shared)

Individual sites presented on the following pages are grouped together by town. Town sections are presented alphabetically and organized as follows. First, a town-wide map shows the location of all selected salt marsh restriction sites. Second, the chart of nine site characteristics is presented. Lastly, each site is presented on one to two pages with a site description, general information, GIS image of the upstream affected wetland area, and photographs of certain site features. A comment section is presented for sites as appropriate. When site conditions and locations warranted it, several sites were grouped and presented together in order to clearly describe their relationship and proximity to one another.

Site Labeling

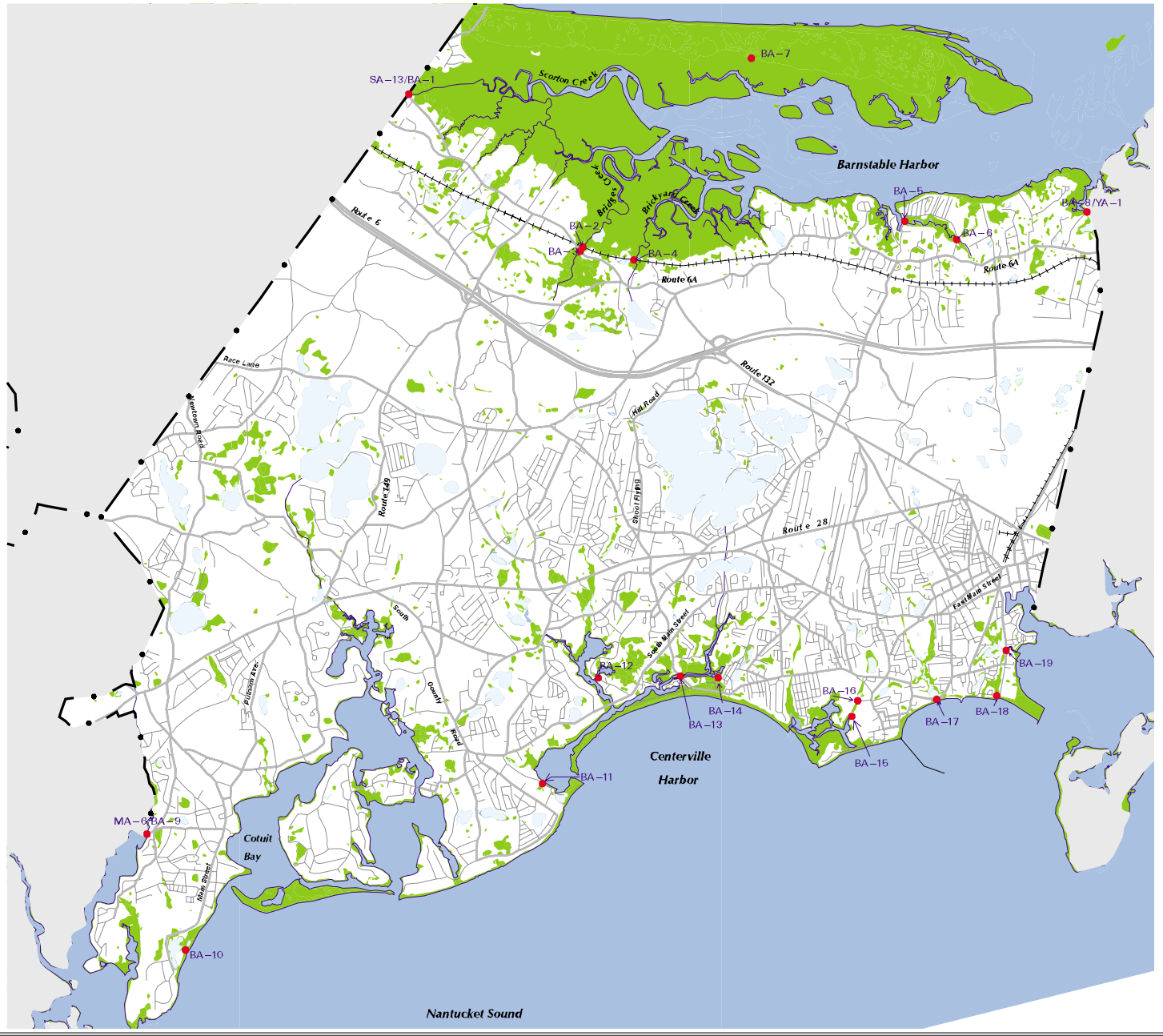
Each final site is identified in this Atlas by a two-letter text label in conjunction with an assigned site number. The text label is a town identifier and is the first two letters of the town in which the site is located. Site numbering is consecutive by town and generally arranged from west to east. On the outer Cape, site numbers were generally assigned from south to north. For example, site TR-1 is the southern most site within the Town of Truro and site TR-7 is the northern most site in Truro. A site that is located on a town line was given a dual town identification label. For example, site BR-7/OR-1 is the western most site in Brewster and the eastern most site in Orleans. The infrastructure (in this case, the Cape Cod Rail Trail) that is causing the salt marsh restriction lies on the Brewster/Orleans town line. Its site description is included in both the Brewster and Orleans town sections.

TOWN INVENTORIES

- Barnstable
- Bourne
- Brewster
- Chatham
- Dennis
- Eastham
- Falmouth
- Harwich
- Mashpee
- Orleans
- Provincetown
- Sandwich
- Truro
- Wellfleet
- Yarmouth

TOWN OF BARNSTABLE

- Town Map
- Chart of Site Characteristics
- Sites 1 to 19



TOWN OF BARNSTABLE

Location of Selected Salt Marsh Restrictions

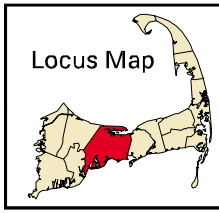
This map was produced by the Cape Cod Commission Geographic Information System office, with digital data from MassGIS and the Cape Cod Commission, 2001.

The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis.

This project was funded, in part, by the Executive Office of Environmental Affairs, Massachusetts Wetlands Restoration Program.

- BA – 1 Tidal Restriction Site
- Wetland
- Ocean
- Pond or Lake
- Local Road
- Major Route
- Stream
- Railroad

Locus Map



Miles
0 1 2
0 5,000 10,000
Massachusetts State Plane Feet
North American Datum – 1927

Land Use • Roads • DCPCs • Parcels • Demographics • Environmental • DRIs
Cape Cod Commission
GIS Services

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S

Town of Barnstable – Site Characteristics

Site Number	Size of upstream affected area (salt marsh acres/ total affected acres)	Is the upstream affected area contiguous to protected open space (ownership)?	Does this tidal channel support a shellfish resource area?	Is the channel or system part of an anadromous fish pathway?	Does the culvert/pipe support an engineered flood control structure?	Is the affected area or site within an ACEC boundary?	Does the affected area include Priority Habitat of Rare Species (PH) or Estimated Habitat of Rare Wildlife (WH)?	Are there any restricted sites upstream of this site (site number)?	Ownership of the site (public vs. private)
SA-13/ BA-1	17.89 / 33.89	NO	YES	NO	NO	YES	YES (PH)	NO[1]	PUBLIC
BA-2	8.83 / 41.95	YES (municipal)	YES	YES	NO	YES	YES (PH & WH)	YES (BA-3)	PUBLIC
BA-3	8.04 / 39.57	YES (municipal)	YES	YES	NO	YES	NO	NO	PUBLIC
BA-4	8.54 / 9.43	NO	YES	YES	NO	YES	YES (PH & WH)	NO	PRIVATE
BA-5	32.82 / 38.21	YES (BA Land Trust)	YES	NO	NO	YES	NO	YES (BA-6)	PUBLIC
BA-6	0.0 / 5.39	YES (BA land Trust)	NO	NO	NO	YES	NO	NO	PUBLIC
BA-7	8.88 / 8.88	YES (municipal)	YES	NO	NO	YES	YES (PH & WH)	NO	PUBLIC
BA-8/ YA-1	15.10 / 19.20	NO	YES	NO	NO	NO	NO	YES (YA-2)	PUBLIC
MA-6/ BA-9	11.07 / 29.77	NO	YES	YES	NO	NO	NO	NO	PUBLIC
BA-10	0.0 / 8.88	NO	NO	NO	NO	NO	NO	NO	PRIVATE
BA-11	1.95 / 2.26	NO	NO	NO	NO	NO	NO	NO	PUBLIC
BA-12	0.0 / 10.06	NO	YES	YES	NO	NO	YES (PH & WH)	NO	PUBLIC
BA-13	56.26 / 81.33	YES (municipal; BA Land Trust)	YES	YES	NO	NO	NO	YES (BA-14)	PUBLIC
BA-14	0.0 / 3.25	NO	YES	YES	NO	NO	NO	NO	PRIVATE

[1] Scorton Creek (Sandwich) flows east to join with Scorton Creek (Barnstable) that is flowing west. It may be correct to include site SA-13/BA-1 as an upstream site of SA-10. However the vegetation, as delineated by the Wetlands Conservancy Program, sizes of channels, and proximity of SA-13/BA-1 to Scorton Creek's (Barnstable) tidal entrance at Barnstable Harbor visually indicate that tidal flow mixes somewhere between sites SA-12 and SA-13/BA-1. Therefore, this Atlas will consider site SA-12, but not SA-13/BA-1, as upstream of site SA-10. Sites SA-12 and SA-13/BA-1are considered to share the same upstream affected area.

(continued on back)

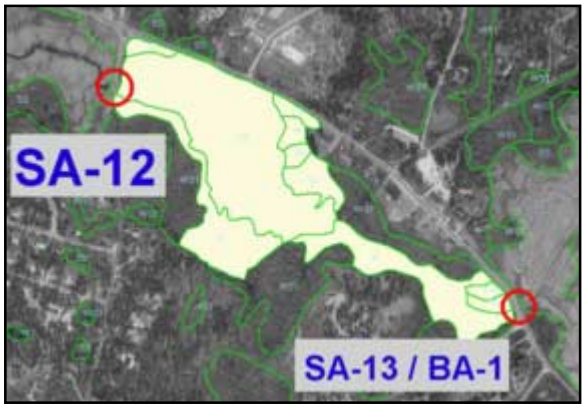
Town of Barnstable – Site Characteristics

Site Number	Size of upstream affected area (salt marsh acres/ total affected acres)	Is the upstream affected area contiguous to protected open space (ownership)?	Does this tidal channel support a shellfish resource area?	Is the channel or system part of an anadromous fish pathway?	Does the culvert/pipe support an engineered flood control structure?	Is the affected area or site within an ACEC boundary?	Does the affected area include Priority Habitat of Rare Species (PH) or Estimated Habitat of Rare Wildlife (WH)?	Are there any restricted sites upstream of this site (site number)?	Ownership of the site (public vs. private)
BA-15	2.52 / 5.56	NO	NO	NO	NO	NO	NO	YES (BA-16)	PRIVATE
BA-16	0.0 / 3.04	NO	NO	NO	YES (stoplogs)	NO	NO	NO	PRIVATE
BA-17	0.0 / 19.31	NO	YES	YES	YES (stoplogs)	NO	NO	NO	PUBLIC
BA-18	12.11 / 12.11	YES (municipal)	YES	NO	NO	NO	NO	YES (BA-m)	PUBLIC
BA-19	0.0 / 20.19	NO	YES	NO	NO	NO	NO	YES (BA-m)	PUBLIC

SANDWICH/BARNSTABLE

Route 6A restriction of Scorton Creek (Barnstable)

Site SA-13/BA-1



Upstream Affected Area (acres): SM – 17.89; M – 13.94; SS – 2.06.

Site Description

Scorton Creek (Barnstable) flows under Route 6A at the Barnstable/Sandwich town line via a 4-foot diameter concrete pipe. The pipe is in good condition – it is not broken or clogged. The upstream side of this pipe is considered to be the marsh area to the southwest of Route 6A, which is also the upstream affected area of site SA-12. It is in this affected area that the flow of Scorton Creek (Sandwich) mixes with the flow of Scorton Creek (Barnstable). Scorton Creek (Barnstable) does support shellfish and anadromous fish. This site and its affected area are located within the Sandy Neck/Barnstable Harbor Area of Critical Environmental Concern.

This 4-foot concrete pipe passes the flow of Scorton Creek (Barnstable) under Route 6A.

General Information

The seaward side of the creek is 5 feet wide and narrows to approximately 2 feet upstream of the pipe. Visual indicators of a restriction include minor scouring at both ends of the pipe and minor upstream erosion. Cattails dominate the vegetation on the seaward side of Route 6A and are significant in the upstream marsh area. *Phragmites* fringes the back extent of the upstream affected area. According to the Wetlands Conservancy Programs wetland delineation, shallow marsh divides salt marsh adjacent to the upstream side of site SA-12 from salt marsh adjacent to the upstream side of site SA-13/BA-1

- Restriction width – 4 feet
- Restriction length – 56 feet
- Upstream salt marsh – 17.89 acres

The upstream affected seen here is scattered with cattails, shrubs, trees, and Phragmites.

Comments

According to the Sandwich Conservation Officer, at the time of this writing this culvert is under consideration for remediation but requires outside funding due to the fact that the structure is within a Massachusetts Highway Department road layout.

BARNSTABLE

Penn Central Railroad restriction of Bridge Creek

Site BA-2

Site Description

Bridge Creek flows in a northerly direction from south of Route 6A, joins with Spring Creek and discharges to Barnstable Harbor. Approximately 500 feet east of the intersection of the railroad and Route 6A, Bridge Creek passes under the railroad bed via a 3-foot metal pipe that is set approximately 10 feet below the railroad grade. The seaward side of this culvert is substantially clogged with silt, vegetation, and wooden boards. This site lies seaward of restricted site BA-3. Bridge Creek supports both shellfish and anadromous fish.

General Information

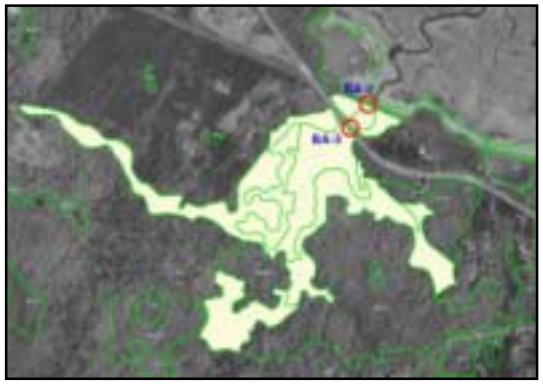
Bridge Creek is 10-15 feet wide both seaward and upstream of the restriction. Visual indicators of restriction on the seaward side are severe and include marsh slumping, vegetation die off, ponded water, *Phragmites*, a wide scouring basin, and major bank erosion. The affected area between sites BA-2 and BA-3 is also degraded. Scour, bank erosion, and *Phragmites* are all present.

- Restriction width – 3 feet
- Restriction length – 40 feet
- Upstream salt marsh – 8.83 acres

Comments

Sites BA-2 and BA-3 were selected and studied by the Army Corps of Engineers (ACOE) in 1996. The study found that a 10-foot by 20-foot box culvert under both Route 6A and the railroad would provide full restoration of tidal flow.

The upstream pipe opening, while not clogged or broken, is dwarfed by the pool of water attempting to pass through it.



Upstream Affected Area (acres): SM – 8.83, SS – 20.23, M – 12.89.

Looking seaward over the salt marsh, vegetation die-back and bank erosion are clearly visible near the restriction.

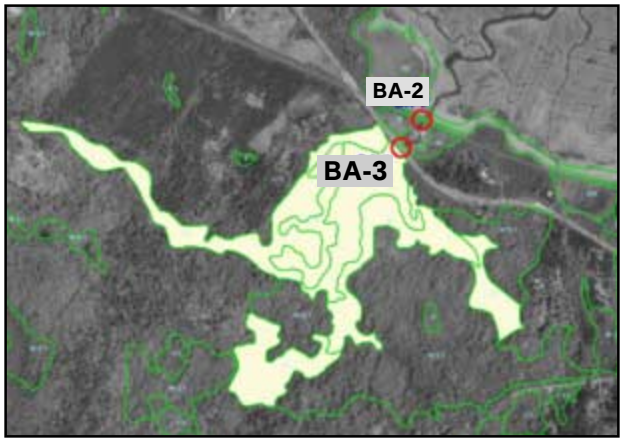
The seaward culvert opening is clogged with debris, blocked by the eroding retaining wall, and inadequately sized.

A 4 by 8-foot box culvert under site BA-2 in conjunction with the existing Route 6A culvert would provide partial restoration of tidal flow (ACOE, 1996, pp. 34-35). This site is currently being studied by the Massachusetts Wetlands Restoration Program for potential restoration in the near future. To date restoration discussions do not include work at upstream site BA-3.

BARNSTABLE

Route 6A restriction of Bridge Creek

Site BA-3



Upstream Affected Area (acres): SM – 8.04, SS – 20.23, M – 11.30.

Site Description

Bridge Creek flows in a northerly direction from south of Route 6A, joins with Spring Creek and discharges to Barnstable Harbor. This site lies upstream of restricted site BA-2. Bridge Creek flows under Route 6A via a 4 by 5-foot dry rubble box culvert. The culvert appears to be in good condition, exhibiting only minor decay. Bridge Creek supports both shellfish and anadromous fish.

General Information

The seaward channel is approximately 10-15 feet wide narrowing to 5-10 feet upstream of the restriction. Visual indicators of a restriction include scour and bank erosion on both sides of Route 6A. *Phragmites* is present in the marsh seaward of BA-3 and fringes the upstream affected area. Cattails are present on both sides of the culvert.

- Restriction width - 4 by 5 feet
- Restriction length - 50 feet
- Upstream salt marsh - 8.04 acres

The seaward culvert opening exhibits minor decay.

The upstream side of culvert seen here is neither broken or clogged.

Comments

Sites BA-2 and BA-3 were selected and studied by the Army Corps of Engineers (ACOE) in 1996. The study found that a 10-foot by 20-foot box culvert under both Route 6A and the railroad would provide full restoration of tidal flow. A 4 by 8-foot box culvert under site BA-2 in conjunction with the existing Route 6A culvert would provide partial restoration of tidal flow (ACOE, 1996, pp. 34-35). The Bridge Creek tidal restrictions are currently being studied by the Massachusetts Wetlands Restoration Program for potential remediation in the near future. However, to date restoration and resizing of only the seaward culvert, site BA-2, is likely.

BARNSTABLE

Penn Central Railroad restriction of Brickyard Creek

Site BA-4

Site Description

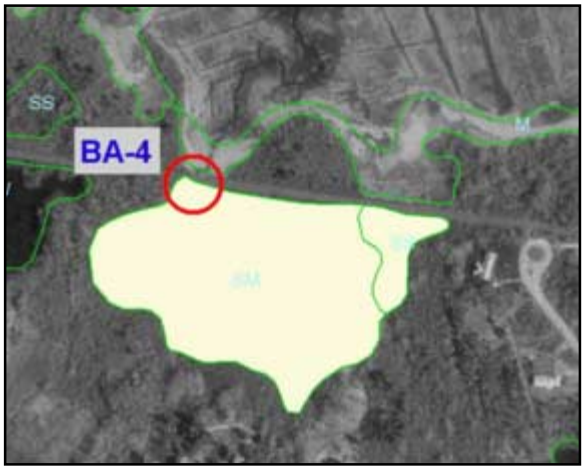
Brickyard Creek flows in a northerly direction from south of Route 6A, joins with Broad Sound and discharges to Barnstable Harbor. Approximately 700 feet west of the end of Buttonwood Lane, Brickyard Creek flows under the railroad via a 2-foot concrete pipe set in a concrete headwall. The culvert is blocked internally, as well as by silt and debris at both openings. Brickyard Creek does support both shellfish and anadromous fish.

General Information

The Creek is approximately 5 feet wide both seaward and upstream of the railroad bed. The marsh area near the seaward opening is severely degraded. Visual indicators of restriction include major erosion, scour, marsh slumping, vegetation die off, and ponded water. The upstream end is in poor condition. Erosion has exposed and undermined the headwall. Because flow is blocked, only minor scouring has scarred the creek bed. *Phragmites* fringes the upstream affected area. Both ends of the pipe are submerged at high tide.

- Restriction width – 2 feet
- Restriction length – 45 feet
- Upstream salt marsh – 8.54 acres

Erosion has exposed and undermined the upstream headwall; high tide lines are visible well above the opening.



Upstream Affected Area (acres): SM – 8.54, SS – 0.89.

The seaward culvert opening, with the high-tide line evident well above it, is scarred by major scouring and bank erosion.

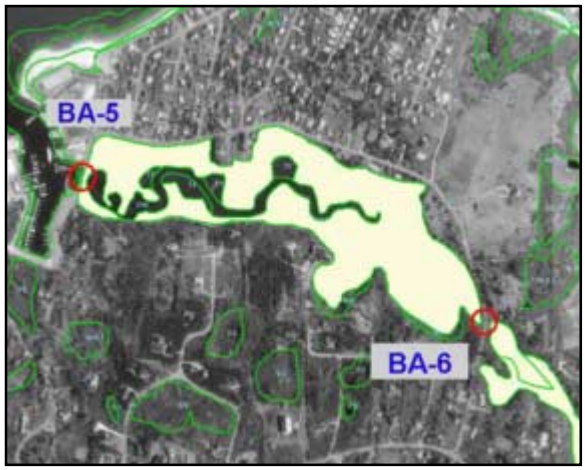
Comments

This culvert is accessible by foot or by small boat at high tide. No road provides direct access to the site. Town officials have witnessed the use of this culvert by anadromous fish, however the run is not nearly as productive as it has been historically.

BARNSTABLE

Millway Road restriction of Maraspin Creek

Site BA-5



Upstream Affected Area (acres): SM – 32.82; SS — 3.82; M — 1.57.

Site Description

Located in Barnstable Village, the concrete bridge of Millway Road separates the marina of Barnstable's inner harbor from the salt marsh of Maraspin Creek. The road crosses the creek via a 23-foot span, with rock armored bridge abutments. The bridge is in excellent condition. This site lies about a half-mile seaward of site BA-6. Barnstable inner harbor does support shellfish, however shellfishing is prohibited. The upstream affected area is located within the Sandy Neck/Barnstable Harbor ACEC.

General Information

Water is detained upstream of the bridge due to an obvious rise in elevation from the seaward to upstream creek bed caused by rocks built up under the bridge. Water flows from the inner harbor under the bridge where it forms a large pool, eventually flowing upstream via approximately four narrow channels. The bridge's abutments are armored, therefore not exhibiting scour or erosion, except for minor signs of each upstream of the bridge. *Phragmites* is not present near the bridge, however does dominate the salt marsh as it nears upstream site BA-6.

- Restriction width – 23 feet
- Restriction length – 36 feet
- Upstream salt marsh – 32.82 acres

Seaward side of Millway Road bridge seen at high tide.

Comments

One of the upstream channels is the site of an old mill dam. Large boulders and cement are still present though the old dam is now breached. This spot may be acting as a restriction and should be considered in any future remedation at this site.

View looking upstream over Maraspin Creek; water pools and then flows upstream via several smaller channels through the marsh.

BARNSTABLE

Commerce Road restriction of Maraspin Creek

Site BA-6

Site Description

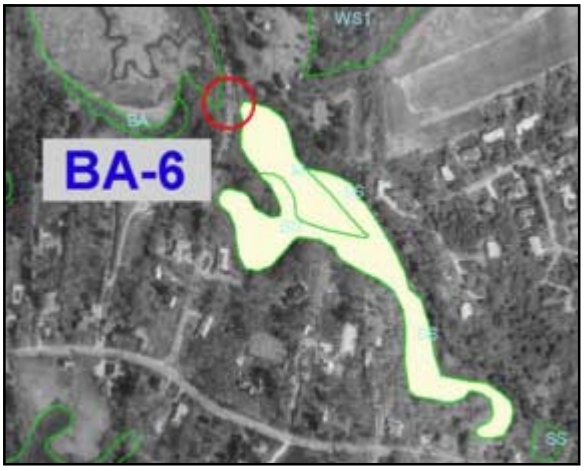
Approximately one-half mile to the east of site BA-5, Maraspin Creek flows under Commerce Road via a 3-foot corrugated metal pipe. The culvert is in fair condition. The upstream end has become elliptical rather than circular, due to the weight of concrete that covers it.

General Information

The creek is approximately 4 feet wide both seaward and upstream of the restriction. Scour and erosion are present near both ends of the pipe. *Phragmites* dominates the marsh on the seaward side. Upstream of the culvert a mix of *Phragmites* and cattails gives way to dominant *Phragmites* approximately 100 yards upstream of the restriction.

- Restriction width – 3 feet
- Restriction length – 75 feet
- Upstream salt marsh – 0 acres

Upstream view of the Commerce Road culvert, which has been misshapen by the weight of this concrete top layer.



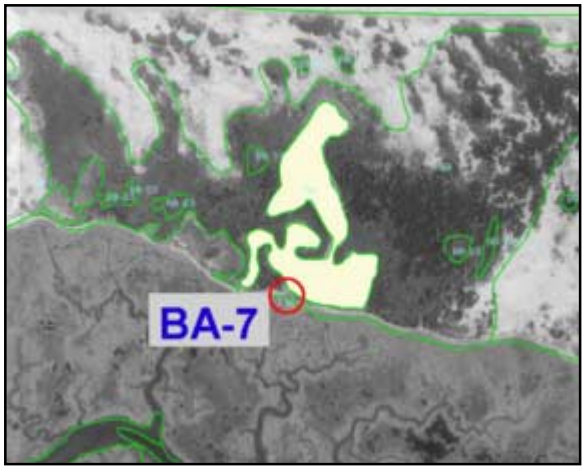
Upstream Affected Area (acres): SS – 3.82; M – 1.57.

The seaward side of culvert under Commerce Road is nearly obscured by the Phragmites.

BARNSTABLE

Jeep trail restriction of channel off Wells Creek

Site BA-7



Upstream Affected Area (acres): SM – 8.88.

Site Description

This site is within the Sandy Neck peninsula of West Barnstable. Sandy Neck is a barrier beach with high dunes separating the beach on its north side from the creeks and marshes on its south side. Wells Creek, flowing north from Barnstable Harbor, crosses under the jeep trail via an 8 by 3.5-foot concrete box culvert. The jeep trail is an unpaved sand and dirt road that runs the length of the peninsula along the edge of the marsh, providing access for the scattered houses on the Neck. Wells Creek supports a shellfish resource area.

General Information

Both the seaward and upstream channels are approximately 10 to 15 feet wide. Rock retaining walls attempt to keep the jeep trail from washing out around the culvert, however scouring and erosion are present at the site.

- Restriction width – 8 feet
- Restriction length – 15 feet
- Upstream salt marsh – 8.88 acres

View of the seaward side of the Sandy Neck culvert at low tide.

High tide at site BA-7, which regularly floods the jeep trail.

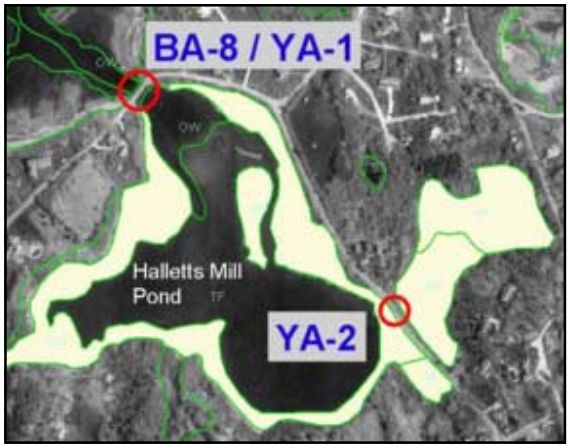
Comments

The existing culvert was constructed in 2000, and is in excellent condition. The town replaced the original structure in order to better accommodate stormflows from the Harbor that had overwhelmed the previous culvert. However, peak high tide flows still cannot be accommodated by the new culvert and result in regular flooding around the site. This site was observed during an incoming tide. Water did not seem to be slowed by the undersized culvert. It simply found its way around the culvert and retaining walls and over the jeep trail.

BARNSTABLE/YARMOUTH

Keveney Lane/Mill Lane restriction of Mill Creek and Hallets Mill Pond

Site BA-8/YA-1



Upstream Affected Area (acres): SM – 15.10; M – 4.10.

Site Description

Mill Creek and Hallets Mill Pond form the Barnstable/Yarmouth town line. The creek flows south from Cape Cod Bay, passes under Keveney/Mill Lane, and flows into Hallets Mill Pond. A bridge spans the river in two sections that are separated by a wide stone center support, in effect acting as two box culverts measuring twelve and thirteen feet wide. The bridge is in good condition. This site lies seaward of restricted site YA-2, which is located at the upstream extent of Hallets Mill Pond. This tidal system supports a shellfish resource area.

General Information

Mill Creek, which is approximately 150 feet wide, must pass through the two openings of the bridge that together total 25 feet. Water is detained upstream of the bridge in Hallets Mill Pond due to an obvious rise in elevation from the seaward to upstream streambed caused by rocks built up under the bridge. Near the bridge, the banks of the pond exhibit visual signs of tidal restriction including minor scour and significant bank erosion, however because much of the bank is armored by rock walls visual indicators are not reliable.

- Restriction width – 25 feet (divided into two sections)
- Restriction length – 12 feet
- Upstream salt marsh – 15.10 acres

Water is detained upstream in Hallets Mill Pond due to rocks built up in the streambed underneath the Keveny/Mill Lane Bridge.

At low tide water flows downhill out of Hallets Mill Pond and seaward via Mill Creek into Cape Cod Bay.

Comments

The upstream affected area lies within both towns, therefore each would need to be involved in any restoration discussion and efforts. According to the Yarmouth Conservation Administrator, Hallets Mill Pond receives about one-third of the flow received in Barnstable Harbor.

MASHPEE/BARNSTABLE

Quinaquissett Road/School Street restriction of the Santuit River

Site MA-6/BA-9

Site Description

The Santuit River forms the town line between Mashpee and Barnstable. Commonly known as the School Street bridge, this site links Quinaquissett Road in Mashpee with School Street in Cotuit, Barnstable. The 45-foot long by 25-foot wide bridge spans the river at its mouth on Shoestring Bay. The bridge span is 45 feet long by 25 feet wide. The upstream banks of the Santuit are largely undeveloped. A narrow strip of salt marsh lines the eastern bank, becoming a larger upstream marsh area comprised of salt marsh, shallow marsh, and shrub swamp. The Santuit River supports an annual herring run. Shellfish are present in Shoestring Bay near this bridge, though shellfishing is prohibited.

General Information

The seaward side of the bridge parallels the northern extent of Shoestring Bay, therefore a channel measurement is not relevant. The Santuit River begins on the upstream side of the bridge and is approximately 100 to 150 feet wide – clearly wider than the 45-foot bridge span. Long bridge abutments were built out from the natural banks to decrease the need for construction of a wider span – obvious contributors to the tidal restriction. Minor scour is visible in the river and bay near the opening. Cattails (seaward and upstream) and *Phragmites* (seaward only) are present along the riverbanks.

- Restriction width – 45 feet
- Restriction length – 25 feet
- Upstream salt marsh – 11.07 acres

Comments

Reconstruction of the bridge began in the fall of 2000. The project is intended to widen the bridge and increase its height above the Santuit River. Unfortunately, reconstruction did not include increasing the width of the span to allow increased tidal flow.

Upstream Affected Area (acres): SM – 11.07; SS – 1.19; M – 17.51.

Construction underway on the Santuit River bridge to widen and raise the roadway; unfortunately plans do not include alleviating the restriction.

Upstream of the bridge salt marsh lines the eastern riverbank while development is visible on the western bank.

BARNSTABLE

Barrier Beach restriction of Rushy Marsh Pond

Site BA-10

Site Description

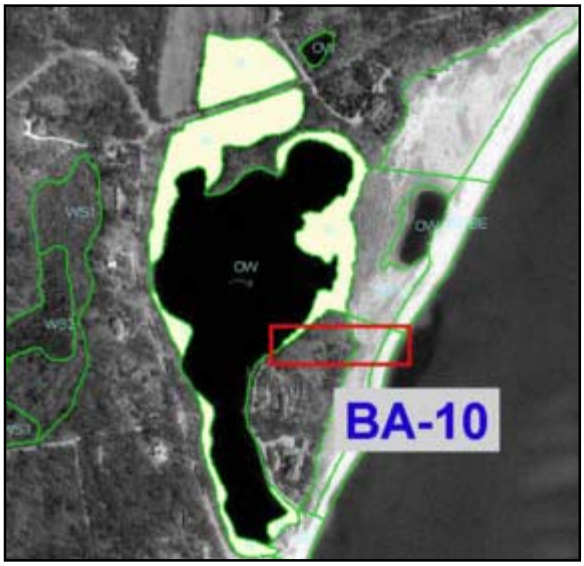
Rushy Marsh Pond is located in the Cotuit section of Barnstable. It is connected to Nantucket Sound by a 1-foot corrugated metal pipe which extends from the Sound under a barrier beach and an upland area of private property to the pond. The length of this crossing is estimated at 300 feet. Main Street crosses the upstream affected area in effect severing the marsh area.

General Information

This culvert is in rather poor condition and provides minimal tidal inflow to the pond. The barrier beach is influenced by longshore currents that frequently alter the beach morphology. A comparison of four USGS topographic maps between 1942 and 1985 shows accretion and erosion of beach spits both north and south of Rushy Marsh Pond (Town of Barnstable GIS department, 2001). The seaward outlet lies in the tidal strip of beach and gets clogged with sand regularly. *Phragmites* covers approximately two-thirds of the pond perimeter.

- Restriction width - 1 foot
- Restriction length - 300 feet (approx.)
- Upstream salt marsh - 0 acres

View from beach toward pond — Phragmites marks the pond's edge.



Upstream Affected Area (acres): M – 8.88.

This stick marks the location of the seaward culvert opening.

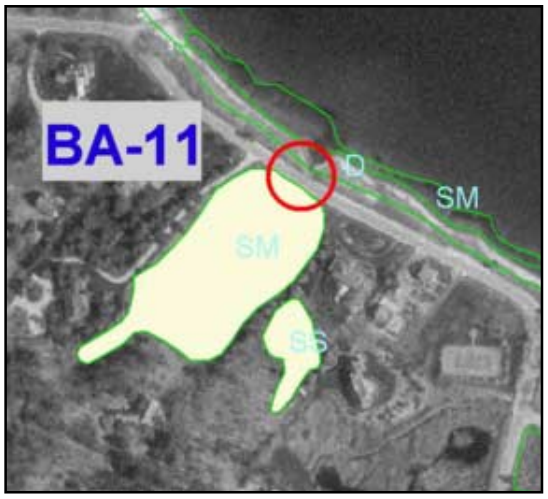
Comments

Staff of the Cape Cod Mosquito Control Project visit the site weekly to clear away sand from the opening. While this seaward side is marked with a pole, the upstream (pond) side could not be found, despite a general indication from the Mosquito Control staff and the assistance of a local historian. A neighborhood group recently formed that advocates for more tidal flushing to the pond.

BARNSTABLE

East Bay Road restriction of an unnamed creek

Site BA-11



Upstream Affected Area (acres): SM – 1.95; SS – .31.

Site Description

A 20-inch diameter concrete culvert under East Bay Road in Osterville connects East Bay with a small salt marsh. The seaward side of the culvert is not visible; it is buried under a pile of rocks. The upstream opening is visibly blocked by sand and muck. Water marks indicate that both ends of the pipe are submerging regularly.

General Information

A channel, 2 feet wide and approximately 20 feet long, connects the seaward opening with East Bay. The upstream channel is also 2 feet wide. Restriction is evidenced by minor erosion on the upstream banks, minor scour in the channel bed, and a large scouring basin on the seaward side. *Phragmites* dominates the vegetation toward the back edge of the affected area.

- Restriction width – 20 inches
- Restriction length – 50 feet
- Upstream salt marsh – 1.95 acres

Stones cover the spot where the seaward opening is believed to be located; a short channel opens into East Bay.

The upstream pipe opening is nearly submerged and erosion has exposed much of the pipe.

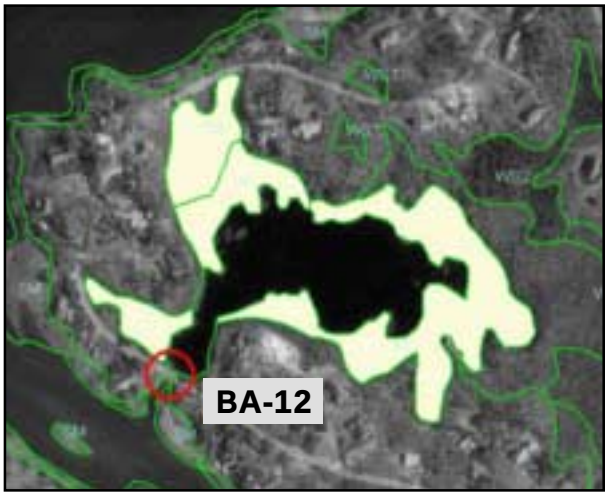
Comments

The wetland area is bordered on three sides by low lying development.

BARNSTABLE

Bay Lane restriction of unnamed channel off the Bumps River

Site BA-12



Upstream Affected Area (acres): SS – 8.38 ; M – 1.68.

Site Description

A tributary of the Bumps River flows under Bay Lane, approximately one-quarter mile north of the South Main Street bridge (see Appendix B, Site BA-e). Flow passes under Bay Lane via a 30-inch opening within a concrete headwall. While the seaward opening is in excellent condition and is not broken or clogged, the upstream opening is clogged by silt and is reduced to only 5 inches by water-control stoplogs that have been inserted to detain flow. Bumps River does support shellfish and anadromous fish.

General Information

A 20-foot wide, 100-foot long, channel connects this culvert to the Bumps River. Visual indicators of a restriction include significant scouring and minor bank erosion near the seaward opening. Upstream, minor erosion is evident. Flow does not appear to be fast and frequent enough to scour the area. The vegetation change is dramatic—seaward, salt marsh exists and dominates, while upstream of Bay Lane *Phragmites* dominates.

- Restriction width – 2.5 feet
- Restriction length – 36 feet
- Upstream salt marsh – 0 acres

Water pools at the seaward side of the culvert under Bay Lane as high tide approaches.

Phragmites dominates the view and the vegetation in the upstream affected area.

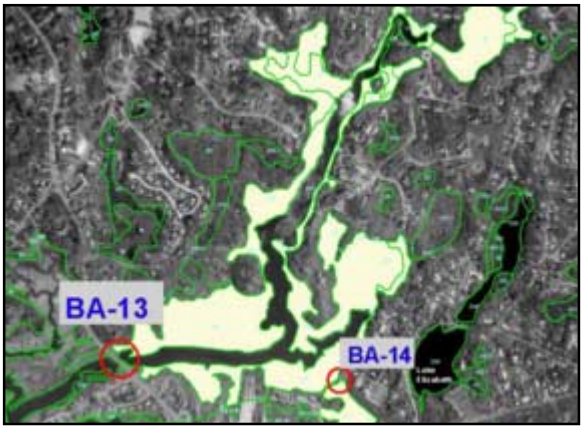
Comments

It appears that the upstream area, now an unnamed pond, was once cranberry bogs. The stoplogs that are in place leaving only a 5-inch opening seem to be preventing any flushing in this upstream area. The party responsible for management of water level and placement of stoplogs should be identified. The Town of Barnstable is currently relaying shellfish in the Bumps River to other locations in town to allow them to depurate and ultimately become available for shellfishing.

BARNSTABLE

Craigville Beach Road restriction of the Centerville River

Site BA-13



Upstream Affected Area (acres): SM – 56.26; SS – 7.48; M – 17.59.

Site Description

In Centerville, Craigville Beach Road crosses the Centerville River on a bridge spanning 55 feet. Upstream of this bridge the Centerville River continues north connecting Long Pond and ultimately Wequaquet Lake. The bridge is supported by wood pylons in the riverbed. This site is the seaward-most restriction found along the Centerville River affecting upstream site BA-14 as well as non-restricted sites BA-i and BA-j (see Appendix B). The Centerville River supports shellfish resources and an anadromous fish run.

The Craigville Beach Road bridge undergoing reconstruction in the fall of 2000.

General Information

The river is approximately 100 feet wide both seaward and upstream of the bridge. Visual indicators of a restriction include significant scouring and minor erosion seaward of the bridge and minor scour, erosion, and vegetation die off upstream. *Phragmites* fringes the salt marsh that lines the upstream riverbanks.

Salt marsh lines the banks of the Centerville River upstream of the Craigville Beach Road bridge.

- Restriction width – 55 feet
- Restriction length – 35 feet (approximate)
- Upstream salt marsh – 56.26 acres

Comments

The bridge underwent reconstruction from autumn 2000 through spring 2001 in order to improve its structural integrity, but not to widen the bridge span. The Town of Barnstable is currently relaying shellfish in the Centerville River to other locations in town to allow them to depurate and ultimately become available for shellfishing.

BARNSTABLE

Pleasant Street restriction of channel to Lake Elizabeth

Site BA-14

Site Description

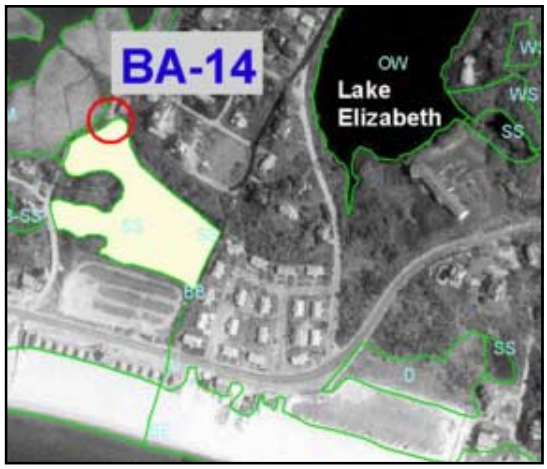
Pleasant Street, an abandoned dirt road, crosses the stream connecting Lake Elizabeth with the Centerville River system. The stream passes under the old road via a 20-inch concrete (seaward opening) and corrugated metal (upstream opening) pipe. This pipe appears to be located on the private property of the Craigville Christian Camp Conference Center. This site lies upstream of restricted site BA-13. The seaward end is in poor condition and is partially clogged with muck and debris, while the upstream end is in fair condition. This stream supports an anadromous fish run from the Centerville River to Lake Elizabeth and Red Lily Pond.

General Information

The seaward channel is approximately 5 feet wide and actually widens upstream where it varies between approximately 5 and 10 feet. Visual indicators of a restriction include minor pooling, scouring basins, and erosion on both the seaward and upstream sides. Small stands of *Phragmites* are also found at the both ends of the culvert. No water was observed to be flowing through this pipe.

- Restriction width – 20 inches
- Restriction length – 60 feet
- Upstream salt marsh – 0 acres

Upstream end of culvert, with seaward side in background.



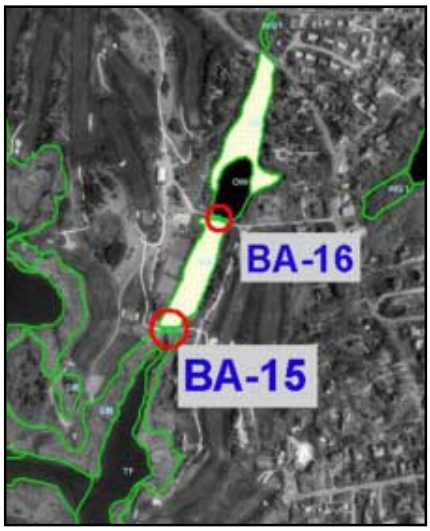
Upstream Affected Area (acres): SS – 3.25.

View from the culvert into the Centerville River and salt marsh beyond; a narrow stand of Phragmites lines the roadway near the pipe.

BARNSTABLE

Hyannisport Golf Club cart path over Halls Creek

Site BA-15



Upstream Affected Area (acres): SM – 2.52; SS – 3.04.

Site Description

Halls Creek flows from Centerville Harbor, past Squaw Island, along the eastern edge of the private Hyannisport Golf Club course and connects with Simmons Pond to the north of Craigville Beach Road. An unpaved golf cart path accessed from Marchant Mill Road, crosses the creek near the third hole's tee-off area. The path crosses the creek via a 10-foot wooden bridge. The bridge span is effectively reduced to approximately 7 feet by a protruding wall that retains the tee-off green. Restricted site BA-16 lies approximately one-quarter mile north of this site. Halls Creek does not support shellfish in the vicinity of this site, nor does it support anadromous fish.

Seaward side of wooden bridge over Halls Creek with the tee-off area protruding into the channel on the right. Vegetation die off and bank erosion scar the creek banks.

General Information

The stream channel is approximately 15-20 feet wide seaward narrowing to 10-15 feet wide upstream of the bridge. By the time the channel reaches upstream site BA-16 it has broken into smaller channels ranging from 2 to 10 feet. Minor bank erosion and vegetation die off occur on both sides of the bridge, and a slight scouring basin is present on the upstream side. There is also minor surface ponding on the upstream side.

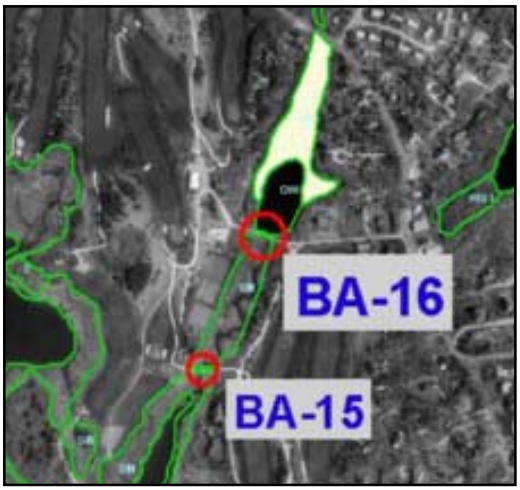
- Restriction width – 10 feet
- Restriction length – 13 feet
- Upstream salt marsh – 2.52 acres

When looking upstream from the bridge across the affected salt marsh the berm of site BA-16 is visible in the distance.

BARNSTABLE

Marchant's Mill Road restriction of Halls Creek

BA-16



Upstream Affected Area (acres): SS – 3.04.

Site Description

Halls Creek flows from Centerville Harbor, past Squaw Island, along the eastern edge of the private Hyannisport Golf Club course and connects with Simmons Pond to the north of Craigville Beach Road. Halls Creek is first restricted by site BA-15 and then is further restricted at this site by Marchant's Mill Road, a private road. Flow passes under the road via a 20-inch concrete pipe. The upstream side of the pipe is set approximately 2 feet below the surface water level within a concrete headwall outfitted for the placement of water-control stoplogs. Halls Creek does not support shellfish resources in the vicinity of this site, nor does it support anadromous fish.

This 20-inch opening moves water from the upstream pond seaward through the downstream salt marsh of Halls Creek.

General Information

The salt marsh that is considered the upstream affected area of site BA-15 extends to the seaward side of Marchant's Mill Road. Cattails are present in the salt marsh as it approaches this site. Upstream of this pipe, the creek becomes a pond that is surrounded by shrub swamp and scattered low-lying development. Channels through the seaward salt marsh range from 2 to 10 feet. Visual indicators of a restriction include ponded water, vegetation die off, minor scour and bank erosion near the seaward pipe opening. No *Phragmites* was visible.

- Restriction width – 20 inches
- Restriction length – 20 feet
- Upstream salt marsh – 0 acres

Upstream of Marchant's Mill Road, a private road, this pond is fringed by shrub swamp and scattered, low-lying development.

Comments

The Wetlands Conservancy Program delineated both open water and shrub swamp adjacent to the upstream pipe opening. When fieldwork was conducted for this Atlas, water-control stoplogs were not in use. The water level was high enough so that water was still ponded upstream and was draining seaward at a steady rate.

BARNSTABLE

Ocean Avenue restriction of Stewart's Creek

Site BA-17

Site Description

Stewart's Creek is restricted by a 2-foot concrete culvert under Ocean Avenue with water-control stoplogs on the upstream end. Stewart's Creek is connected to Hyannis Harbor by this culvert. The culvert appears to be in good condition and, except for the stoplogs, is not clogged. Hyannis Harbor does support shellfish resources, though fishing is prohibited. Stewart's Creek supports an anadromous fish run that is severely restricted by many undersized culverts in the upstream creek system.

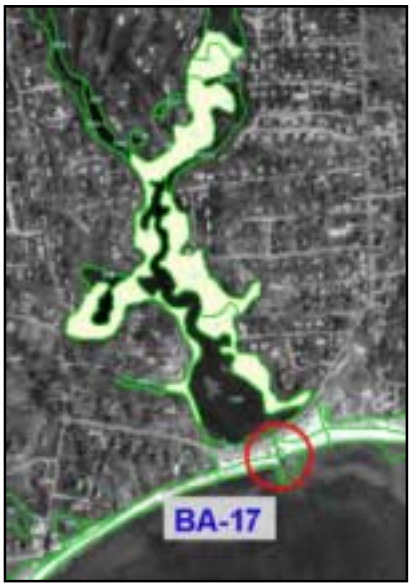
General Information

The seaward side of the creek is 20 feet wide and runs approximately 100 feet from the culvert to the shoreline of Hyannis Harbor. Visual indicators of a restriction include seaward scour and erosion. The seaward side of the pipe becomes submerged at high tide, evidenced by high water marks. The upstream end is elevated above the seaward opening. *Phragmites* is the dominant vegetation visible along the upstream banks of Stewart's Creek, continuing along the banks of Joshua's Creek. Minor bank erosion is also evident in the upstream channel.

- Restriction width – 2 feet
- Restriction length – 45 feet
- Upstream salt marsh – 0 acres

Comments

This site was examined by the Massachusetts Wetlands Restoration Program in July 1999, which documented the upstream embayment as becoming eutrophic and likely to benefit from greater tidal flushing. Sedimentation, water depths, and effects on shellfish in the Harbor are issues of concern at this site. Recently, this site was picked up by Army Corps of Engineers Section 206 Program. A Preliminary Restoration Plan will be released in early fall, 2001. Should the Town of Barnstable elect to partner with the Corps, the next step will be to study feasibility of remediation and prepare a Planning Design and Analysis that could ultimately lead to reconstruction of the site.



Upstream Affected Area (acres): SS – 15.07; M – 4.24.

Seaward side of the Ocean Avenue culvert viewed from Keyes Beach. High water marks appear above the top of the culvert opening.

Looking upstream from Ocean Avenue into the Stewart's Creek marshes. Phragmites is visible all along the heavily developed shoreline.

BARNSTABLE

Hawes Avenue restriction of unnamed creek

Site BA-18

Upstream Affected Area (acres): SM – 12.11.

Site Description

The culvert is located approximately 200 feet west of the entrance to Kalmus Park Beach in Hyannis. Hawes Avenue runs east to west, paralleling the shoreline of Hyannis Harbor. A 3-foot culvert runs under Hawes Avenue, connecting tidal flow in the Harbor with a large salt marsh area north of the road. The seaward side of the culvert is a 3-foot metal pipe set within a stone jetty in Hyannis Harbor. The opening is submerged at mean high tide. The pipe is approximately 250 feet long, emerging upstream as a 3-foot diameter concrete culvert set in an angled wing and headwall.

General Information

There are no measurable channels in this system. Hyannis Harbor is the seaward area and an unnamed pond within a patch of salt marsh makes up the upstream area. Visual indicators of restriction include a major scour basin near the upstream opening, as well as minor bank erosion and erosion behind the concrete headwall. Ocean Street delineates the eastern edge of the upstream affected area, and *Phragmites* visibly dominates the marsh area behind the houses on it.

- Restriction width – 3 feet
- Restriction length – 250 feet (approximate)
- Upstream salt marsh – 12.11 acres

The seaward side of the pipe, seen under this stone jetty, opens directly into Hyannis Harbor.

Concrete wing walls frame the culvert opening on the upstream side, submerged here at high tide.

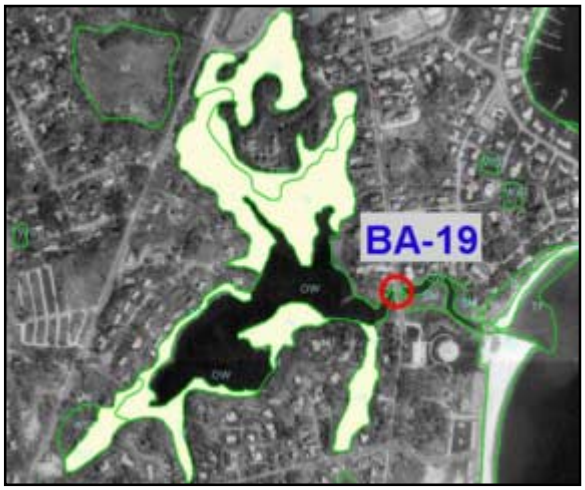
Comments

Non-restricted site BA-m effectively separates the upstream affected areas of sites BA-18 and BA-19. According to the Barnstable Engineering Division, it is likely that historically site BA-m was an operating culvert, allowing flow to pass under Gosnold Avenue and hydrologically connecting the affected areas of sites BA-18 and BA-19.

BARNSTABLE

Ocean Street restriction of Snows Creek

Site BA-19



Upstream Affected Area (acres): SS – 6.78 ; M – 13.41.

Site Description

In Hyannis, Snows Creek flows under Ocean Street via a 3-foot metal pipe set in large concrete retaining walls. On the seaward side, the wall rises five feet above the stream bed. The upstream opening is semi-circular with a 3-foot diameter. It is set in a concrete headwall with two concrete side walls containing the stream. The semi-circular shape is the result of a stone base plate blocking half of the pipes opening. The seaward opening is clogged by silt and debris.

General Information

Seaward, the creek is approximately 30 feet wide. The upstream channel is short, and becomes an open pond approximately 100 feet beyond the culvert. A minor stand of *Phragmites* is present near the upstream opening. Other evidence of tidal restriction includes a minor scouring basin and vegetation die-off near the seaward opening.

- Restriction width – 3 feet
- Restriction length – 30 feet (approximate)
- Upstream salt marsh – 0 acres

Concrete headwall on the seaward side of Snows Creek obscures the culvert opening below the water surface.

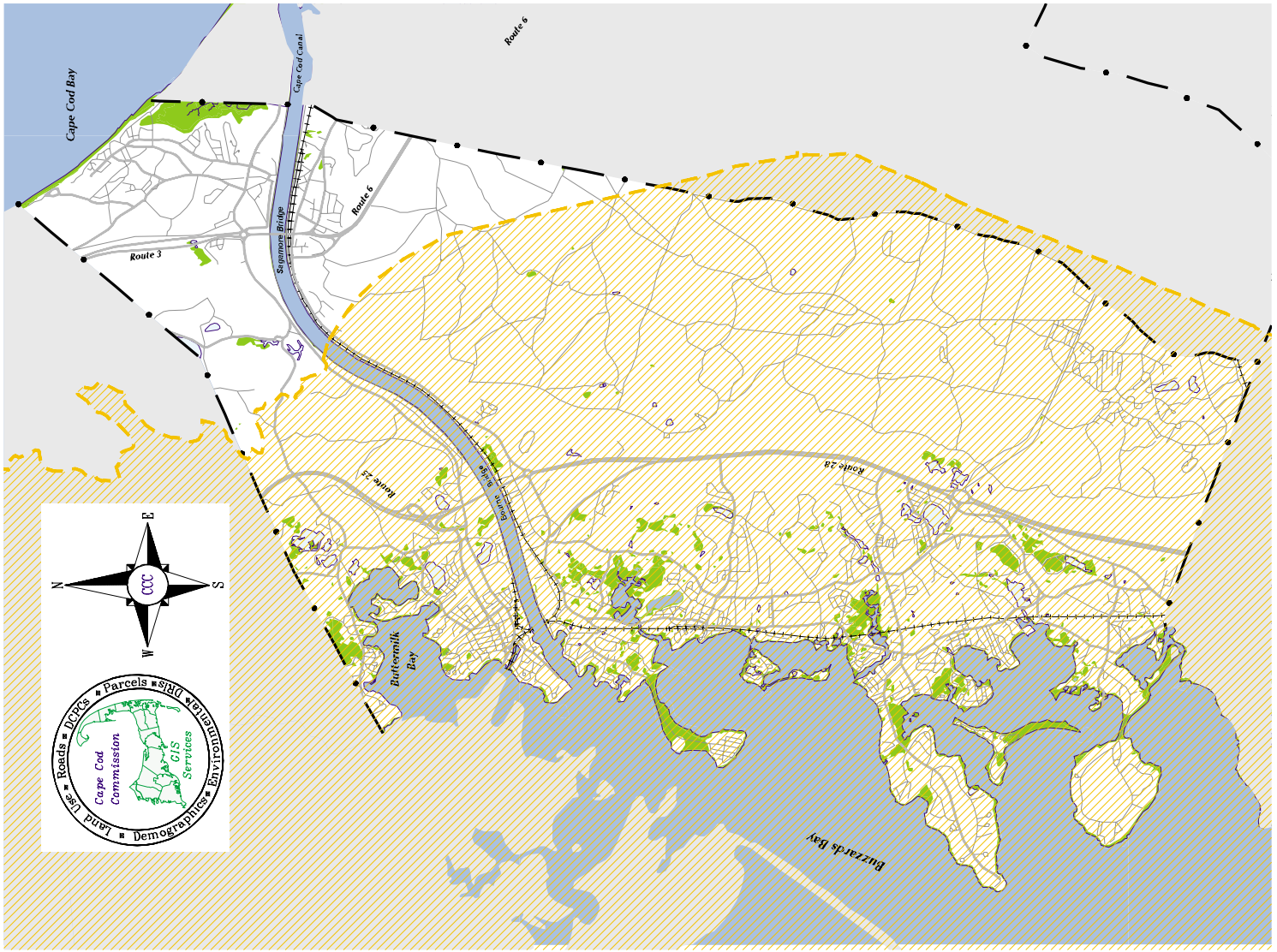
Concrete retaining walls channel Snows Creek into a 3-foot opening, submerged here at high tide.

Comments

Sand build up at the mouth of Snows Creek is a constant problem for the tidal system causing a major restriction before the flow can even reach this culvert. Non-restricted site BA-m effectively separates the upstream affected areas of sites BA-18 and BA-19. According to the Barnstable Engineering Division, it is likely that site BA-m was a historically operating culvert, allowing flow to pass under Gosnold Avenue and hydrologically connecting the affected areas of sites BA-18 and BA-19.

TOWN OF BOURNE

- Town Map



TOWN OF BOURNE

Location of Selected Salt Marsh Restrictions

This map was produced by the Cape Cod Commission Geographic Information System office, with digital data from MassGIS and the Cape Cod Commission, 2001.

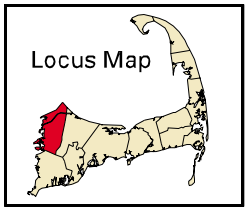
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis.

This project was funded, in part, by the Executive Office of Environmental Affairs, Massachusetts Wetlands Restoration Program.

- Restriction Site *
- Wetland
- Ocean
- Pond or Lake
- Buzzards Bay Watershed **
- Local Road
- Major Route
- Stream
- Railroad

* There are no identified salt marsh restriction sites in the Town of Bourne located outside of the Buzzards Bay Watershed.

** Area covered in the "Atlas of Tidally Restricted Salt Marshes," for the Buzzards Bay Watershed, prepared by the Buzzards Bay Project National Estuary Program, December 2000.



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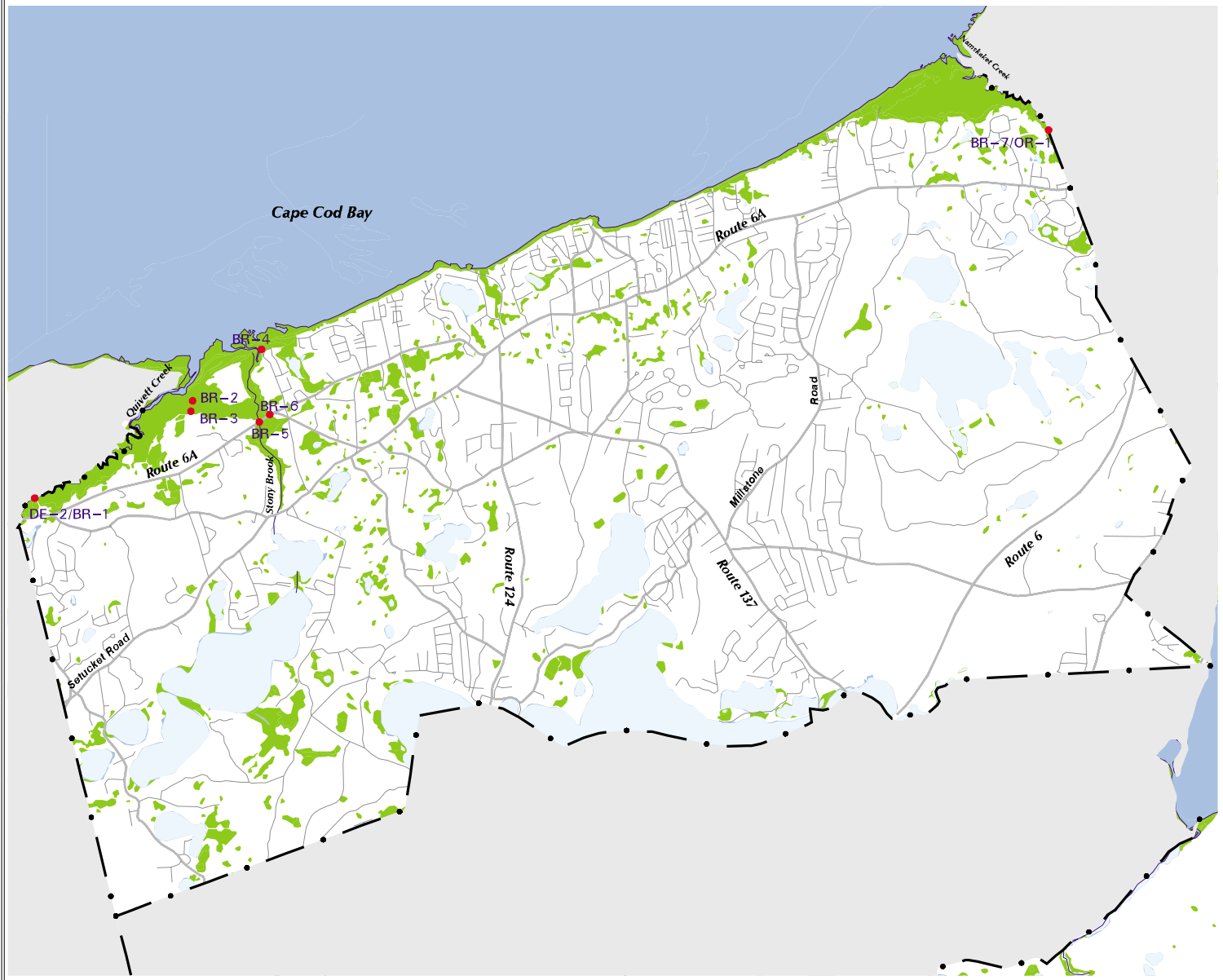
Massachusetts State Plane Feet

2001

TOWN OF BREWSTER

- Town Map
- Chart of Site Characteristics
- Sites 1 to 7



TOWN OF BREWSTER

Location of Selected Salt Marsh Restrictions

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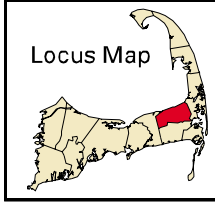
This project was funded, in part, by the Executive Office of Environmental Affairs, Massachusetts Wetlands Restoration Program.

- BR – 1 Restriction Site
- Wetland
- Ocean
- Pond or Lake
- Local Road
- Major Route
- Stream
- Railroad

Locus Map



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0 2,500 5,000
Massachusetts State Plane Feet
North American Datum – 1927

Land Use ✱ Roads ✱ DCPCs ✱ Parcels ✱ Demographics ✱ Environmental ✱ DRIs
Cape Cod Commission
GIS Services

N W CCC E S

2001

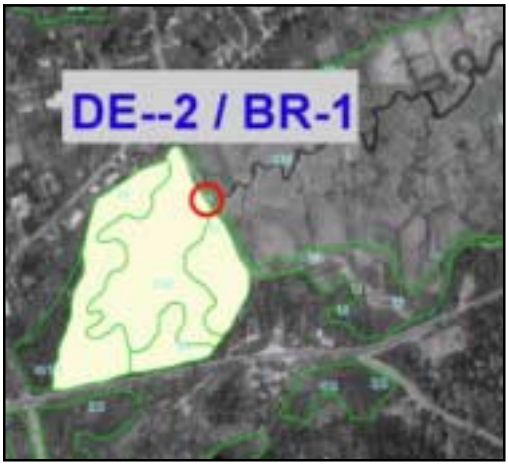
Town of Brewster –Site Characteristics

Site Number	Size of upstream affected area (salt marsh acres / total affected acres)	Is the upstream affected area contiguous to protected open space (ownership)?	Does this tidal channel support a shellfish resource area?	Is the channel or system part of an anadromous fish pathway?	Does the culvert/pipe support an engineered flood control structure?	Is the affected area or site within an ACEC boundary?	Does the affected area include Priority Habitat of Rare Species (PH) or Estimated Habitat of Rare Wildlife (WH)?	Are there any restricted sites upstream of this site (site number)?	Ownership of the site (public vs. private)
DE-2/ BR-1	5.29 / 11.62	YES (municipal)	YES	YES	NO	NO	YES (PH)	NO	PUBLIC
BR-2	0.83 / 4.94	NO	NO	NO	NO	NO	YES (PH)	YES (BR-3)	PRIVATE
BR-3	0.0 / 3.75	NO	NO	NO	YES (flapper gate)	NO	YES (PH)	NO	PRIVATE
BR-4	8.39 / 21.29	YES (municipal)	NO	YES	NO	NO	NO	NO	PUBLIC
BR-5	12.25 / 31.56	NO	YES	YES	NO	NO	YES (PH, WH)	NO	PUBLIC
BR-6	12.25 / 31.56	NO	YES	YES	NO	NO	YES (PH, WH)	NO	PUBLIC
BR-7/ OR-1	1.12 / 6.94	YES (state)	YES	NO	NO	YES	YES (PH, WH)	NO	PUBLIC

DENNIS/BREWSTER

Sea Street restriction of Quivett Creek

Site DE-2/BR-1



Upstream Affected Area (acres): SM – 5.29; SS – 0.99; M – 5.34.

Site Description

Sea Street was abandoned just north of Quivett Creek near its headwaters on the Dennis/Brewster town line. Pedestrian access continues south on the abandoned road-bed across Quivett Creek. According to local officials, there are two culverts under the former Sea Street each measuring 20-inches (these culverts were not visible during fieldwork conducted for this Atlas). The seaward side of the Creek pools significantly at the roadway berm as tidal flow tries to pass under Sea Street. A three-sided concrete structure passes the flow on the upstream side of the Sea Street path. A 20-inch corrugated metal pipe is also located at the site. Although it is sited high in the bank, it regularly passes water at high tide. Quivett Creek supports an active anadromous fish run to spawning ponds south of Route 6A.

This corrugated metal pipe is suspended high in the bank but does pass water regularly. Water also flows through an obscured opening below this water line.

General Information

Quivett Creek is approximately 10 feet wide both seaward and upstream of the restriction. Obvious characteristics of a tidal restriction are present on either side of the submerged culverts – major scouring occurs as the water is detained in basins it has formed near the culvert openings; the banks of Quivett Creek are eroding significantly due to the unnatural stream conditions; the marsh near the seaward opening exhibits both marsh slumping and vegetation die off. The vegetation changes significantly from the seaward to the upstream sides of the restriction – there is a significant presence of *Phragmites* in the upstream area.

- Restriction width – two 20-inch pipes
- Restriction length – 55 feet
- Upstream salt marsh – 5.29 acres

Flow is directed down through this concrete structure; broken pipe and the suspended pipe are visible in the background.

Comments

After significant study by a team including the National Marine Fisheries Service (NMFS), the Massachusetts Wetlands Restoration Program, and local officials from Dennis and Brewster, this site is targeted for remediation. One tidal measurement taken during a study showed a high tide water level 18 inches higher on the seaward than on the upstream side of Sea Street. The NMFS has funding in place for this restoration and is moving forward with the cooperation of both communities.

BREWSTER

Cranberry bog berm restriction of channel off Quivett Creek

Site BR-2

Upstream Affected Area (acres): SM – 0.83; SS – 0.36; M – 3.75.

Site Description

West of Drummer Boy Park Butler Lane extends north from Route 6A, ending at a cul-de-sac where several walking trails lead into the woods north of Butler Lane. For detailed trail directions speak with the local Conservation Commission, which is aware of this restriction and its specific location. Privately owned, now inactive, cranberry bogs dot the marsh. Berms built to support past cranberry farming are still in place, severing the tidal flow. This site (lying seaward of BR-3) consists of a 6-inch plastic, PVC pipe set low in the cranberry bog berm. To keep the weight of the berm off the pipe, and to help keep the opening clear, wooden boards form a casing around the pipe's seaward opening. The upstream pipe opening sticks out under a heavily eroded retaining wall.

Bank scouring is severe as water pools by the seaward side of this restrictive cranberry bog berm; boards form a casing around the tiny, 6 inch pipe.

General Information

The seaward channel is approximately 5 feet wide. Where the tide attempts to pass through the berm it is effectively dammed by the berm – the 6-inch pipe allows on a fraction of the tidal flow to pass upstream. Delineated as salt marsh by the WCP, *Phragmites* and scrub brush dominate the upstream area. This vegetation is in stark contrast to the extensive salt marsh just seaward of this site, extending to the berm itself. At the seaward opening the visual indicators of a tidal restriction are extreme – scour, bank erosion, and vegetation die-off are each evident and are among the worst observed.

- Restriction width – 6 inches
- Restriction length – 22 feet
- Upstream salt marsh – 0.83 acres

Scour, erosion, and vegetation die-off are severe in the seaward salt marsh adjacent to site BR-2.

Comments

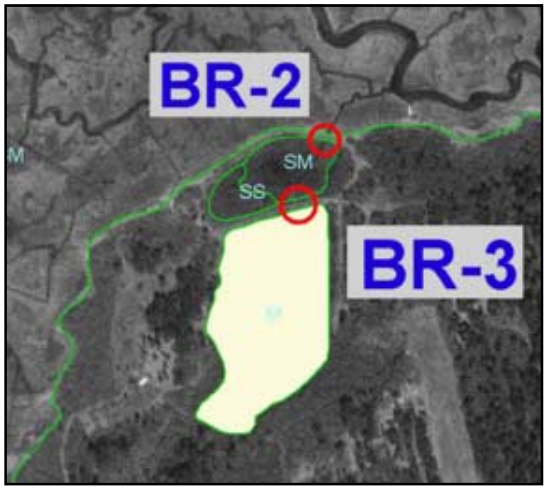
While the berms and bog areas are privately owned, these and other pathways traversing the Quivett Creek marshes are heavily used by the public. There are no protected open space parcels directly adjacent to this upstream affected area. The town is interested in purchasing and protecting land in this area however, land prices are high and there is hope that private citizens will take steps to protect this marsh area.

The upstream opening of the 6-inch pipe is barely visible under the heavily eroding wooden retaining wall.

BREWSTER

Cranberry bog berm restriction of channel off Quivett Creek

Site BR-3



Upstream Affected Area (acres): M – 3.75.

Site Description

The restriction is a 2-foot corrugated metal pipe with flapper gate (seaward) and a box–type dam structure (upstream) restricting flow under an old cranberry bog berm. This site lies at the rear of the 0.83 acre patch of salt marsh delineated upstream of site BR-2. As is site BR-2, this site is reached via walking trails accessed from the Butler Lane cul-de-sac.

General Information

The pipe is set approximately 4 feet below the upstream dam structure, effectively preventing any incoming tidal flow from rising up and out of the pipe to naturally flush the upstream affected area. The upstream affected area is dominated by *Phragmites.* Water is pooled around the dam structure upstream; currently no stoplogs are in place and water is constantly draining from this area. The seaward channel (estimated width averaging 4 feet) is approximately twice the width of the 2-foot pipe. There is a flapper valve stuck in place, open only 5 inches.

- Restriction width – 2-foot pipe with flapper gate
- Restriction length – 30 feet
- Upstream salt marsh – 0 acres

Corrugated metal pipe with flapper gate visible through the Phragmites at the seaward opening of BR-3.

Metal dam structure in the Phragmites-dominant marsh upstream of the old cranberry bog berm (now a footpath).

Comments

Site BR-2 lies seaward of this site and is severely restricted – fieldwork was conducted during an incoming tide but no tidal waters were reaching the seaward side of BR-3. There are no protected open space parcels directly adjacent to this upstream affected area. The town is interested in purchasing and protecting land in this area, however land prices are high and there is hope that private citizens will take steps to protect this marsh area.

BREWSTER

Paine's Creek Road restriction of channel into Freemans Pond

Site BR-4

Site Description

At the mouth of Stony Brook on Cape Cod Bay a tidal creek flows under Paine's Creek Road via a 3-foot corrugated metal pipe. The tidal creek, which flows into Freemans Pond, is approximately one quarter mile long and runs parallel to the shoreline for about half its length. Originally, the pond connected to the Bay by a creek flowing due north from the pond. The pipe is in fair condition. Rock reinforcement lines the banks near the pipe openings. The seaward opening is submerged at mean high tide, evidenced by high tide lines visible well above the opening. This channel supports an anadromous fish run (brown trout).

General Information

A 20-foot wide channel branches off of Stony Brook at its mouth and travels only about 15 feet before reaching the culvert. The upstream channel is approximately 6-feet wide. Visual indicators of restriction include minor scouring basins and minor bank erosion at both the seaward and upstream ends of the pipe. Natural stream conditions and free flow are not evident. There is no *Phragmites* in sight of this restriction.

- Restriction width – 3 feet
- Restriction length – 60 feet
- Upstream salt marsh – 8.39 acres

Comments

Freemans Pond is the only salt pond in the town of Brewster. Conditions are severely degraded and the system is converting to a freshwater ecosystem. According to the Brewster Natural Resources officer, the town would like to restore the natural saltwater ecosystems. This site was selected and studied by the Army Corps of Engineers in 1996. The study found that restoration of tidal flows would be best provided by a slightly larger and deeper culvert along with channel dredging (ACOE, 1996, pp. 37-48).

Upstream Affected Area (acres): SM – 8.39; M – 4.36; SS – 8.54.

The 3-foot opening, dwarfed by the pooling water, clearly restricts natural free-flowing stream conditions.

Erosion and scour are visible near the upstream opening; the channel meanders between coastal banks and salt marsh on its way to Freemans Pond.

BREWSTER

Route 6A restriction of Stony Brook

Site BR-5

Site Description

Stony Brook crosses under Route 6A via a 3-foot wide metal pipe set in concrete and stone headwalls. This site lies just to the east of the Cape Cod Museum of Natural History, west of the intersection of Lower Road with Route 6A, and approximately 150 feet west of site BR-6. Sites BR-5 and BR-6 affect the same upstream salt marsh, shrub swamp, and shallow marsh systems. Stony Brook is an active and successful anadromous fish pathway for both herring and brown trout.

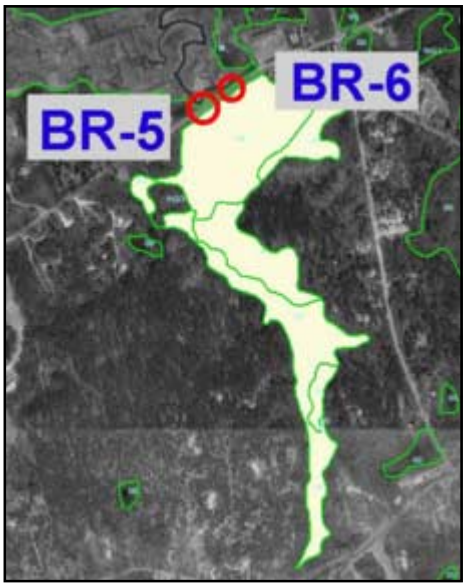
General Information

The seaward pipe opening protrudes from a stone headwall that is in serious disrepair; the stone slabs have eroded, slipped out of place, and now partially block the pipe opening adding to its restrictive nature. The upstream channel is approximately 10-15 feet wide. By contrast the upstream channel is only 3 feet wide. The pipe is submerged at high tide – water marks are visible on the headwall well above the opening. Other visual indicators of a restriction include scouring and bank erosion near the seaward opening. Additionally, there is significant scouring adjacent to the upstream opening. A large amount of sand has been deposited at the edge of the scour pool in the upstream channel.

- Restriction width – 3 feet
- Restriction length – 50 feet
- Upstream salt marsh – 12.25 acres

Comments

According to the Brewster Natural Resources Officer, anadromous fish are found well upstream of this restriction throughout the freshwater ponds south of the Stony Brook Mill.



Upstream Affected Area (acres): SM – 12.25; SS – 13.12; M – 6.19.

The seaward culvert is visible at low tide with water pooling by this partially blocked opening.

A large sandbar has formed in the upstream channel near the culverts' scour basin – road runoff from the nearby major road junction is a likely source.

BREWSTER

Route 6A restriction of a channel off of Stony Brook

Site BR-6

Site Description

Immediately west of the intersection of Lower Road and Route 6A a branch off of Stony Brook crosses under Route 6A via a 2.5-foot wide metal pipe set in concrete and stone headwalls. The main branch of Stony Brook crosses under Route 6A at site BR-5 just to the west of this site. Both sites affect the same upstream salt marsh, shrub swamp, and shallow marsh systems. Stony Brook is an active and successful anadromous fish pathway for both herring and brown trout.

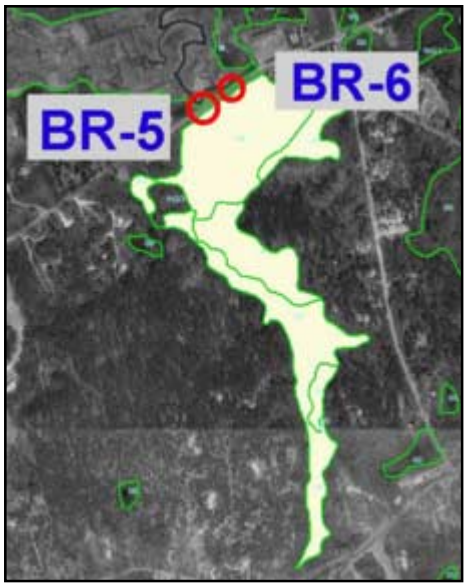
General Information

The seaward side of the pipe is in generally good condition except for erosion near the headwall that has caused a rockslide from the bank into the channel. There is a significant scour basin present near the seaward opening, which is submerged at mean high tide. The upstream pipe opening is set in a rock and concrete headwall that was originally designed to enable the placement of water-tight stop logs. The frame to hold such logs has eroded away and the remaining headwall is beginning to crumble. Both seaward and upstream tidal channels are approximately 10 feet wide. *Phragmites* is the significant vegetation in the upstream affected area.

- Restriction width – 2.5 feet
- Restriction length – 50 feet
- Upstream salt marsh – 12.25 acres

Comments

According to the Brewster Natural Resources Officer, spawning fish are found well upstream of this restriction throughout the freshwater ponds south of the Stony Brook Mill. Although this culvert does not pass the flow from the main channel of Stony Brook, it is part of the same tidal creek system and flows into the same upstream marsh area.



Upstream Affected Area (acres): SM – 12.25; SS – 13.12; M – 6.19.

This headwall supporting the upstream opening is in need of repair—it is eroding and falling into the channel below.

The seaward opening is nearly submerged even well before the tide is high. Watermarks are visible near the top of the headwall.

BREWSTER/ORLEANS

Cape Cod Rail Trail restriction of Namskaket Creek

Site BR-7/OR-1

Site Description

The Cape Cod Rail Trail bike path crosses the Namskaket Creek at the Brewster-Orleans town line causing a major tidal restriction. Access to the site is via the bike path only. One 1-foot pipe was found here, however there might be additional pipes that were not visible. This pipe is so egregiously undersized and the site degraded that tidal flow is effectively cut off from the upstream marsh area. This site is located within the boundaries of the Inner Cape Cod Bay Area of Critical Environmental Concern, owned and managed by the state Department of Environmental Management (DEM).

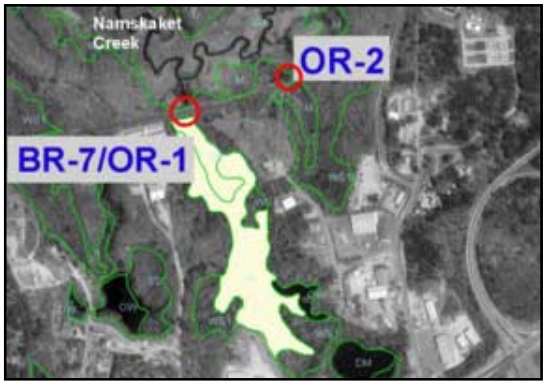
General Information

The site is in serious disrepair. The seaward pipe opening was obscured and buried under a pile of rocks. After some digging a 1-foot metal pipe was uncovered. Upstream of the bike path, water is flowing down into a hole below ground where the pipe is presumed to be – the pipe itself is not visible. The creek banks at the site are extremely eroded, with vegetation die off and major scouring pools scarring the upstream site. The width of Namskaket Creek varies between 6 and 10 feet both seaward and upstream of the Rail Trail. *Phragmites* dominates the upstream affected area. The restriction has persisted for so long that the upstream system has become mainly a freshwater marsh.

- Restriction width – 1 foot (estimated)
- Restriction length – 62 feet
- Upstream salt marsh – 1.12 acres

Comments

A joint restoration effort is underway by the Natural Resources Conservation Service (NRCS), DEM, Orleans and Brewster local officials, the state Wetlands Restoration Program, and MA Coastal Zone Management. At the time of this writing inventory and assessment, a needs assessment, and cost estimates for materials and services have been completed. The restoration project is currently in the permitting process and work is expected to begin in Fall 2002.



Upstream Affected Area (acres): SM – 1.12; M – 5.82.

An eroding retaining wall helps support the Cape Cod Rail Trail that is restricting tidal flow in Namskaket Creek – water is seen bubbling out from under a pile of rocks that covers the 1-foot pipe.

Phragmites and shrubs are seen taking over the once salt marsh upstream of the Rail Trail.

TOWN OF CHATHAM

- Town Map
- Chart of Site Characteristics
- Sites 1 to 7

TOWN OF CHATHAM

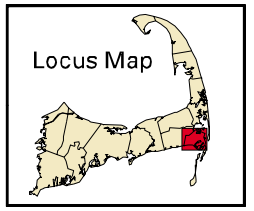
Location of Selected Salt Marsh Restrictions

This map was produced by the Cape Cod Commission Geographic Information System office, with digital data from MassGIS and the Cape Cod Commission, 2001.

The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis.

This project was funded, in part, by the Executive Office of Environmental Affairs, Massachusetts Wetlands Restoration Program.

- CH – 1 Restriction Site
- Wetland
- Ocean
- Pond or Lake
- CC National Seashore
- Local Road
- Major Route
- Stream
- Railroad



Miles
0 0.5 1
0 2,500 5,000
Massachusetts State Plane Feet
North American Datum – 1927

Land Use ■ Roads ■ DCPCs ■ Parcels ■ Demographics ■ Environmental ■ DRIs
Cape Cod Commission
GIS Services

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2001

Town of Chatham –Site Characteristics

Site Number	Size of upstream affected area (salt marsh acres / total affected acres)	Is the upstream affected area contiguous to protected open space (ownership)?	Does this tidal channel support a shellfish resource area?	Is the channel or system part of an anadromous fish pathway?	Does the culvert/pipe support an engineered flood control structure?	Is the affected area or site within an ACEC boundary?	Does the affected area include Priority Habitat of Rare Species (PH) or Estimated Habitat of Rare Wildlife (WH)?	Are there any restricted sites upstream of this site (site number)?	Ownership of the site (public vs. private)
HA-8/ CH-1	3.0 / 3.0	YES (private)	YES	YES	NO	NO	NO	NO	PUBLIC
CH-2	0.0 / 3.24	NO	YES	NO	NO	NO	NO	NO	PRIVATE
CH-3	Unable to determine	YES (private)	YES	NO	NO	NO	NO	NO	PUBLIC
CH-4	4.77 / 5.51	NO	YES	NO	NO	NO	NO	NO	PRIVATE
CH-5	4.32 / 4.87	YES (municipal, private)	YES	NO	NO	NO	NO	NO	PUBLIC
CH-6	0.0 / 34.58	YES (private)	NO	YES[1]	YES (stoplogs)[2]	YES	NO	NO	PRIVATE
HA-9/ CH-7	2.73 / 18.07	YES (municipal)	YES	YES[3]	NO	YES	NO	NO	PUBLIC

[1] Frost Fish Creek historically supported an anadromous fish run to Lovers Lake. It is not believed to be currently active.
[2] The infrastructure is present for stoplogs, however they have not been used for many years and the structure is in disrepair.
[3] Muddy River historically supported an anadromous fish run. It is not believed to be currently active.

HARWICH/CHATHAM

Deep Hole Road restriction of the Red River

Site HA-8/CH-1

Site Description

The Red River forms the boundary between Harwich and Chatham and discharges into Nantucket Sound. Deep Hole Road crosses the Red River, passing its flow via a 16-inch corrugated metal pipe set in a concrete headwall. The pipe appears to be in good condition – it is not broken or clogged. The seaward opening is submerged at mean high tide. Tidal restriction sites HA-6 and HA-7 lie on a channel of the Red River that is located seaward of Deep Hole Road, and they are therefore not connected to site HA-8/CH-1. The Red River does support shellfish resources and is used by anadromous fish en route to Skinequit Pond in South Harwich.

General Information

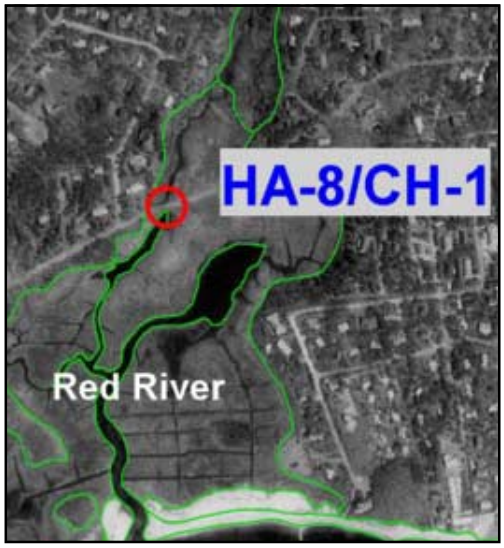
The seaward channel is approximately 10 to 15 feet wide, narrowing upstream to 2 to 5 feet. Visual indicators of a restriction on the seaward side of the road include minor bank erosion and minor vegetation die back. A scour pool is also evident near the upstream pipe opening. Cattails are present seaward of the roadway berm and become more prevalent upstream. *Phragmites* was also observed in the upstream affected area.

- Restriction width – 16 inches
- Restriction length – 26 feet
- Upstream salt marsh – 3 acres (estimate)

Comments

According to the Director of the Chatham Water Quality Laboratory, the area upstream of Deep Hole Road is a natural low point that collects significant fresh water drainage and is therefore a transition zone. An increase in the size of the pipe would likely not change the area affected by tidal flow, but could serve to make the existing salt marsh healthier.

[1] The Wetland Conservancy Program delineated salt marsh lying both seaward and upstream of Deep Hole Road as one continuous area, totaling 45.63 acres. The road does sever this salt marsh, which should have been delineated as two polygons. The area upstream of Deep Hole Road, estimated at 3.0 acres, could not be highlighted independently of the seaward area for this image.



Upstream Affected Area (acres): SM – 3.0.[1]

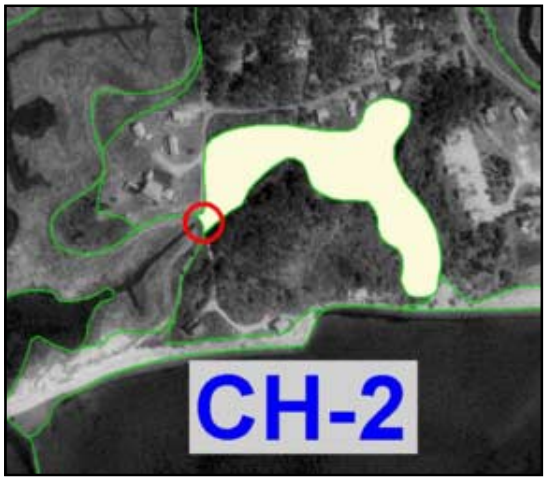
This 16-inch corrugated metal pipe set in the concrete headwall passes the flow of the Red River under Deep Hole Road.

Visual indicators in this upstream affected marsh include a small scour pool near the pipe opening and significant growth of Phragmites and cattails.

CHATHAM

Chatharbor Lane restriction of unnamed channel off Mill Creek

Site CH-2



Upstream Affected Area (acres): SS – 3.24.

Site Description

Mill Creek flows north from Cockle Cove in Nantucket Sound. Near the mouth of Mill Creek a channel branches off in an easterly direction, flowing nearly parallel to the Cockle Cove Beach. This unnamed channel flows under Chatharbor Lane (a dirt road) via a 10-inch diameter metal pipe. The pipe appears to be in poor condition and is visibly blocked by debris and detritus. The seaward opening is consistently submerged at mean high tide. Low-lying development around the upstream affected area is subject to flooding during storm and extremely high tides under present conditions. Mill Creek does support shellfish resources.

General Information

The seaward channel is approximately 5 to 10 feet wide, narrowing upstream to 3 to 4 feet. Visual indicators of a restriction include major seaward scouring and erosion, and significant vegetation die off. Upstream conditions included minor scouring with major erosion of the berm behind the pipe opening. A significant number of dead and dying shrubs were observed within the upstream affected area. *Phragmites* was not observed near this site.

- Restriction width – 10 inches
- Restriction length – 78 feet
- Upstream salt marsh – 0.0 acres

Water trickling out of a mound of dead seaweed near the seaward opening enabled field staff to dig out the opening of the 10-inch pipe. Erosion is a serious problem near the opening.

Comments

What is now considered the upstream affected area of site CH-2 was historically connected with tidal flow in Nantucket Sound via two locations. First, at the location of site CH-2, and second, at a natural opening in the barrier beach between the mouths of Mill Creek and Cockle Cove Creek. This second opening no longer exists and beach nourishment projects at Cockle Cove Beach will prevent its re-opening in the future.

This 10-inch metal pipe passes tidal flow under Chatharbor Lane. Erosion is eating away at the roadway berm.

CHATHAM

Ridgevale Road restriction of channel between Cockle Cove Creek and Bucks Creek

Site CH-3

Site Description

Bucks Creek (or Sulphur Springs) and Cockle Cove Creek share the same discharge point into Nantucket Sound, located near Cockle Cove Beach and Ridgevale Beach. After branching near their mouth, Bucks Creek flows northeast and Cockle Cove Creek flows northwest. A 77-foot long culvert under Ridgevale Road, at its intersection with Cranberry Lane, connects the marshes of Cockle Cove Creek (to the west) with Bucks Creek (to the east). Tidal flow passes under the road via a 25-inch diameter corrugated metal pipe. The pipe appears to be in good condition – it is not visibly broken or clogged. The creeks' shared discharge area creeks supports shellfish resources.

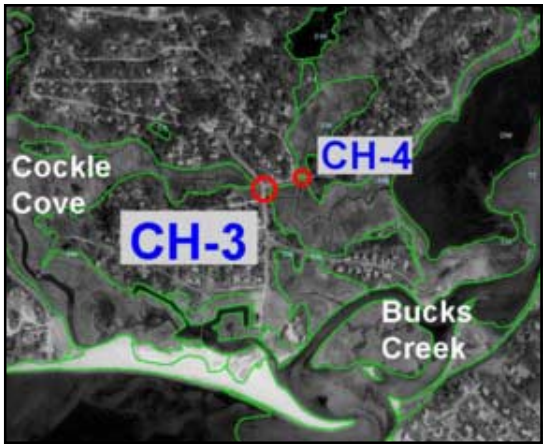
General Information

Tidal flow may reach this site from either the east or west, therefore, seaward and upstream "sides" are not appropriate labels for this site. The channel approaching the site from the east (Bucks Creek side) is approximately 5 feet wide. The channel to the west (Cockle Cove Creek side) is approximately 1-foot wide. Scouring is significant to the east and minor to the west. Minor bank erosion was also observed to the east. The Wetlands Conservancy Program delineated salt marsh adjacent to both sides of this site. Vegetation observed to the east included shrubs and salt marsh, while *Phragmites* dominated the view to the west of Ridgevale Road.

- Restriction width –25 inches
- Restriction length – 77 feet
- Upstream salt marsh – unable to determined

Comments

The Director of the Chatham Water Quality Laboratory believes that a nominal amount of flow actually reaches either side of this pipe and, therefore, if this pipe did not exist conditions would be similar to con-



Upstream Affected Area (acres): SM – unable to determine.

The metal pipe, barely visible above the water line, is set in the steep berm of Ridgevale Road.

The pipe to the west of the road sits in this scoured pool of stagnant water. Phragmites dominates the vegetation around it.

CHATHAM

Cranberry Lane restriction of unnamed channel off Bucks Creek

Site CH-4

Upstream Affected Area (acres): SM – 4.77; SS – 0.74.

Site Description

Bucks Creek, or Sulphur Springs, supports a large area of salt marsh. One channel travels north through the marshes and crosses under Cranberry Lane (a gravel road) to the east of Ridgevale Road at site CH-3. Flow passes under Cranberry Lane via an 18-inch diameter metal pipe. The seaward side of the pipe appears to be in poor condition. The upstream side was inaccessible. Cranberry bogs are still active upstream of Cranberry Lane and farmers use flow in this system to support their operations. Bucks Creek supports shellfish resources.

This pool of water submerged the 18-inch opening on the seaward side of Cranberry Lane.

General Information

The seaward channel is approximately 2 to 4 feet wide, narrowing to 1 to 2 feet upstream. Visual indicators of a restriction include significant seaward scouring and bank erosion, with water pooled by the pipe opening. Minor scouring was visible upstream, however the area adjacent to the pipe opening was largely blocked by dense shrubs. What appeared to be the upstream channel bed was dry. Vegetation changed significantly from the seaward to upstream sides of Cranberry Lane – with some areas covered by cattails and with *Phragmites* dominating the upstream affected area.

- Restriction width – 18 inches
- Restriction length – 31 feet
- Upstream salt marsh – 4.77 acres

The Wetlands Conservancy Program delineated salt marsh upstream of Cranberry Lane, but shrubs, Phragmites, cattails, and a dry creek channel were observed.

Comments

According to the Director of the Chatham Water Quality Laboratory, the health of the salt marsh upstream of Cranberry Lane is mainly dependent upon the management of the water resource by the cranberry farmers using this system.

CHATHAM

Stage Harbor Road restriction of Champlain Creek

Site CH-5

Site Description

Champlain Creek runs northwest from its mouth on the Mitchell River, near the intersection of the Mitchell River with Stage Harbor. The creek flows under Stage Harbor Road via a 20-inch (estimated) metal pipe. The pipe is in serious disrepair – it is broken in several places. The seaward opening was buried under rocks in the channel bed. Champlain Creek does not serve as an anadromous fishway. Stage Harbor does support shellfish resources.

Upstream Affected Area (acres): SM – 4.32; SS – 0.55.

General Description

The seaward channel is approximately 10 to 15 feet wide and 20 yards long with a parking lot retaining wall serving as one of its banks. The channel narrows slightly upstream of the road to approximately 10 feet wide. Visual indicators of a restriction include major scouring and significant erosion both seaward and upstream of the pipe. Vegetation die back was observed around the edges of both channels. Both salt marsh and *Phragmites* were observed between the road and the Mitchell River. The vegetation changes upstream of Stage Harbor Road where *Phragmites* and cattails were mixed amongst shrubs and salt marsh.

- Restriction width – 20 inches
- Restriction length – 55 feet
- Upstream salt marsh – 4.32 acres

The 20-inch pipe lies partially buried under rocks at the base of the roadway berm where the channel appears to end abruptly. The pipe is broken into several segments.

It was possible to measure the pipe on this upstream side, were it protrudes from the berm jutting into this severely scoured and eroded pool.

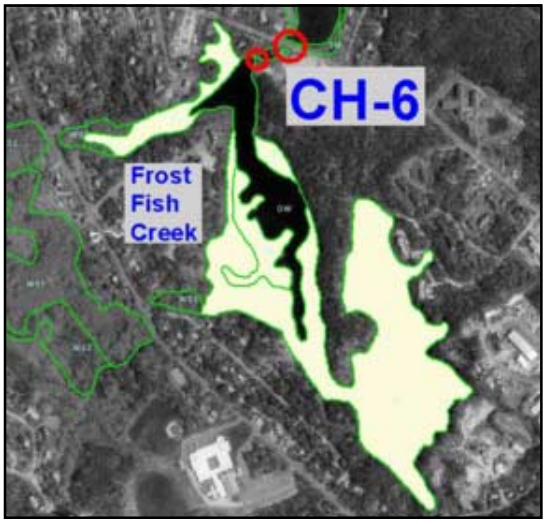
Comments

The marsh area further upstream of the area considered the upstream affected area of site CH-5 is a transition zone, where cedar swamp has taken hold and a there is a significant amount of fresh water input. Therefore, the Director of the Chatham Water Quality Laboratory believes that the upstream affected area is not likely to benefit from any increase in tidal flow in Champlain Creek.

CHATHAM

Route 28 and Earthen Dike restriction of Frost Fish Creek

Site CH-6



Upstream affected area (acres): SS – 31.69; M – 2.89.

This bubbling pool of water marks the spot where one of the three pipes discharges seaward of Route 28.

Site Description

Frost Fish Creek, a sub-embayment of Pleasant Bay, flows south from its connection with Ryder's Cove and Bassing Harbor. Just off of Ryder's Cove, Route 28 crosses the mouth of the creek. Flow passes under the road via three 18-inch pipes, which are set low in the roadway berm. None of the pipe openings were observed above the water line. The three pipes are far apart, located approximately 60 feet and 15 feet apart.

Upstream of Route 28, the Wetlands Conservancy Program delineated a small pool of open water. An earthen dike crosses the Creek upstream of this open water, causing an even smaller second tidal restriction of Frost Fish Creek. This dike was inaccessible, however according to local officials it is either an 18 or 24-inch diameter pipe set within a concrete weir. Historically the weir enabled the placement of watertight stoplogs, but it has not been used for many years and is in disrepair. This control structure was installed in order to regulate tidal flow for the benefit of upstream cranberry farming operations.

Frost Fish Creek historically supported an anadromous fish run to Lovers Lake. It is not active today. The portion of the creek that extends from Ryder's Cove to the Route 28 berm does not support significant shellfish resources – the creek bed is too muddy to provide shellfish habitat.

General Description

The Wetlands Conservancy Program did not delineate any wetland vegetation around the small pool of open water between Route 28 and the dike. Upstream of the dike however, shrub swamp and shallow marsh were delineated. Because the pipes were submerged and the upstream site was not accessible, visual indicators of a restriction were not easily observed. Water was surging and bubbling up at three distinct spots where the submerged pipes were assumed to be. Scour pools were visible at these locations. *Phragmites* was not observed on either side of Route 28.

- Restriction width – three 18-inch pipes (under Route 28); 18 or 24-inch pipe with structure for stoplogs (under the dike)
- Restriction length – 75 feet (estimated for Route 28); 20 feet (estimated for dike)
- Upstream salt marsh – 0.0 acres

(continued on page C9)

continued from page C8

Route 28 and Earthen Dike restriction of Frost Fish Creek

Site CH-6

Comments

Frost Fish Creek has been studied as part of Chatham's comprehensive wastewater management study, a search for ways to improve the quality of the water in local embayments and prevent further degradation from pollution. This sub-embayment suffers from poor flushing, which makes the creek vulnerable to pollution (particularly from nutrients). In fact, Frost Fish Creek has a system residence time of 422.3 days, caused mainly by the under-sized culverts at site CH-6.[1] According to the Director of the Chatham Water Quality Laboratory, Frost Fish Creek has been considered for conversion into a fresh water system by installing dikes in the upper reaches of the estuary. However, due to the low point at which it crosses under Route 28 and other factors this is not likely to be considered a feasible alternative. Further studies need to be done to determine the benefits and detriments of conversion.

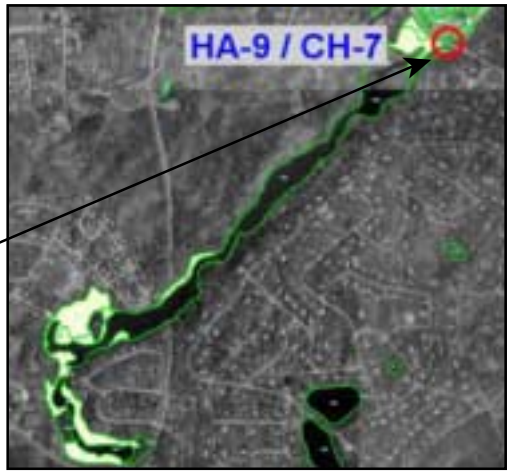
Water pools between the Route 28 berm and the upstream earthen dike – both infrastructure crossings severely restrict the flow of Frost Fish Creek.

[1] Wood, 2000, p. 5.

HARWICH/CHATHAM

Route 28 restriction of the Muddy River

Site HA-9/CH-7



Upstream affected area (acres): SM – 2.73; SS – 13.37; M – 1.97.

Site Description

The Muddy River, a sub-embayment of Pleasant Bay, runs generally in a southwesterly direction from its mouth to the west of Nickersons Neck in Chatham on Pleasant Bay. The river forms the town boundary between Harwich and Chatham who share responsibility for the rivers' upstream affected area. Muddy Creek flows under Route 28 via two box culverts that are approximately 2.6 feet in height and 3.7 feet in width. These culverts are set into stone slab retaining walls and placed far below the road surface. The culverts are owned and maintained by the Massachusetts Highway Department. The Muddy River historically supported an anadromous fish run – it is not active today – and does support shellfish resources near its discharge area in Pleasant Bay.

General Description

The Muddy River is approximately 75 feet wide seaward of Route 28, widening to approximately 100 feet upstream of the roadway berm. Visual indicators of a restriction include major seaward scouring, minor bank erosion, and minor vegetation die back. *Phragmites* fringes the upstream affected area.

- Restriction width – two, 2.6 by 3.7-foot box culverts
- Restriction length – 75 feet (estimate)
- Upstream salt marsh – 2.73 acres

These 2 box culverts pass the flow of the Muddy River under Route 28. The stone slab retaining wall supporting the culverts appears to be in poor condition.

Comments

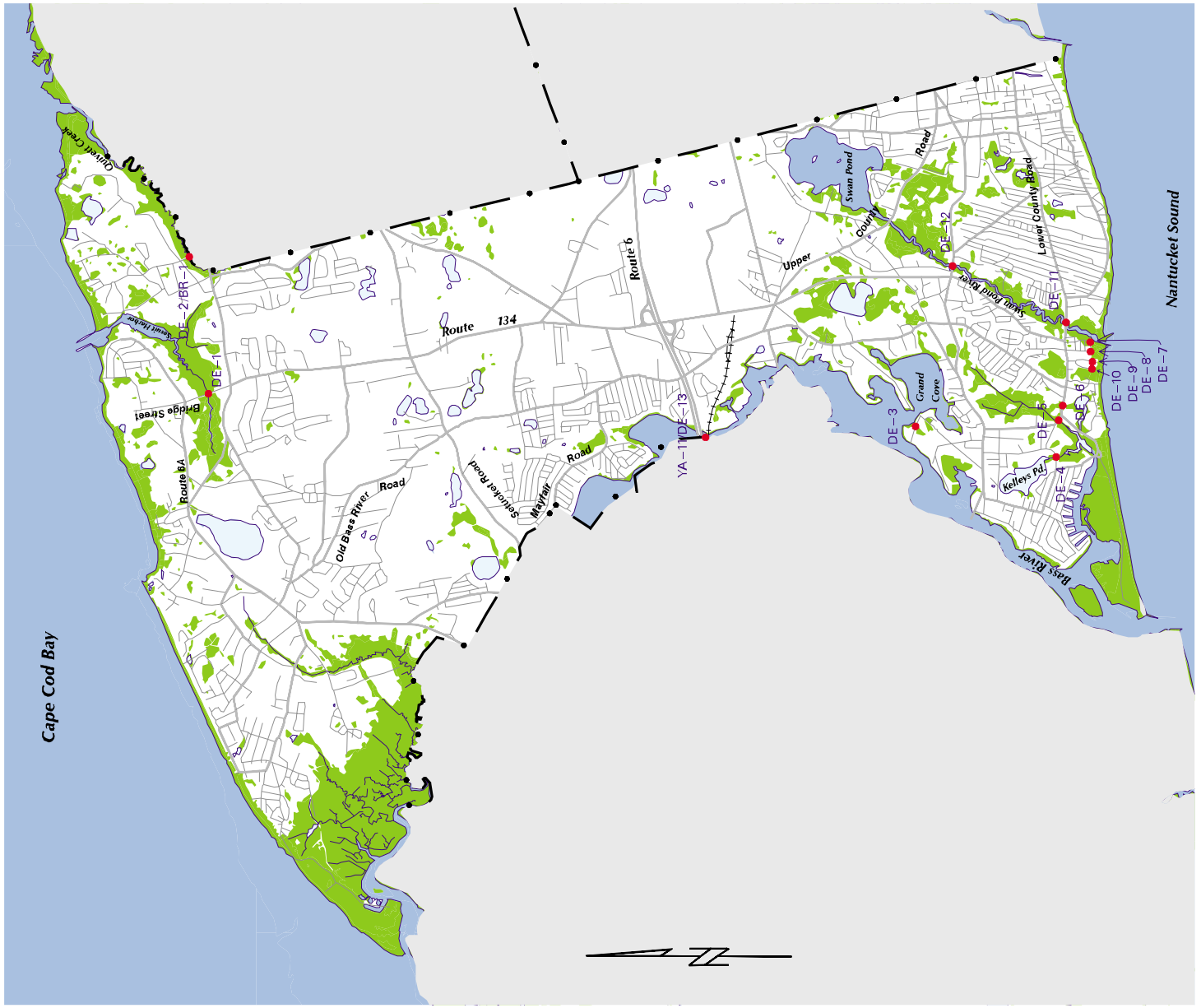
Muddy River has been studied as part of Chatham's comprehensive wastewater management study, a search for ways to improve the quality of the water in local embayments and prevent further degradation from pollution. Chatham is currently working on a Restoration Management Plan for the Muddy River through the Pleasant Bay Alliance. Muddy River has been considered for conversion into a fresh water system as one way to address its poor water quality. This system's conversion would be easier than that of Frost Fish Creek because of the high embankment of Route 28 between Pleasant Bay and the river. To accomplish this, tide gates could be placed on the existing culverts. A significant environmental drawback of this option would be the loss of the existing 2.73 acres of salt marsh along the northern portion of the river upstream of the road. To avoid this loss but still achieve partial conversion, a dike could be installed upstream of the existing salt marsh.[1]

Upstream of Route 28 salt marsh exists along the banks of the Muddy River.

[1] Wood, 2001, p. 5.

TOWN OF DENNIS

- Town Map
- Chart of Site Characteristics
- Sites 1 to 13



TOWN OF DENNIS

Location of Selected Salt Marsh Restrictions

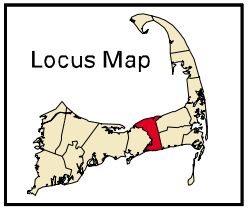
This map was produced by the Cape Cod Commission Geographic Information System office, with digital data from MassGIS and the Cape Cod Commission, 2001.

The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis.

This project was funded, in part, by the Executive Office of Environmental Affairs, Massachusetts Wetlands Restoration Program.

- DE – 1 Restriction Site
- Wetland
- Ocean
- Pond or Lake
- Local Road
- Major Route
- Stream
- Railroad

Locus Map



Miles
0 0.5 1
0 2,500 5,000
Massachusetts State Plane Feet
North American Datum – 1927

Land Use ▪ Roads ▪ DCPCs ▪ Parcels ▪ Demographics ▪ Environmental ▪ Orthos
Cape Cod Commission
GIS Services

2001

Town of Dennis –Site Characteristics

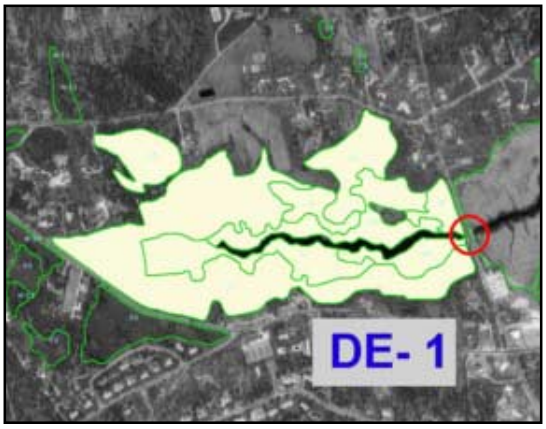
Site Number	Size of upstream affected area (salt marsh acres / total affected acres)	Is the upstream affected area contiguous to protected open space (ownership)?	Does this tidal channel support a shellfish resource area?	Is the channel or system part of an anadromous fish pathway?	Does the culvert/pipe support an engineered flood control structure?	Is the affected area or site within an ACEC boundary?	Does the affected area include Priority Habitat of Rare Species (PH) or Estimated Habitat of Rare Wildlife (WH)?	Are there any restricted sites upstream of this site (site number)?	Ownership of the site (public vs. private)
DE-1	9.35 / 53.31	NO	YES	NO[1]	NO	NO	NO	NO	PUBLIC
DE-2 / BR-1	5.29 / 11.62	YES (municipal)	YES	YES	NO	NO	YES (PH)	NO	PUBLIC
DE-3	3.14 / 4.11	NO	YES	NO	YES (tide gate)	NO	NO	NO	PRIVATE
DE-4	0.0 / 3.56	YES (municipal)	YES	NO[2]	NO	NO	NO	NO	PUBLIC
DE-5	10.99 / 42.16	NO	YES	NO	NO	NO	NO	NO	PUBLIC
DE-6	1.67 / 3.72	NO	YES	NO	NO	NO	NO	NO	PUBLIC
DE-7	5.85 / 5.58	YES (municipal)	NO	NO	NO	NO	YES (PH)	YES (DE -8, 9, 10)	PUBLIC
DE-8	5.85 / 5.85	NO	NO	NO	NO	NO	YES (PH)	YES (DE-9, 10)	PUBLIC
DE-9	5.85 / 5.58	NO	NO	NO	NO	NO	YES (PH)	YES (DE-10)	PUBLIC
DE-10	5.47 / 5.47	NO	NO	NO	NO	NO	NO	NO	PRIVATE
DE-11	85.44 / 112.36	YES (municipal)	YES	YES	NO	NO	NO	YES (DE-12)	PUBLIC
DE-12	46.62 / 72.71	YES (municipal)	YES	YES	NO	NO	NO	NO	PUBLIC
YA-11/ DE-13	19.54 / 31.71	YES[3] (municipal)	YES	YES	NO	NO	NO	NO	PUBLIC

[1] Town officials are presently trying to restore a once active herring run into Scargo Lake.
[2] Historically there was a herring run into Kelleys Pond – a tide gate used to be located here to maintain the pond as a freshwater system.
[3] Conservation lands are scattered along the banks of the Bass River. In total there are four parcels identified in Yarmouth and Dennis as conservation lands contiguous to the upstream affected area of site YA-11/DE-13.

DENNIS

Bridge Street restriction of Sesuit Creek

Site DE-1



Upstream Affected Area (acres): SM – 9.35; SS – 33.23; M – 10.73.

Site Description

Tidal flow to the site is from Sesuit Harbor into Sesuit Creek. Sesuit Creek passes through a 2-foot corrugated metal culvert at Bridge Street about one mile upstream from the Harbor. The structure of the pipe has been compromised and is in need of repair. The seaward opening is set very low and appears to be consistently submerged at low tide. Both sides of the Bridge Street roadway berm at the culvert crossing are supported by wooden retaining walls. In the past Sesuit Creek supported a herring run to Scargo Lake. It is no longer active and town officials are engaged in an ongoing effort to restore the run. Sesuit Harbor and Creek do support shellfish resource areas.

General Information

The Sesuit Creek channel is approximately 20 feet wide seaward, widening to 30 feet upstream of the culvert. According to one Army Corps of Engineers (ACOE) study in 1996, the restriction causes the tidal range to differ by approximately 3.75 feet from the seaward to upstream sides of the culvert. Visual indicators of restriction include major scouring, bank erosion, marsh slumping, and vegetation die off seaward of the culvert, as well as significant scouring and minor bank erosion upstream. *Phragmites* fringes the salt marsh seaward of the culvert, becoming a major presence within the upstream affected salt marsh and shrub swamp area.

- Restriction width – 2 feet
- Restriction length – 60 feet
- Upstream salt marsh – 9.35 acres

This view into the upstream affected area shows that Phragmites has taken hold in much of the salt marsh and shrub swamp.

This retaining wall supports the berm of Bridge Street and the 2-foot metal pipe. Rocks are built up in the creek bed in front of the culverts' upstream opening.

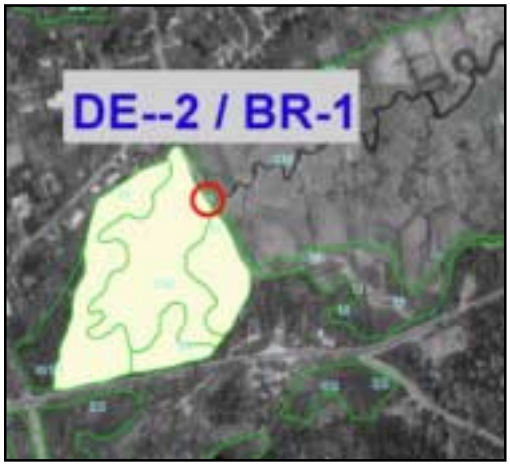
Comments

Site DE-1 was selected and studied by the ACOE in 1996. Hydraulic modeling indicated that one 6 by 10-foot culvert under Bridge Street would provide partial tidal restoration. A 10 by 20-foot box culvert would provide full restoration (ACOE, June 1996, pp. 71). Town officials anticipate that at the next annual Dennis Town Meeting they will ask for additional money to undertake site reconstruction. The town previously spent money to hire a wetlands biologist to conduct a biological survey and an engineering company to establish wetlands and contours in the area and to determine an appropriate culvert size. Early field observations indicated that there is a healthy fresh water marsh system in the upper reaches of the upstream affected area, which will need to be taken into consideration during restoration of tidal flow under Bridge Street.

DENNIS/BREWSTER

Sea Street restriction of Quivett Creek

Site DE-2/BR-1



Upstream Affected Area (acres): SM – 5.29; SS – 0.99; M – 5.34.

Site Description

Sea Street was abandoned just north of Quivett Creek near its headwaters on the Dennis/Brewster town line. Pedestrian access continues south on the abandoned road-bed across Quivett Creek. According to local officials, there are two culverts under the former Sea Street each measuring 20-inches (these culverts were not visible during fieldwork conducted for this Atlas). The seaward side of the Creek pools significantly at the roadway berm as tidal flow tries to pass under Sea Street. A three-sided concrete structure passes the flow on the upstream side of the Sea Street path. A 20-inch corrugated metal pipe is also located at the site. Although it is sited high in the bank, it regularly passes water at high tide. Quivett Creek supports an active anadromous fish run to spawning ponds south of Route 6A.

This corrugated metal pipe is suspended high in the bank but does pass water regularly. Water also flows through an obscured opening below this water line.

General Information

Quivett Creek is approximately 10 feet wide both seaward and upstream of the restriction. Obvious characteristics of a tidal restriction are present on either side of the submerged culverts – major scouring occurs as the water is detained in basins it has formed near the culvert openings; the banks of Quivett Creek are eroding significantly due to the unnatural stream conditions; the marsh near the seaward opening exhibits both marsh slumping and vegetation die off. The vegetation changes significantly from the seaward to the upstream sides of the restriction – there is a significant presence of *Phragmites* in the upstream area.

- Restriction width – two 20-inch pipes
- Restriction length – 55 feet
- Upstream salt marsh – 5.29 acres

Flow is directed down through this concrete structure; broken pipe and the suspended pipe are visible in the background.

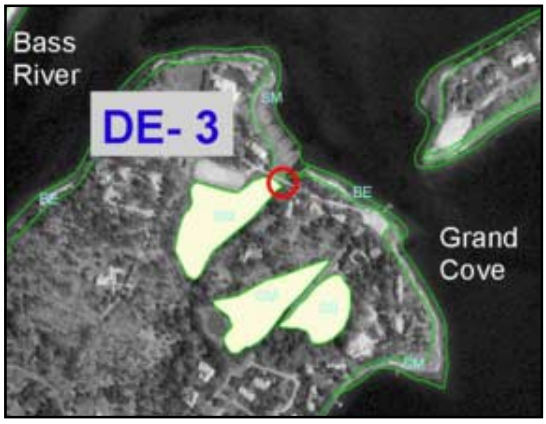
Comments

After significant study by a team including the National Marine Fisheries Service (NMFS), the Massachusetts Wetlands Restoration Program, and local officials from Dennis and Brewster, this site is targeted for remediation. One tidal measurement taken during a study showed a high tide water level 18 inches higher on the seaward than on the upstream side of Sea Street. The NMFS has funding in place for this restoration and is moving forward with the cooperation of both communities.

DENNIS

Wheatfield Lane restriction of unnamed channel

Site DE-3



Upstream Affected Area (acres): SM – 3.14; SS – 0.97.

Site Description

Wheatfield Lane, a private dirt road, crosses a small tidal channel flowing from the entrance to Grand Cove off of the Bass River. The culvert is next to a town landing. A 16 inch corrugated metal pipe is sealed on its seaward side by a flapper gate; only a few inches remain open to pass the incoming tide. The opening is submerged at mean high tide. The pipe is in poor condition and, in addition to the tide gate, appears to be blocked by silt and debris on the upstream end. Grand Cove does support shellfish resources, which are closed to shellfishing on a seasonal basis.

This flapper gate blocks a 16-inch seaward pipe opening, set low in this 10-foot high wooden retaining wall. Erosion and scour undermine the dirt berm of Wheatfield Lane and scar the tidal channel.

General Information

The seaward channel varies from 5 to 10 feet and runs for about 10 yards from the cove to the tide gate. Upstream of the roadway berm the channel narrows to approximately 5 feet. Visual indicators of a restriction include major scouring and erosion on the seaward side of the berm. Because there is only minimal flow upstream of the berm, scouring and erosion are minor near the pipe. The upstream affected area that was visible was being over-taken by large stands of *Phragmites.*

- Restriction width – 16 inch pipe with flapper gate
- Restriction length – 30 feet
- Upstream salt marsh – 3.14 acres

This narrow upstream channel travels between significant stands of Phragmites that are overtaking this upstream affected area.

Comments

The upstream affected area is segregated into three distinct patches delineated by the Wetlands Conservancy Program as 1.73 and 1.41 acres of salt marsh and 0.97 acres of shrub swamp. Based on field surveys and GIS work it is assumed that these three areas of marsh are each connected to each other and to the tidal flow entering Grand Cove through this site. The tidal crossings between these patches of marsh were not accessible.

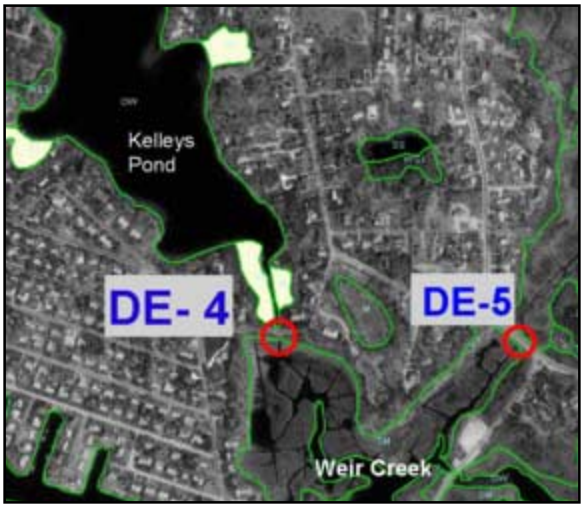
DENNIS

Fisk Street restriction of Kelleys Pond

Site DE-4

Site Description

Weir Creek flows northeast from the mouth of the Bass River and, prior to reaching this crossing, passes under a 22-foot bridge span for Loring Avenue (see site DE-e, Appendix B). Just upstream of the DE-e crossing, this tributary of Weir Creek flows north to Kelleys Pond passing under Fisk Street via a 2-foot concrete pipe set in a stone slab headwall. The seaward opening is submerged at mean high tide and the pipe appears to be in good condition – it is neither broken nor clogged. Historically, Kelleys Pond supported an anadromous fish run that is not active today. Weir Creek does support shellfish resources.



Upstream Affected Area (acres): SS – 3.06; M – 0.50.

General Information

The seaward channel is approximately 15 feet wide, narrowing to 10 feet upstream of Fisk Street. Vegetation changes significantly from salt marsh seaward to a significant amount of *Phragmite*s within forested and lawn-lined channel banks upstream. Visual indicators of a restriction include significant scouring and minor erosion seaward of the crossing. Scouring and erosion upstream of the pipe are minor.

- Restriction width – 2 feet
- Restriction length – 60 feet
- Upstream salt marsh – 0 acres

This 2-foot culvert opening passes flow under Fisk Street between Weir Creek and Kelleys Pond.

As evidenced by these two photographs, the vegetation changes significantly from the seaward (left) to upstream (right) sides of the Fisk Street tidal crossing.

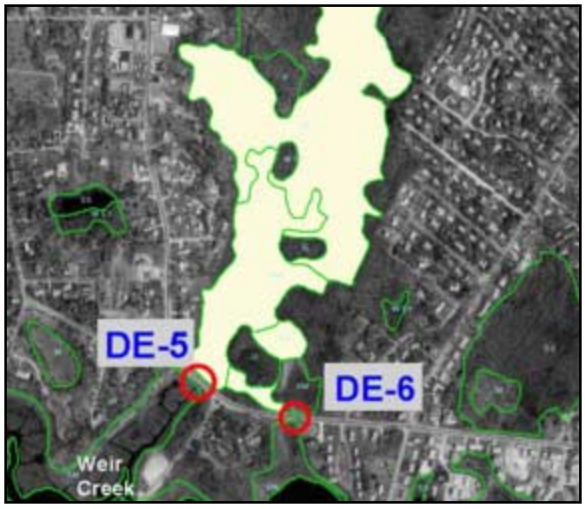
Comments

This site used to have a tide gate that maintained Kelleys Pond as a freshwater system and enabled an active herring run. The tide gate is no longer in place and the system no longer supports a herring run.

DENNIS

Lower County Road restriction of Weir Creek

Site DE-5



Upstream Affected Area (acres): SM – 10.99; SS – 31.17.

Site Description

Weir Creek flows northeast from the mouth of the Bass River and, prior to reaching this crossing, passes under a 22-foot bridge span for Loring Avenue (see site DE-e, Appendix B). Weir Creek passes under Lower County Road via a 2-foot concrete and metal pipe. The seaward opening is submerged at mean high tide. The pipe appears to be in good condition – it is neither broken nor clogged. This site lies to the west of site DE-6. Weir Creek does not support anadromous fish but does support shellfish resources.

General Information

The seaward channel is approximately 5 feet wide, actually widening to about 10 feet upstream of this crossing. Visual indicators of a restriction include minor scouring and bank erosion both seaward and upstream of this site. *Phragmites* lines the upstream channels of the Creek; none was visible seaward of the road.

- Restriction width – 2 feet
- Restriction length – 57 feet
- Upstream salt marsh – 10.99 acres

This 2-foot concrete and metal pipe passes the flow of the 5 to 10-foot channels of Weir Creek under Lower County Road.

Upstream of the road the pipe juts out into Weir Creek beyond the edge of the roadway berm thereby increasing the necessary length of this restriction by about 10 feet.

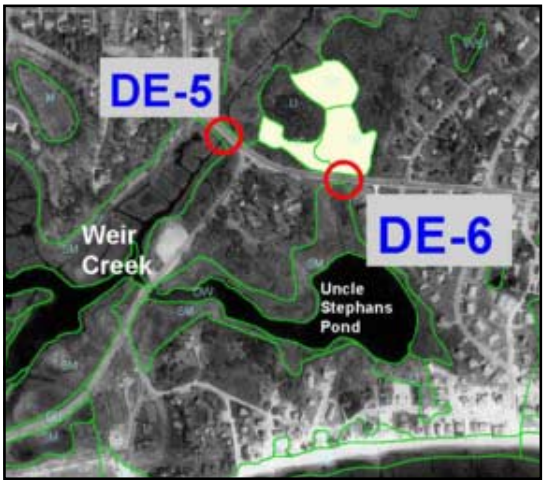
Comments

According to the Dennis Department of Natural Resources, this location has great potential and need for remediation.

DENNIS

Lower County Road restriction of channel from Uncle Stephans Pond

Site DE-6



Upstream Affected Area (acres): SM – 1.67; SS – 2.05.

Site Description

This site is located on Lower County Road, just east of site DE-5. Tidal flow into Uncle Stephans Pond originates from Weir Creek, passing through two seaward infrastructure crossings and through Uncle Stephans Pond before reaching this site - both are not tidally restrictive of salt marsh (see Appendix B, site DE-e, Loring Avenue, and site DE-f, Lighthouse Road). A channel runs north from the pond, flowing under Lower County Road via a 16 inch opening in a concrete headwall. The pipe is assumed to be in poor condition – while the opening was not visible, it appears to be clogged by silt and debris. The seaward side of the pipe was submerged at low tide. Weir Creek does not support anadromous fish but does support shellfish resources.

General Information

The seaward channel is approximately 2 feet wide. There was no measurable channel upstream. Visual indicators of a restriction include significant scouring and major bank erosion seaward of the pipe. Upstream of Lower County Road there was a pool of stagnant water near the pipe opening but no channel was observed flowing into the upstream affected area. *Phragmites* fringes the upstream salt marsh area. Water is ponded on the marsh surface toward the rear of the area. The upstream affected areas of sites DE-5 and DE-6 are contiguous, however the affected salt marsh patches remain distinct – shrub swamp is delineated between them.

- Restriction width – 16 inches
- Restriction length – 50 feet
- Upstream salt marsh – 1.67 acres

The seaward channel stops abruptly at the roadway berm. Flow does not appear to be moving through the 16-inch culvert that is visibly blocked by debris and silt.

This upstream affected salt marsh is not fed by a measurable channel. Phragmites fringes the patch of marsh and water is ponding and flooding the surface.

DENNIS

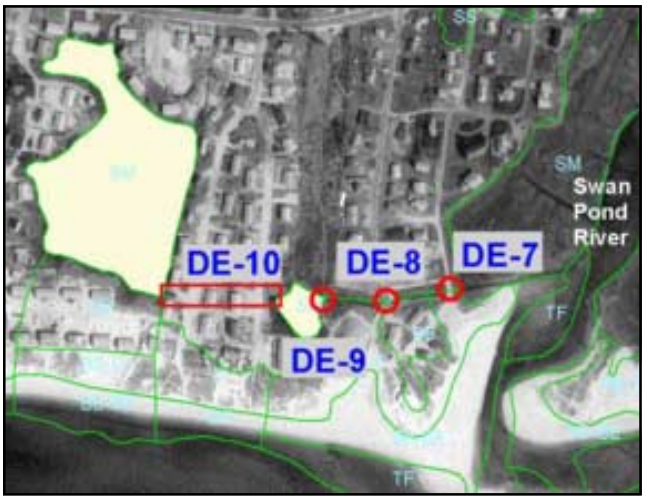
Unnamed channel off Swan Pond River restricted by:

Baker Beach Road
Site DE-7

South Village Road
Site DE-8

Earthen berm
Site DE-9

Laynard Lane to Fiddlers Green Lane
Site DE-10



Upstream Affected Area (acres): SM – 5.85 (underestimate).

Site Descriptions

A narrow tidal channel originating at the Swan Pond River near its mouth runs parallel to South Village Road Beach in West Dennis. Beginning with the seaward most restriction at Baker Beach Road and heading upstream this channel makes four infrastructure crossings. Because these four sites are located in such close proximity to one another they warrant group treatment in this Atlas. In sum, the channel is underground for a total crossing length of 377 feet. The roads serve a predominately summer-use cottage community. South Village Road (DE-8) is the only paved crossing. This channel does not support shellfish or ana-dromous fish, though the Swan Pond River does support both.

General Information

The seaward channel running between the Swan Pond River and the first restriction (site DE-7) is approximately 15 to 20 feet wide. When the channel emerges upstream of DE-10 is approximately 5 to 10 feet wide. The Wetlands Conservancy Program delineated two patches of salt marsh totaling 5.85 acres (0.38 acres upstream of site DE-9 and 5.47 acres upstream of site DE-10). Additional marsh area was observed during fieldwork as narrow bands lining the channel banks between each infrastructure crossing, therefore 5.85 acres is an underestimation of the total upstream affected area.

The restriction classification scheme comparing channel size to culvert opening was the greatest indicator of restriction along this series of crossing. Site DE-8 appears to be fairly new – two 30-inch corrugated plastic pipes pass flow under South Village Road. Site DE-10 is remarkable for its 245-foot crossing length. Pipe openings at sites DE-7, DE-9, and DE-10 were submerged at a mid to high, outgoing tide. *Phragmites* is present in the marsh area upstream of site DE-9, and both seaward and upstream of site DE-10. Other visual indicators of a restriction include:

- Site DE-7 - significant scouring and major bank erosion
- Site DE-8 – minor scouring and erosion
- Site DE-9 – minor scouring
- Site DE-10 – minor upstream scour and erosion

(continued on page D10)

continued from page D9

Sites DE-7 through DE-10

This photo series shows each restriction or a segment of the tidal channel. The arrows indicate the direction of flow from the seaward to upstream openings.

Baker Beach Road
Site DE-7


Seaward ***Upstream***

- Restriction width – 2 feet
- Restriction length – 75 feet
- Condition – fair, submerged at mean high tide

Earthen berm
Site DE-9


Seaward ***Upstream***

- Restriction width – 2 feet
- Restriction length – 27 feet
- Condition - fair

South Village Road
Site DE-8[1]


Seaward ***Upstream***

- Restriction width – 5 feet (2 at 30 inches)
- Restriction length – 40 feet
- Condition – excellent (appears new)

Laynard Lane to Fiddlers Green Lane
Site DE-10


Seaward ***Upstream***

- Restriction width – 20 inches
- Restriction length – 235 feet
- Condition – fair

Comments

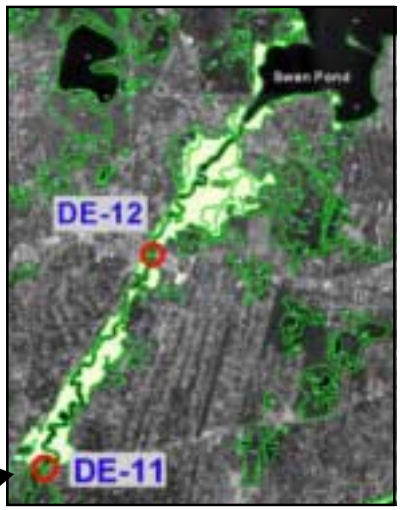
The Wetlands Conservancy Program delineated a patch of shallow marsh (1.30 acres) and shrub swamp (15.16 acres) to the north of Lower County Road, which seemed to be connected by a small channel to the salt marsh lying upstream of site DE-10. However, field investigation did not reveal a connection.

[1] Photos at site DE-8 were not taken the same day, or under the same tidal conditions, as other site photos. Therefore the lower water level observed in the channels does not correlate to levels observed in the other photos of this series. DE-8 was photographed during a low, outgoing tide. All other site photos were taken during a mid to high, incoming tide. Further investigation is needed.

DENNIS

Lower County Road restriction of Swan Pond River

Site DE-11



Upstream Affected Area (acres): SM – 85.44; SS – 13.85; M – 13.07.

Site Description

Swan Pond River flows northeasterly from Nantucket Sound into Swan Pond. Lower County Road crosses the river via a 58-foot concrete bridge set on wooden pylons. This site lies seaward of restricted site DE-12 and non-restricted site DE-g (see Appendix B). Swan Pond River supports shellfish resources and serves as an anadromous fish pathway for whitefish and perch.

General Information

The seaward and upstream river channels are both approximately 80 feet wide. Visual indicators of a restriction include minor scouring and significant erosion seaward, and minor scouring and erosion upstream of the bridge. Minor vegetation die off is also visible. *Phragmites* was not observed in the upstream affected area near this restriction.

- Restriction width – 58 feet
- Restriction length – 32 feet
- Upstream salt marsh – 85.44 acres

View from the Lower County Road Bridge across the seaward salt marsh; the rivers' mouth at Nantucket Sound is visible in the distance.

Comments

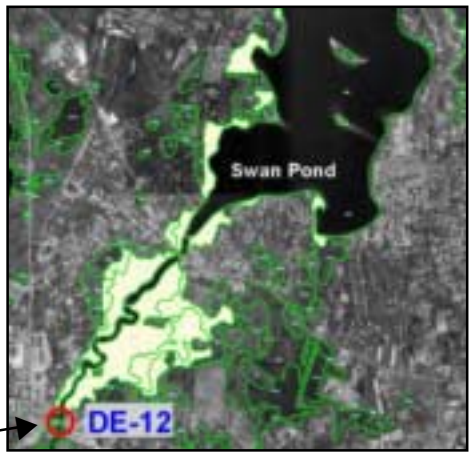
As the seaward restriction on the Swan Pond River any remediation work at this site will need to include study, and likely necessitate work, at the two upstream infrastructure crossing. Presently, restriction intensity diminishes as you move upstream along Swan Pond River. Site DE-g does not exhibit signs of restriction, however, it is critical to note that the flow reaching that site is diminished by the restriction at this site and site DE-12.

This 58-foot bridge span carries the traffic of Lower County Road across the Swan Pond River.

DENNIS

Route 28 restriction of Swan Pond River

Site DE-12



Upstream Affected Area (acres): SM – 46.62; M – 13.07; SS – 13.02.

Site Description

The Swan Pond River flows under the 60-foot bridge span of Route 28. This site lies upstream of restricted site DE-11 and seaward of non-restricted site DE-g (see Appendix B). The bridge is in good condition. Swan Pond River supports shellfish resources and serves as an anadromous fish pathway for whitefish and perch.

The flow of Swan Pond River passes under this 60-foot bridge span of Route 28.

General Information

The seaward and upstream river channels are approximately 80 feet wide. Visual indicators of a restriction include minor scouring basins and bank erosion. *Phragmites* fringes both seaward and upstream salt marsh. A wide channel breaks off the main river stem and bends to the west of the bridge (see close-up image on this page). Because this occurs both north and south of the bridge it indicates a possible connection of flow to the west of the bridge under Route 28, however no culvert was found during fieldwork.

- Restriction width – 60 feet
- Restriction length – 40 feet
- Upstream salt marsh – 46.62 acres

Salt marsh lines much of the upstream banks, however low-lying development is also scattered along the banks of Swan Pond River.

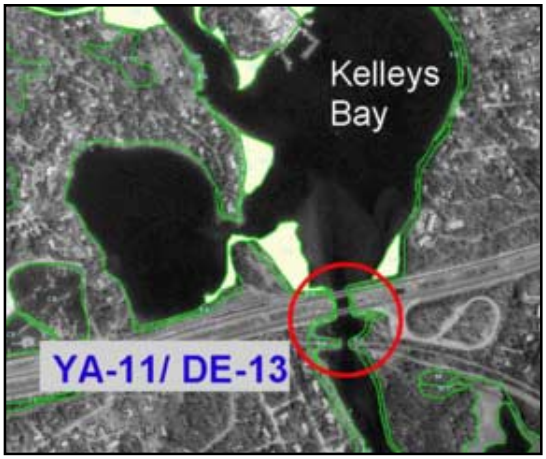
Comments

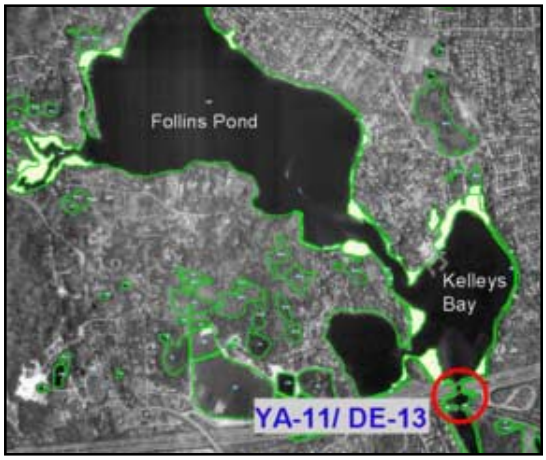
Restriction intensity diminishes as you move upstream along Swan Pond River. The greatest restriction along the river lies seaward of this site at Lower County Road, site DE-11. Under current flow conditions with existing bridge widths, upstream site DE-g does not exhibit signs of restriction.

YARMOUTH/DENNIS

Penn Central Railroad bridge and Route 6 restrictions of Bass River

Site YA-11/DE-13





Upstream Affected Area (acres): SM – 19.54; M – 10.35; SS – 1.82.

Site Description

The Bass River forms the boundary between Yarmouth and Dennis. There are four locations where infrastructure crosses the Bass River including (listed from seaward to upstream) Route 28 and Highbank Road, the Penn Central Railroad, and Route 6. Yarmouth, Dennis, the railroad, and the Massachusetts Highway Department each have responsibility for some of this infrastructure. The Bass River supports an important shellfish resource area as well as anadromous and catadromous fish pathways. Follins Pond supports the largest white perch fishery in Yarmouth and productive commercial shellfishing, whose use is classified as conditional, hinging upon rainfall.

This site actually encompasses two distinct infrastructure crossings that are situated approximately 200 feet apart. Coastal bank, but not wetlands, exist between them. Approximately 200 feet south of the Mid-Cape Highway (Route 6) the Penn Central railroad bed crosses the Bass River. Berms were constructed out into the river leaving only 63 feet open to accommodate flow. Just upstream, two bridges support the four lanes of Route 6 as it crosses the Bass River. Measurements could not be taken on Route 6.

General Information

These crossings cause the river to take on a double hour-glass shape, with a large pool between the two restrictions. The river channel seaward of the railroad bridge was estimated to be between 150 and 200 feet wide – or approximately 2 to 3 times wider than the bridge span. Upstream of the Route 6 bridges the river becomes a series of interconnected bays and ponds collectively known as the Upper Bass River, a condition that made it hard to estimate the upstream width of the river. Scour was observed on

(continued on page D14)

The bridges of Route 6 crossing the Bass River as seen from the top of the railroad bed.

continued from page D13

Penn Central Railroad bridge and Route 6 restrictions of Bass River

Site YA-11/DE-13

the riverbanks both seaward and upstream of the railroad bridge. No *Phragmite*s was visible in the vicinity of this site. This site was included in this Atlas even though salt marsh is not contiguous to its seaward side. Salt marsh exists in isolated patches scattered along the Upper Bass River banks.

Railroad bridge:
- Restriction width - 63 feet
- Restriction length - 50 feet (approximate)
- Upstream salt marsh - 19.54 acres

Route 6 bridges:
- Restriction width - inaccessible
- Restriction length - 200 feet (approximate)
- Upstream saltmarsh - 19.54 acres

The now unused railroad bed is seen restricting the Bass River, only allowing water to flow through a 63-foot opening.

Water pools between the railroad bed and Route 6 causing bank and riverbed scour.

Comments

Trains no longer use this section of the railroad track — use is terminated at the Yarmouth transfer station, 2.5 miles west of this site — however this railroad bridge is a historic structure and is slated for future use as part of the rail trail bike path.

In 1996, Aubrey Consulting, Inc. concluded that the "Upper Bass River tides become significantly distorted through the entrance to the system at the Railroad and Route 6 bridge constrictions." They also concluded that further information is required to "fully investigate the expected impact of improving the entrance channel to Upper Bass River at [site YA-11/DE-13]."[1]

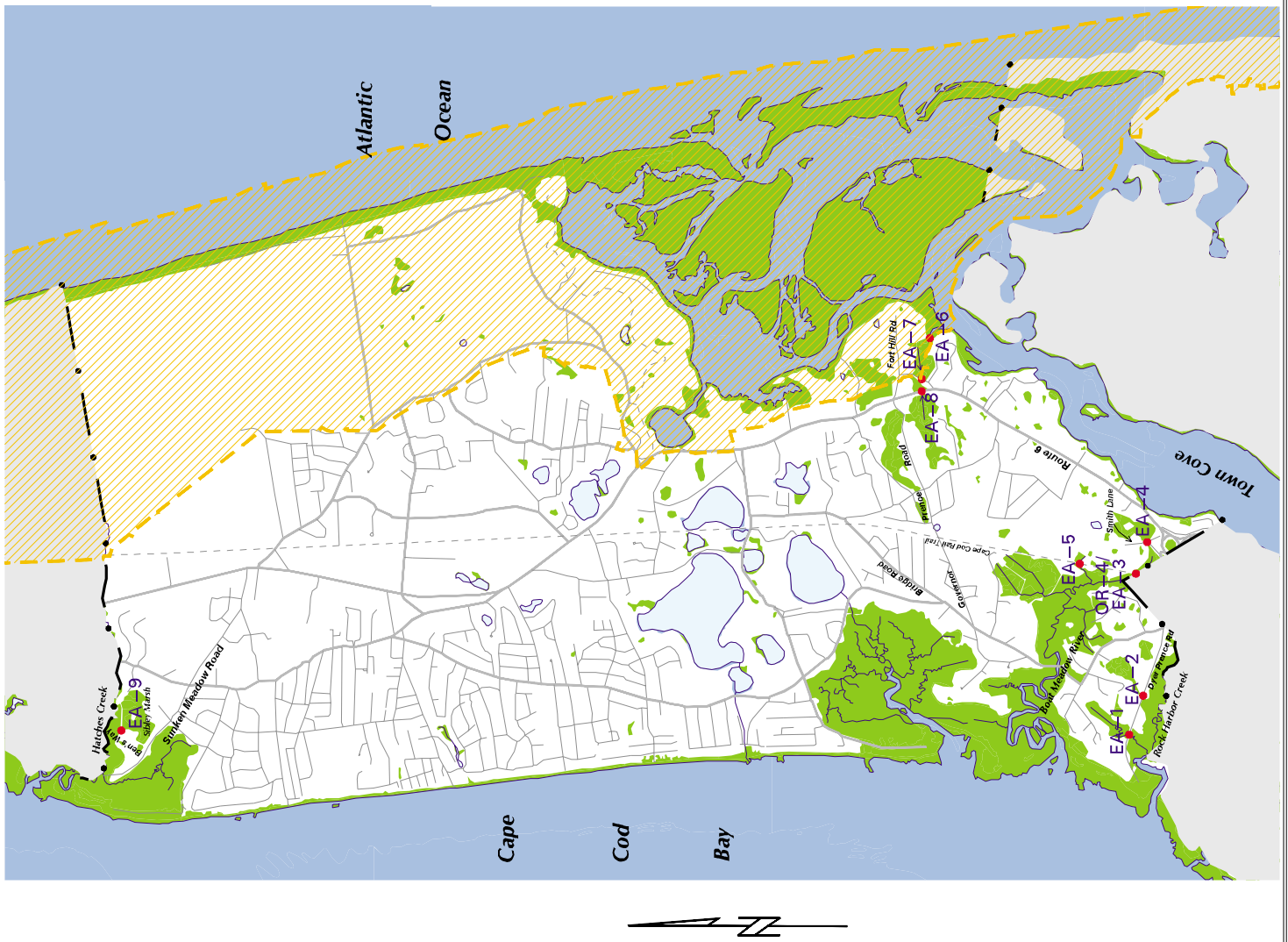
[1] Aubrey Consulting, Inc., 1996, pgs. 31-32.

TOWN OF EASTHAM

- Town Map
- Chart of Site Characteristics
- Sites 1 to 9

TOWN OF EASTHAM

Location of Selected Salt Marsh Restrictions

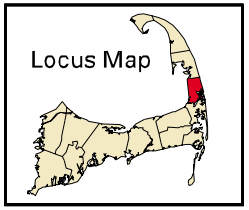


This map was produced by the Cape Cod Commission Geographic Information System office, with digital data from MassGIS and the Cape Cod Commission, 2001.

The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis.

This project was funded, in part, by the Executive Office of Environmental Affairs, Massachusetts Wetlands Restoration Program.

- EA – 1 Restriction Site
- Wetland
- Ocean
- Pond or Lake
- CC National Seashore
- Local Road
- Major Route
- Bike Trail
- Stream



Miles
0 0.5 1
0 2,500 5,000
Massachusetts State Plane Feet
North American Datum – 1927

Cape Cod Commission
Land Use ■ Roads ■ DCPCs ■ Parcels ■ Demographics ■ Environmental ■ Risk
GIS Services

2001

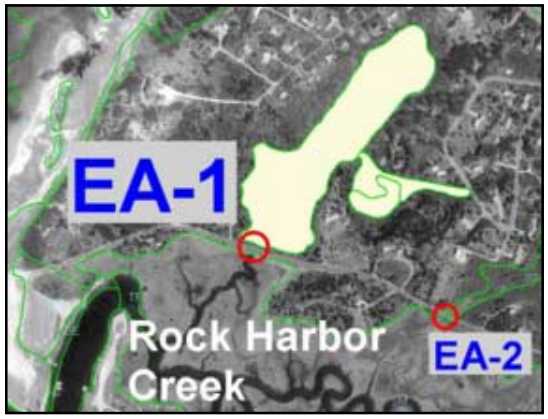
Town of Eastham–Site Characteristics

Site Number	Size of upstream affected area (salt marsh acres / total affected acres)	Is the upstream affected area contiguous to protected open space (ownership)?	Does this tidal channel support a shellfish resource area?	Is the channel or system part of an anadromous fish pathway?	Does the culvert/pipe support an engineered flood control structure?	Is the affected area or site within an ACEC boundary?	Does the affected area include Priority Habitat of Rare Species (PH) or Estimated Habitat of Rare Wildlife (WH)?	Are there any restricted sites upstream of this site (site number)?	Ownership of the site (public vs. private)
EA-1	9.71 / 11.56	YES (municipal)	YES	YES	NO	YES	YES (PH,WH)	NO	PUBLIC
EA-2	0.72 / 6.87	NO	YES	YES	NO	YES	YES (PH,WH)	NO	PUBLIC
OR-4/ EA-3	5.20 / 16.94	YES (private)	YES	NO	NO	YES	YES (PH,WH)	YES (EA-4)	PUBLIC
EA-4	0.0 / 10.18	NO	YES	NO	NO	YES	YES (PH)	NO	PRIVATE
EA-5	1.13 / 1.13	YES (municipal)	YES	NO	NO	YES	YES (PH,WH)	NO	PUBLIC
EA-6	7.71 / 18.74	YES (federal, state)	YES	NO	NO	NO	YES (PH,WH)	YES (EA-7, EA-8)	PUBLIC
EA-7	1.71 / 6.93	YES (federal, state)	YES	NO	YES (tide gate)	NO	YES (PH,WH)	YES (EA-8)	PUBLIC
EA-8	1.71 / 4.51	NO	YES	NO	NO	NO	NO	NO	PUBLIC
EA-9	6.31 / 16.51	YES (private)	YES	NO	YES (tide gate)	YES	YES (PH,WH)	NO	PRIVATE

EASTHAM

Dyer Prence Road restriction of Rock Harbor Creek

Site EA-1



Upstream Affected Area (acres): SM – 9.71; SS – 1.11; M – 0.74.

Site Description

Rock Harbor Creek forms the town line between Orleans and Eastham and flows in a southeasterly direction from its mouth on Cape Cod Bay into Cedar Pond. Dyer Prence Road runs parallel to the creek on its north shore and intersects two tidal channels. Site EA-1 is the western most site. Flow passes under the road via a 28-inch concrete pipe set in a concrete headwall. The opening is consistently submerged by high tide and appears to be in good condition. It does not appear to be broken or clogged. The Rock Harbor Creek system supports anadromous fish and shellfish resources that are closed to shellfishing.

General Information

The seaward channel is approximately 20 to 25 feet wide, narrowing to 5 to 10 feet upstream. Salt marsh is delineated by the Wetlands Conservancy Program on both sides of the roadway bed. While there is no significant change in vegetation from the seaward to upstream sides, there are other visual indicators of a restriction including major scouring and erosion on both sides of Dyer Prence Road. Additionally, marsh slumping was observed within the seaward marsh area.

- Restriction width – 28 inches
- Restriction length – 60 feet
- Upstream salt marsh – 9.71 acres

The roadway berm around this seaward headwall and the channel edges are severely eroded. A wide, deep scour pool has formed in front of this 28-inch opening.

Scouring and erosion scar the upstream side. As was the seaward headwall, this side is consistently submerged. Note the placement of the tide gauge to monitor flow in this system.

EASTHAM

Dyer Prence Road restriction of Rock Harbor Creek

Site EA-2

Upstream Affected Area (acres): SM – 0.72; SS – 3.65; M – 2.50.

Site Description

Rock Harbor Creek forms the town line between Orleans and Eastham and flows in a southeasterly direction from its mouth on Cape Cod Bay into Cedar Pond. Dyer Prence Road runs parallel to the creek on its north shore and intersects two tidal channels. Site EA-2 lies to the east of EA-1. Measurements of the culvert could not be taken at this site. Even at low tide both pipe openings were submerged within pools of stagnant water and were inaccessible. The site appeared to be severely degraded, warranting immediate repair. The Rock Harbor Creek system supports anadromous fish and shellfish resources that are closed to shellfishing.

A stagnant pool filled with reeds makes the seaward culvert opening inaccessible even at low tide.

General Information

Flow through this culvert appeared to be minimal. A 1 to 2-foot channel was visible on the seaward side that petered out and did not appear to extend to the seaward side of the roadway bed. Upstream, a 2 to 3-foot channel filled with stagnant, murky water extended from the pipe opening into the shrub swamp beyond. Scouring was minor at this site, likely due to the minimal flow. No erosion was observed.

- Restriction width – not accessible
- Restriction length – 42 feet
- Upstream salt marsh – 0.72 acres

This view into the upstream shrub swamp shows the stagnant channel in the distance.

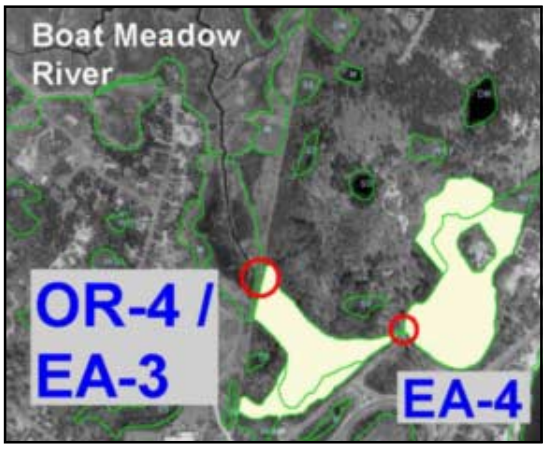
Comments

The Wetlands Conservancy Program delineated salt marsh adjacent to the seaward side of the roadway berm and shrub swamp immediately upstream of this infrastructure. The Program also delineated 0.72 acres of salt marsh upstream of the shrub swamp. If not for this upstream salt marsh, this site would likely have been excluded from this Atlas because the seaward channel does not appear to reach the roadway berm.

ORLEANS/EASTHAM

Cape Cod Rail Trail restriction of Boat Meadow River

Site OR-4/EA-3



Upstream Affected Area (acres): SM – 5.20; SS – 2.31; M – 9.43.

Site Description

Boat Meadow River runs in an easterly direction from its mouth on the Cape Cod Bay. Prior to reaching the Cape Cod Rail Trail, the river flows under Bridge Road via a 57-foot unrestricted bridge (see site EA-a, Appendix B). Boat Meadow River is conveyed under the bike trail via a 36-inch concrete pipe. The pipe is in serious disrepair. The trail's side slope embankments are eroding and its paved surface is being undermined. Restricted site EA-4 lies upstream. Boat Meadow River is within the Inner Cape Cod Bay Area of Critical Environmental Concern. While the river does support extensive shellfish resources, they are closed to shellfishing.

General Information

Seaward of this site the river channel is approximately 15 feet wide, narrowing to approximately 5 feet upstream. Visual indicators of a restriction are severe and include major scouring and erosion both seaward and upstream. Vegetation die off and ponded water are significant in the adjacent seaward marsh area. The vegetation changes noticeably from the seaward to upstream sides of the bike path with minor *Phragmites* growth seaward, becoming significant on the fringes and in the rear of the upstream affected area. An exposed length of seaward pipe is broken off in several sections. The opening is jammed by large logs, pieces of docks, and other debris that have collected at this site.

- Restriction width – 36 inches
- Restriction length – 45 feet
- Upstream salt marsh – 5.20 acres

Debris marks the seaward opening of this culvert under the bike trail. Pieces of the pipe have broken off and lie in the deep scour pool in front of the opening.

Comments

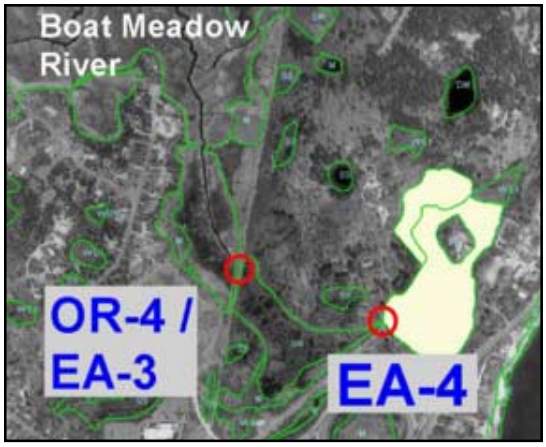
An Environmental Notification Form (EOEA file number 12421) for Cape Cod Rail Trail Safety Improvements was filed in January 2001, stating that the pipe is a tidal restriction reducing critical upstream habitat for fish and invertebrates and that the vegetative community suffers as well. Massachusetts Coastal Zone Management (MCZM) has examined this site as part of the US Environmental Protection Agency sponsored Salt Marsh Assessment Project. This project calls for replacement of the existing pipe with a 6 by 4-foot precast concrete box culvert. Restoration work at this site has now been funded by the Massachusetts Wetlands Restoration Program's Corporate Wetlands Restoration Partnership, the National Fish and Wildlife Federation, the Department of Environmental Management and MCZM. At this time all permits have been approved and construction bids received.

Upstream of the bike trail the bank has eroded away from this 36-inch pipe. Scour and erosion scar the area.

EASTHAM

Smith Lane restriction of Boat Meadow River

Site EA-4



Upstream Affected Area (acres): SS – 2.31; M – 7.87.

Site Description

Boat Meadow River runs in an easterly direction from its mouth on the Cape Cod Bay. Smith Lane crosses Boat Meadow River upstream of restricted site OR-4/EA-3. Flow passes under Smith Lane via a 40-inch concrete pipe. The seaward opening appears to be consistently submerged at mean high tide. The pipe appears to be unbroken, but clogged with muck. Boat Meadow River is within the Inner Cape Cod Bay Area of Critical Environmental Concern. While the river does support extensive shellfish resources, they are closed to shellfishing.

Upstream of Smith Lane the affected area is dominated by Phragmites.

General Information

The seaward channel is approximately 3 to 5 feet wide, widening to about 5 feet upstream. Vegetation changes significantly from one side of the road to the other – *Phragmites* growth is minor on the seaward side and dominates the upstream affected area. Cattails are present on both sides of the road – with significant growth seaward and minor growth upstream. Other visual indicators of a restriction include minor scouring and erosion both seaward and upstream.

- Restriction width – 40 inches
- Restriction length – 40 feet (estimate)
- Upstream salt marsh – 0 acres

Comments

Because the restriction caused by site OR-4/EA-3 is severe, the Eastham Department of Natural Resources suggests waiting for the remediation work to be completed and to give the system a chance to adapt to any improvements. Over time, the scope of work that is needed at upstream site EA-4 may become more apparent.

EASTHAM

Cape Cod Rail Trail restriction of channel off Boat Meadow River

Site EA-5

Site Descriptions

Upstream of unrestricted site EA-a at Bridge Road (see Appendix B) several channels meander through the marshes of Boat Meadow River. North of restricted site OR-4/EA-3 on the Cape Cod Rail Trail one of these channels passes under the bikeway via an estimated 1-foot diameter metal pipe. The pipe appeared to be in poor condition – it is visibly clogged with muck and consistently submerged at mean high tide. Boat Meadow River is within the Inner Cape Cod Bay Area of Critical Environmental Concern. While the river does support extensive shellfish resources, they are closed to shellfishing.

General Information

The seaward channel is approximately 2 to 4 feet wide, narrowing to 2 feet upstream of the Rail Trail. Visual indicators of a restriction include significant seaward scouring and minor upstream scouring. Upstream erosion was significant. *Phragmites* growth is minor on the seaward side and fringes the upstream affected area. There did not appear to be significant flow passing through the culvert – stagnant pools of water submerged the pipe opening on both sides of the Rail Trail.

- Restriction width – 1 foot (estimate)
- Restriction length – 40 feet (estimate)
- Upstream salt marsh – 1.13 acres

Upstream Affected Area (acres): SM – 1.13.

Standing on the bike trail there is a clear view of the upstream affected with its fringe of Phragmites.

Standing in the upstream affected area one can see how steep the bike trail berm is. The metal pipe is circled in the bottom of this photo.

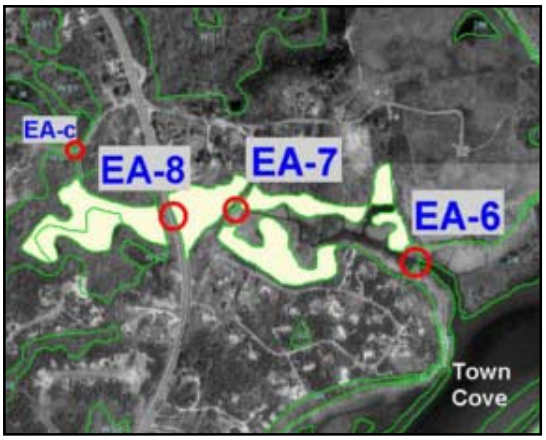
EASTHAM

Restrictions of Abelino's Creek by:

Stone Dike
Site EA-6

Governor Prence Road
Site EA-7

Route 6
Site EA-8



Upstream Affected Area (acres): SM – 7.71; M – 11.03. The SM acreage between EA-6 and EA-7 is estimated at 6 acres. Not all of the SM is highlighted in this image.

Site Descriptions

The mouth of Abelino's Creek is located off of Town Cove about 1.1 miles west from Nauset Inlet. The wetland associated with the creek are crossed by: a stone dike owned by the Cape Cod National Seashore (site EA-6); Governor Prence Road (site EA-7); and Route 6 (site EA-8). The area between sites EA-7 and EA-8 is known as the Mary Chase Salt Marsh and is owned and managed jointly by the Massachusetts Division of Fisheries and Wildlife and Ducks Unlimited, Inc. Continuing upstream of site EA-8, the creek and wetland area is crossed again by Governor Prence Road (see Appendix B, site EA-c). Abelino's Creek does support shellfish resources that are closed to shellfishing.

This broken clapper gate covers the 30 inch pipe and restricts the incoming tide under Governor Prence Road.

General Information[1]

The old stone dike, site EA-6, is made of large boulders located at the mouth of Abelino's Creek. The creek flows through an opening in the dike about 5 feet wide. The stream channel upstream of the dike is about 4 feet wide. Site EA-7 is a 30-inch diameter reinforced concrete pipe under Governor Prence Road with a flapper gate on the seaward side that closes on an incoming tide. The existing flapper gate was installed in 1989 to replace an older structure. Today, only half of the flapper gate remains intact. Site EA-8 is a 30-inch reinforced concrete pipe, approximately 60 feet long, the runs under Route 6. Tidal flow reaching this site is minimal due to the flapper gate upstream at site EA-7.

Vegetation upstream of site EA-6 and seaward of EA-7 is comprised mainly of salt marsh with a wide band of *Phragmites* fringing the wetland area. Within the Mary Chase Marsh *Phragmites* visibly dominates the vegetation. Upstream of Route 6, site EA-8, *Phragmites* is also dominant.

[1]See ACOE, 1996, pp. 73-84. Information provided is based on both fieldwork conducted at sites EA-7 and EA-8 and the ACOE report.

(continued on page E9)

(continued from page E8)

Restrictions of Abelino's Creek by:

Stone Dike
Site EA-6

Governor Prence Road
Site EA-7

Route 6
Site EA-8

Site EA-6
- Restriction width – 5 feet (approximate)
- Restriction length – unknown
- Upstream salt marsh – 7.71 acres (estimate)

Site EA-7
- Restriction width – 30 inches (tide gate)
- Restriction length – 43 feet
- Upstream salt marsh – 1.71 acres

Site EA-8
- Restriction width – 30 inches
- Restriction length – 60 feet
- Upstream salt marsh – 1.71 acres

Comments

These sites were selected and studied by the Army Corp of Engineers (ACOE) in 1996, which found that "during spring tide conditions, there does not appear to be any restriction caused by either the Gov. Prence Road [site EA-7] or the Route 6 [site EA-8] culverts. However, the closure of the [clapper] gate at the Gov. Prence Road culvert restricts tidal flow to the marsh." The study also referenced the possible negative effects of this on low-lying development and found that the stone dike does not appear to be restricting flow into the wetland.[2] The Massachusetts Wetlands Restoration Program is currently studying the potential and necessity for remediation at these sites. According to the Director of Natural Resources site EA-6 is emerging as the focus of any future restoration effort.

[2]ACOE, 1996, p. 84.

Phragmites visibly dominates the Marsh Chase Salt Marsh, an area of approximately 2.42 acres of shallow marsh between Governor Prence Road and Route 6.

This concrete headwall houses the upstream opening of the 30 inch pipe passing under Route 6. Stagnant water obscures the submerged pipe.

While Phragmites visibly dominates the view into the upstream wetland area from site EA-8, the Wetlands Conservancy Program has identified 1.71 acres of salt marsh further upstream.

EASTHAM

Earthen dike restriction of channel off Hatches Creek

Site EA-9

Site Descriptions

Hatches Creek forms the border between Eastham and Wellfleet. Tidally connected to the creek is an area known as Sibley Marsh, which lies south of the creek, north of North Sunken Meadow road, and east of Ben's Way. A low earthen dike extends east to west and can be accessed from the end of Ben's Way (all land and the roadway are privately owned). A tidal channel passes under this dike via a 2-foot corrugated metal pipe that is effectively sealed by a metal flapper gate. Hatches Creek does support shellfish resources that are closed to shellfishing.

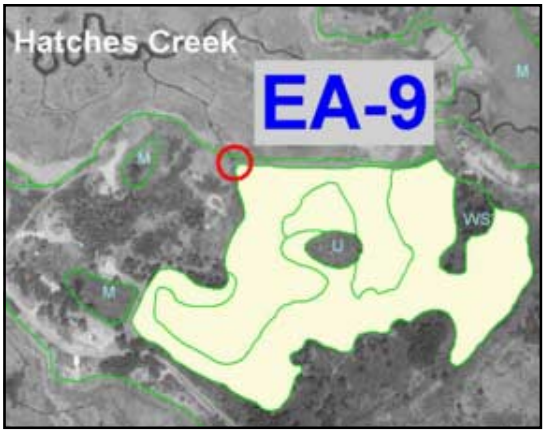
General Information

Both the seaward and upstream channels are approximately 5 feet wide. Visual indicators of a restriction include significant scouring and minor bank erosion near the seaward opening. The flapper gate appears to be rusted shut but is missing its bottom 2 inches, which provide a small opening that could allow some salt water to pass upstream. The flapper gate and pipe appear to be consistently submerged at high tide. Visual indicators of a restriction upstream include minor scouring and bank erosion. *Phragmites* growth is dominant in the upstream affected area.

- Restriction width – 2 feet (tide gate)
- Restriction length – 30 feet
- Upstream salt marsh – 6.31 acres

Comments

According to the Eastham Department of Natural Resources, the Cape Cod National Seashore would like to utilize this restriction and its associated wetland area as a control site. Therefore, restoration at this location may not be favored.



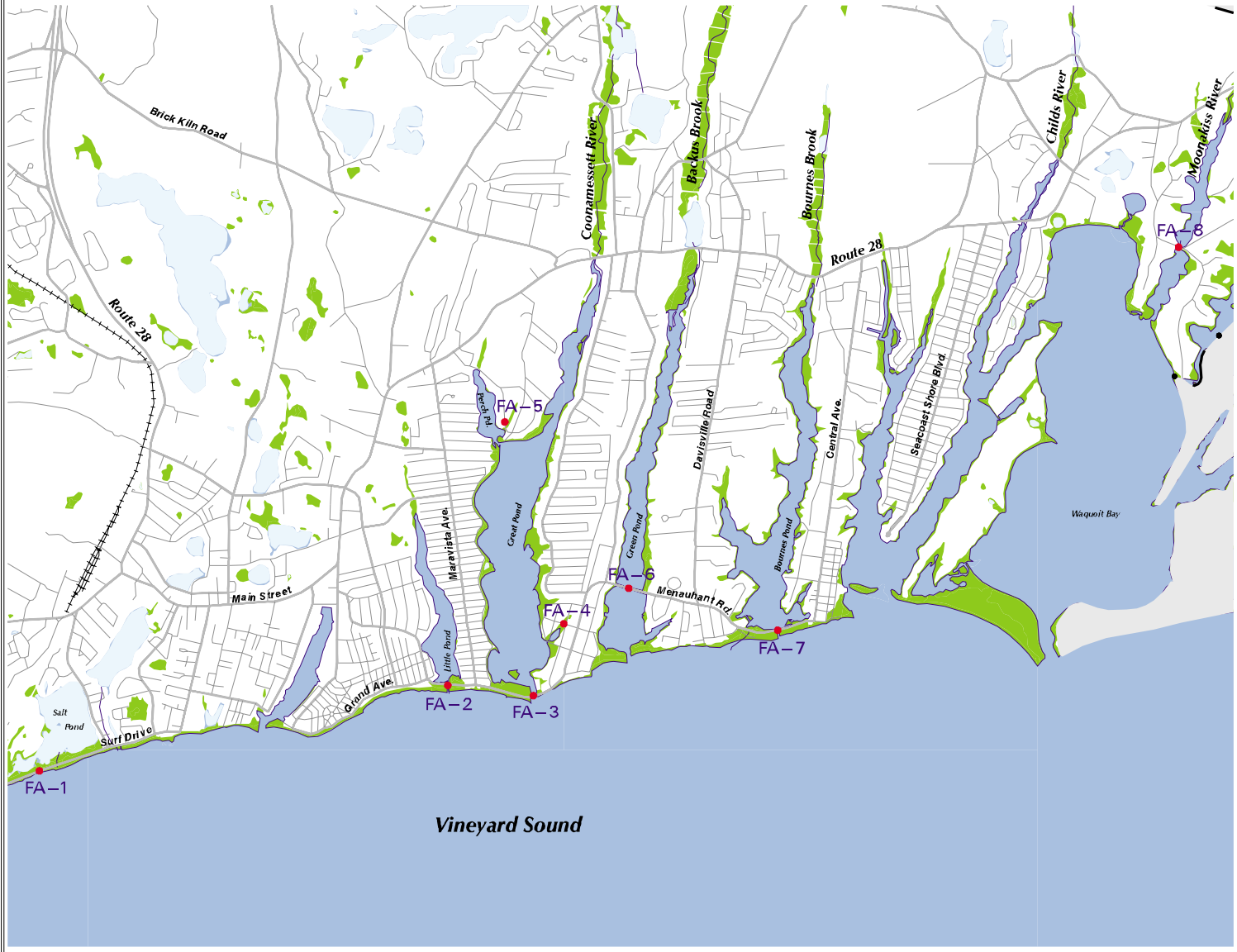
Upstream Affected Area (acres): SM – 6.31; SS – 9.43; M – 0.77.

This flapper gate prevents tidal flow from passing upstream via the 2-foot pipe. Note the tide gauge installed at this location.

This corrugated metal sluiceway is located on the upstream side of the dike, with its opening approximately 1-foot lower than the seaward side's opening.

TOWN OF FALMOUTH

- Town Map
- Chart of Site Characteristics
- Sites 1 to 8



TOWN OF FALMOUTH

Location of Selected Salt Marsh Restrictions

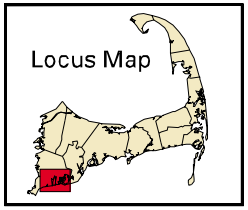
This map was produced by the Cape Cod Commission Geographic Information System office, with digital data from MassGIS and the Cape Cod Commission, 2001.

The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis.

This project was funded, in part, by the Executive Office of Environmental Affairs, Massachusetts Wetlands Restoration Program.

- FA – 1 Restriction Site
- Wetland
- Ocean
- Pond or Lake
- Local Road
- Major Route
- Stream
- Railroad

Locus Map



Miles
0 0.5 1
0 2,500 5,000
Massachusetts State Plane Feet
North American Datum – 1927

Land Use ▪ Roads ▪ DCPCs ▪ Parcels ▪ Demographics ▪ Environmental Data
Cape Cod Commission
GIS Services

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2001

Town of Falmouth – Site Characteristics

Site Number	Size of upstream affected area (salt marsh acres / total affected acres)	Is the upstream affected area contiguous to protected open space (ownership)?	Does this tidal channel support a shellfish resource area?	Is the channel or system part of an anadromous fish pathway?	Does the culvert/pipe support an engineered flood control structure?	Is the affected area or site within an ACEC boundary?	Does the affected area include Priority Habitat of Rare Species (PH) or Estimated Habitat of Rare Wildlife (WH)?	Are there any restricted sites upstream of this site (site number)?	Ownership of the site (public vs. private)
FA-1	0.99 / 9.57	YES (municipal, private)	YES	YES	NO	NO	NO	NO	PUBLIC
FA-2	0.75 / 1.64	NO	YES	NO	YES (stoplogs)	NO	NO	NO	PUBLIC
FA-3	34.17 / 35.78	YES (municipal)	YES	YES	NO	NO	NO	YES (FA-4, 5)	PUBLIC
FA-4	0.60 / 0.60	NO	NO	NO	NO	NO	NO	NO	PUBLIC
FA-5	0.99 / 0.99	NO	YES	NO	NO	NO	NO	NO	PUBLIC
FA-6	18.10 / 19.59	NO	YES	YES[1]	NO	NO	NO	NO	PUBLIC
FA-7	53.78 / 55.27	YES (municipal)	YES	NO	NO	NO	NO	NO	PUBLIC
FA-8	1.66 / 6.46	YES (municipal)	YES	YES	NO	YES	YES (PH)	NO	PUBLIC

[1] The Town of Falmouth is currently working with the Massachusetts Highway Department to restore a historic anadromous fish run through this location.

FALMOUTH

Surf Drive restriction of channel into Salt Pond

Site FA-1

Site Description

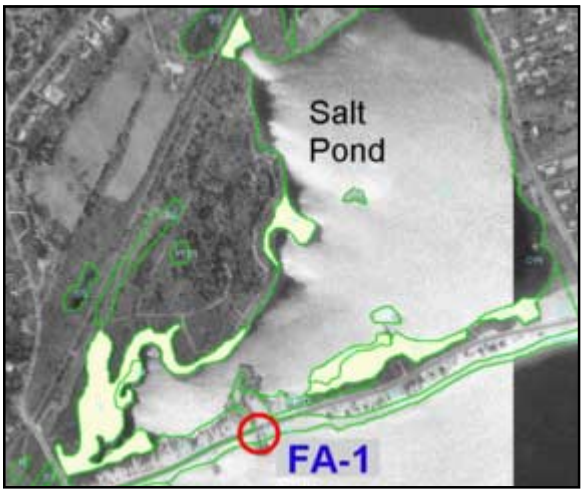
Surf Drive restricts the tidal channel connecting Vineyard Sound with Salt Pond. The restriction is a 6-foot concrete box culvert under Surf Drive that is in excellent condition. There are no upstream tidal crossings. Salt Pond supports shellfish resources, though shellfishing is prohibited. The pond supports an anadromous fish run.

General Information

The 10-foot wide seaward channel is armored by rock walls. Upstream, the channel widens to approximately 20-30 feet. Visual indicators of a restriction include minor scour and erosion. Salt marsh, shrub swamp, and shallow marsh are found on the banks of Salt Pond. *Phragmites* was visible in small fringe patches on the upstream channel and pond shoreline.

- Restriction width – 6 feet
- Restriction length – 45 feet
- Upstream salt marsh – 0.99 acres

Upstream channel with fringe Phragmites and minor scour visible.



Upstream Affected Area (acres): SM - 0.99; SS - 2.88; M - 5.70.

Armored seaward channel flowing through the 6-foot box culvert under Surf Drive into Salt Pond.

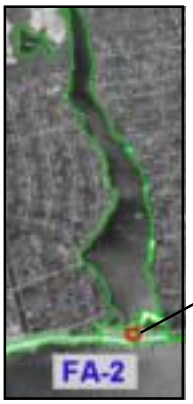
Comments

Local officials noted the presence of eel grass in the pond as recent as 5 years ago, however believe there is none present today. While Salt Pond is in the proximity of low-lying developed areas, the shoreline itself remains mostly undeveloped.

FALMOUTH

Grand Avenue restriction of channel into Little Pond

Site FA-2



Upstream Affected Area (acres): SM – 0.75; M – 0.89.

Site Description

A 10-foot concrete culvert under Grand Avenue at Bristol Beach connects Vineyard Sound to Little Pond. The upper reaches of Little Pond are not tidally influenced (see Appendix B, site FA-d). This site underwent major reconstruction between 1991 and 1995, during which the seaward and upstream channels were both armored and the existing culvert installed. The seaward channel flows between two paved beach parking lots that are connected by a footbridge suspended seaward of the culvert. Shellfish resources in Little Pond currently have a "prohibited" status.

General Information

The seaward channel is 20 feet wide, widening to 30 feet upstream. Both seaward and upstream channels are armored and therefore limit visual signs of restriction such as erosion and scour. The seaward opening is nearly submerged at high tide and has a metal frame to enable the placement of water-tight stoplogs. The banks of Little Pond are densely developed but do have four isolated pockets of salt marsh as well as several minor patches of *Phragmites.*

- Restriction width – 10 feet
- Restriction length – 50 feet
- Upstream salt marsh – 0.75 acres

Seaward culvert opening nearly submerged by the rising high tide.

Rock armored upstream channel flowing into Little Pond.

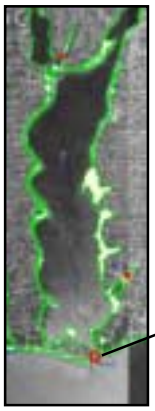
Comments

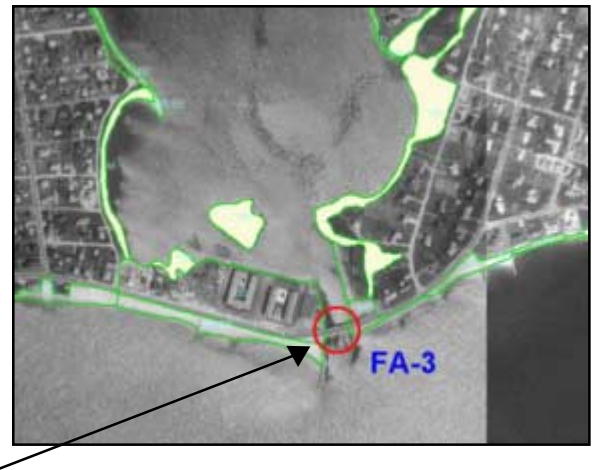
A narrow channel was purposely constructed to increase the velocity of incoming and outgoing tides. This was done to enable the tidal entrance to keep itself clear, thereby lessening the frequency of maintenance dredging. Little Pond was historically a fresh water pond and once supported a herring run that is non-existent today.

FALMOUTH

Menauhant Road restriction of channel into Great Pond

Site FA-3





Upstream Affected Area (acres): SM – 34.17; M – 1.61.

Site Description

In the Maravista neighborhood of Falmouth, Menauhant Road restricts the tidal channel connecting Vineyard Sound with Great Pond. The restriction is a 170-foot wide bridge span supported on wooden pilings. Two tidal crossings are found upstream of this site, FA-4 and FA-5. Shellfishing in the lower extent of Great Pond is subject to seasonal closures. Great Pond supports an anadromous fish run.

General Information

Two seaward jetties form a channel approximately 200 feet wide. There is significant accretion of sand behind the easterly jetty. The seaward jetty armoring follows banks that were previously scoured; the indentations of this scour are visible in the armored shoreline. Rock walls also armor the upstream channel into Great Pond, thereby limiting visual signs of a restriction such as erosion and scour. The shoreline of Great Pond is heavily developed, however there is salt marsh fringing most of the pond. *Phragmites* was visible in small fringe patches along the pond shoreline.

- Restriction width – 170 feet
- Restriction length – 30 feet
- Upstream salt marsh – 34.17 acres

Rock armored seaward channel following the contours of previously scoured channel banks.

Comments

Great Pond was dredged in October 2000 as far upstream as Perch Pond. Several docks and piers are located along the shoreline of Great Pond, which is used heavily for recreation.

A study completed for Falmouth in 2000 determined Great, Green, and Bourne Ponds to be rapidly flushing systems, which is typically indicative of good relative water quality. However these ponds each show signs of ecological stress indicative of poor water quality, and "therefore, the levels of nutrient loading likely controls water quality...to a greater degree than the hydrodynamic characteristics of each pond." Tide attenuation through Great Pond inlet was negligible suggesting that improvements to the inlet will have a negligible impact on estuarine water quality.[1]

Heavily armored upstream channel flowing into Great Pond.

[1] Applied Coastal Research and Engineering, Inc., 2000, p. 8 and Task 2 p. 32.

FALMOUTH

Pine Grove Avenue restriction of channel off Great Pond

Site FA-4

Site Description

A one-foot corrugated metal pipe passes tidal flow under Pine Grove Avenue in the Acapesket neighborhood of Falmouth. Pine Grove Avenue is a narrow dirt road that severs a small patch of salt marsh extending inland from the banks of Great Pond. This small tidal restriction lies upstream of site FA-3. The pipe is in poor condition and is clogged with debris and silt.

General Information

The seaward channel is 3-5 feet wide, pooling at the pipe opening as it tries to flow through the one-foot pipe. The seaward opening is submerged at mean high tide. Water is nearly stagnant in the pool formed at the upstream pipe outlet, where signs of repeated scour are visible. The upstream channel is approximately 1-2 feet wide and its banks are eroding. *Phragmites* borders the edges of Pine Grove Avenue as the road passes through the salt marsh, and grows in a small patch at the rear of the upstream affected area.

- Restriction width – 1 foot
- Restriction length – 35 feet
- Upstream salt marsh – 0.60 acres

The upstream pipe is nearly submerged in pool of stagnant water, and water ponds in the upstream salt marsh.

Upstream Affected Area (acres): SM – 0.60.

View of the seaward channel and salt marsh through the Phragmites at the culvert's mouth.

Comments

The upstream affected area of salt marsh is contained within three dirt roadway berms, those of Pine Grove Avenue, Cove Street, and Oak Grove Avenue. It is likely that a small increase in the amount of tidal flow could be introduced to this salt marsh and still be contained within the man-made roadway berms.

FALMOUTH

Teaticket Path restriction of channel off Perch Pond

Site FA-5

Upstream Affected Area (acres): SM – 0.99.

Site Description

A 16-inch concrete pipe passes tidal flow under Teaticket Path just north of its intersection with Playstead Lane. The road severs salt marsh jutting inland from the banks of Perch Pond, which is the northwest arm of Great Pond. Tidal flow into Great Pond is restricted at site FA-3. The seaward opening of the pipe is located under a rock conglomerate headwall. Perch Pond supports shellfish resources though shellfishing is prohibited.

General Information

The seaward and upstream channels are both approximately 2 feet wide. Visual signs of a restriction include minor scour and bank erosion on both sides of the road. There is no *Phragmites* visible near the site.

- Restriction width – 16 inches
- Restriction length – 40 feet
- Upstream salt marsh – 0.99 acres

16-inch seaward pipe opening under Teaticket Path.

View of upstream affected salt marsh as seen from Teaticket Path.

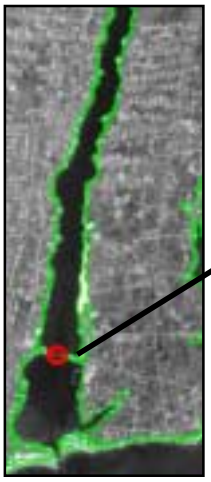
Comments

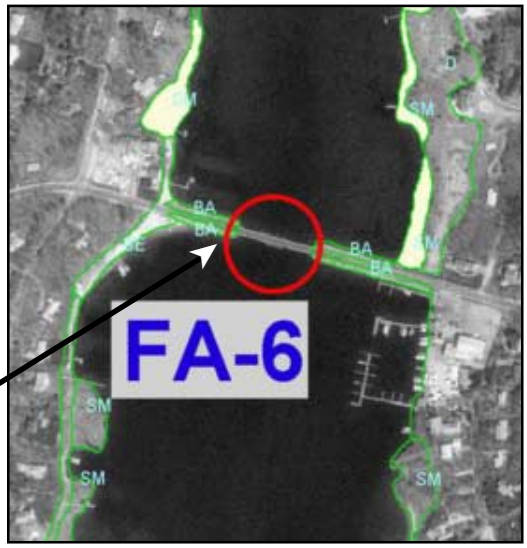
Falmouth's shellfish officer commented on the extent of *Phragmites* on the banks of Perch Pond and the fact that heavy development in the area was responsible for the shellfish closures. A neighbor passing during fieldwork commented on the extreme "low tide" smell often emanating from this small patch of salt marsh even during high tide cycles.

FALMOUTH

Menauhant Road restriction of Green Pond

Site FA-6





Upstream Affected Area (acres): SM – 18.1; M – 1.49.

Site Description

Menauhant Road crosses Green Pond between Acapesket and Davisville roads via a 280-foot bridge. The bridge abutments extending into the pond are significant enough to effectively sever Green Pond so that it appears to be two distinct water bodies. Shellfishing in Green Pond is subject to seasonal closures.

General Information

The seaward and upstream ponds are both approximately 600 feet wide, more than twice the bridge span. Recognizing that the bridge span was insufficient, five box culverts were later cut into the berms by the Massachusetts Highway Department. However, these culverts were sited and constructed too high and therefore do not pass tidal flow except during extreme high tides.

- Restriction width – 280 feet
- Restriction length – 35 feet
- Upstream salt marsh – 18.1 acres

View of Green Pond outlet into Vineyard Sound as seen from Menauhant Road bridge.

Comments

The Town of Falmouth and the Massachusetts Highway Department are currently in the process of restoring a historic anadromous fish run by re-constructing fish passageways under Route 28 (see Appendix B, site FA-f).

A study completed for Falmouth in 2000 determined Great, Green, and Bourne Ponds to be rapidly flushing systems, which is typically indicative of good relative water quality. However these ponds each show signs of ecological stress indicative of poor water quality, and "therefore, the levels of nutrient loading likely controls water quality...to a greater degree than the hydrodynamic characteristics of each pond." Tide attenuation through Green Pond inlet was negligible suggesting that improvements to the inlet will have a negligible impact on estuarine water quality.[1]

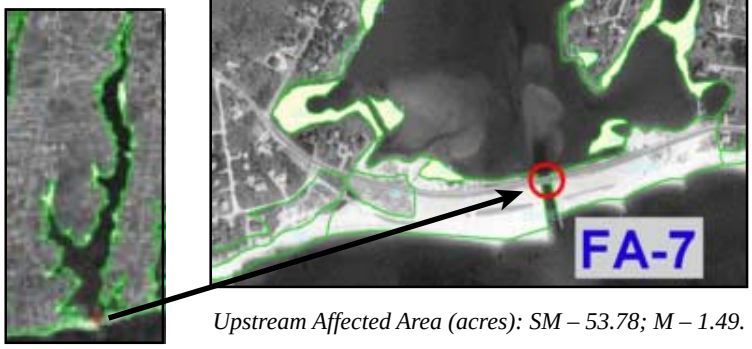
Seaward side of the bridge as seen from the Green Pond Town Landing.

[1] Applied Coastal Research and Engineering, Inc., 2000, p. 8 and Task 2 p. 32.

FALMOUTH

Menauhant Road restriction of channel into Bournes Pond

Site FA-7



Upstream Affected Area (acres): SM – 53.78; M – 1.49.

Site Description

Menauhant Road crosses the tidal channel entering Bournes Pond over a bridge spanning 58 feet. The seaward channel is 60 feet wide and is armored with large boulders. There is no channel upstream of the bridge—the pond abuts the upstream side of the road. Bournes Pond supports extensive shellfish resources. The southern half of the pond is open for shellfishing year-round, while the northern half is subject to seasonal closures. Bournes Pond does not support anadromous fish.

General Information

The channel connecting Bournes Pond with Vineyard Sound was purposely constructed to a narrow 60 feet in order to increase the velocity of tidal exchange, which, to date, has eliminated the need for maintenance dredging. The shores of the pond are not heavily developed even though they are mostly privately owned. Undeveloped lands include the Sea Farms Marsh and the Carter Reservation. The outlet into Vineyard Sound has migrated naturally over the years and, in 1986, was manually relocated to its current location. Visual signs of a restriction are limited by the seaward channel armoring. Upstream, minor scour and erosion are visible. *Phragmites* was not observed in the vicinity of this site.

- Restriction width – 58 feet
- Restriction length – 25 feet
- Upstream salt marsh – 53.78 acres

Observed during a mid/high outgoing tide, the opening on the seaward side of the bridge is nearly flowing at capacity.

Comments

In 1999, the Coastal Pollution Remediation Program of Massachusetts Coastal Zone Management, funded a water quality improvement project intended to improve water quality substantially enough to enable year-round shellfishing in the ponds' upper reaches.

A study completed for Falmouth in 2000 found this inlet to be restricted, causing a tide lag of approximately one-hour, and stating that "[e]ngineering improvements (dredging and/or widening of the inlet) could reduce this tide lag and improved tidal flushing of Bournes Pond."[1]

Armored channel on the seaward side of Menauhant Road connecting Bournes Pond with Vineyard Sound.

[1] Applied Coastal Research and Engineering, Inc., 2000, Task 2 p. 32.

FALMOUTH

Meadow Neck Road restriction of Moonakiss River

Site FA-8

Site Description

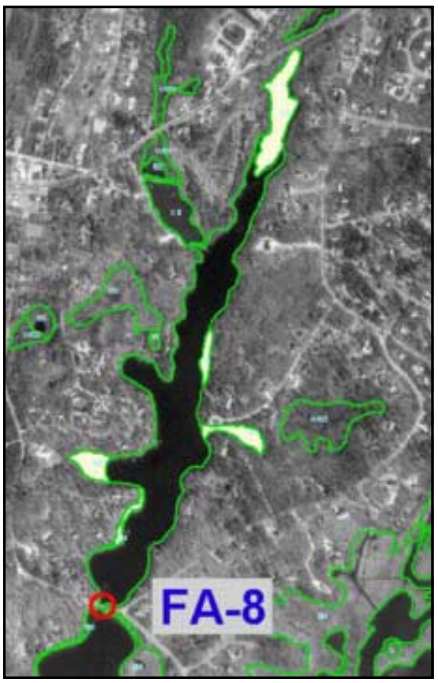
Meadow Neck Road crosses the Moonakiss River via a 27-foot concrete, box culvert-type bridge. Both bridge and roadway are in good repair. The Moonakiss River supports an anadromous fish run as well as shellfish resource areas that are closed both upstream of the bridge and immediately seaward of it. However, just north of the rivers' entrance into Waquoit Bay, there are soft shell clam flats that are open year-round to shellfishing.

General Information

Seaward of the bridge the river channel is approximately 200-400 feet wide narrowing to approximately 100-150 feet wide upstream. Evidence of scour is significant on both sides of the bridge.

- Restriction width – 27 feet
- Restriction length – 35 feet
- Upstream affected salt marsh – 1.66 acres

Seaward side of the concrete box opening under Meadow Neck Road.



Upstream Affected Area (acres): SM – 1.66; SS – 3.2; M – 1.6.

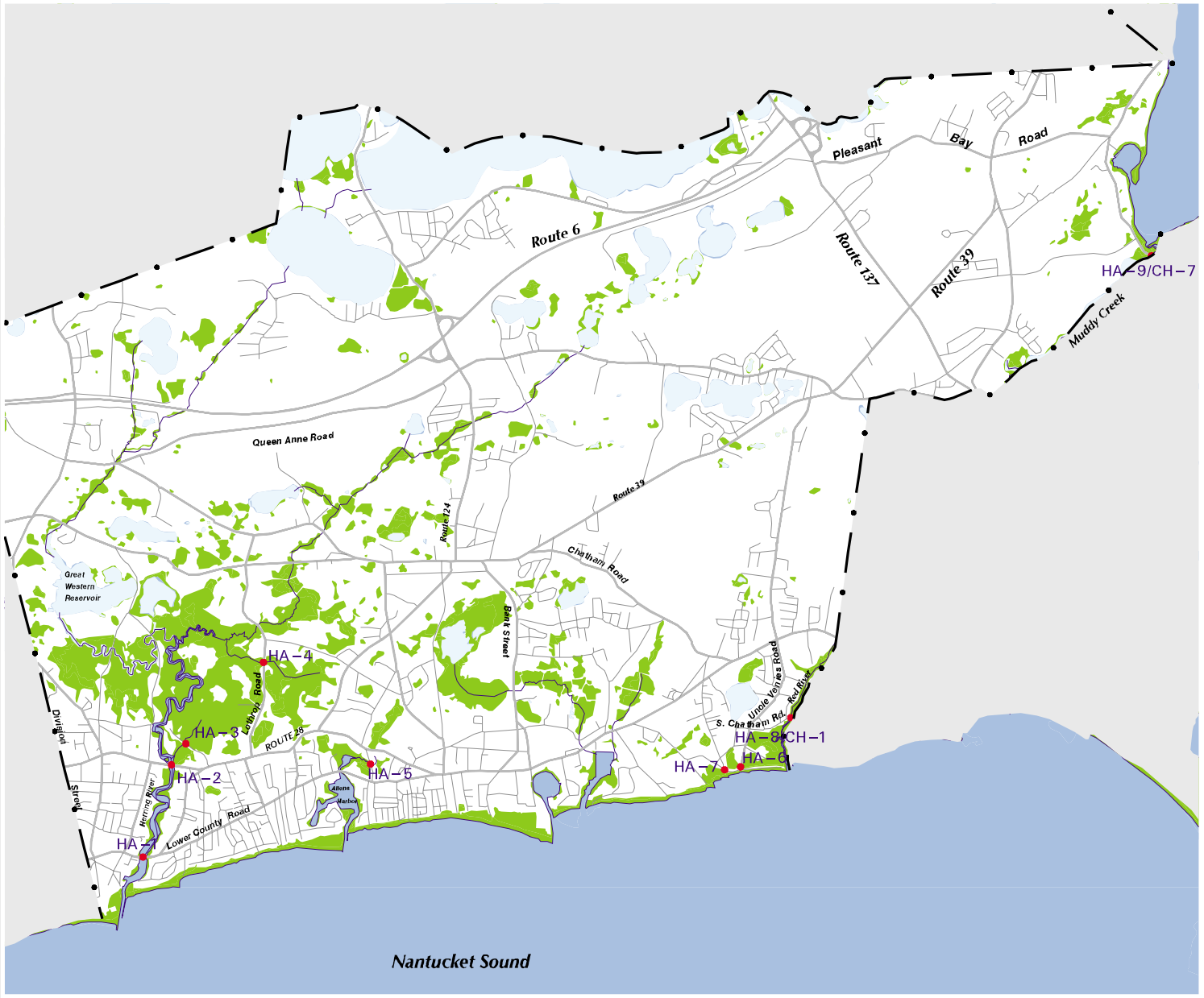
View of 27-foot bridge opening, seen to be significantly narrower than the width of the Moonakiss River.

Comments

The entrance into Waquoit Bay from Vinyard Sound is not crossed by any infrastructure but is artificially maintained by a pair of jetties that have, to date, successfully kept this entrance from shoaling. The Falmouth Local Comprehensive Plan sites water quality concerns in the Moonakiss River, which obviously affects the status of shellfish beds in the area.

TOWN OF HARWICH

- Town Map
- Chart of Site Characteristics
- Sites 1 to 9



TOWN OF HARWICH

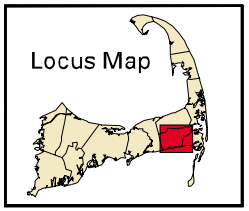
Location of Selected Salt Marsh Restrictions

This map was produced by the Cape Cod Commission Geographic Information System office, with digital data from MassGIS and the Cape Cod Commission, 2001.

The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis.

This project was funded, in part, by the Executive Office of Environmental Affairs, Massachusetts Wetlands Restoration Program.

- HA – 1 Restriction Site
- Wetland
- Ocean
- Pond or Lake
- Local Road
- Major Route
- Stream
- Railroad



Miles
0 0.5 1
0 2,500 5,000
Massachusetts State Plane Feet
North American Datum – 1927

Cape Cod Commission
Land Use ▪ Roads ▪ DCPCs ▪ Parcels ▪ Demographics ▪ Environmental Data
GIS Services

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2001

Town of Harwich – Site Characteristics

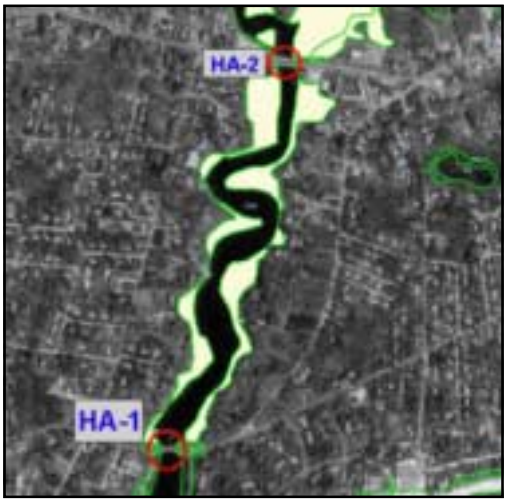
Site Number	Size of upstream affected area (salt marsh acres / total affected acres)	Is the upstream affected area contiguous to protected open space (ownership)?	Does this tidal channel support a shellfish resource area?	Is the channel or system part of an anadromous fish pathway?	Does the culvert/pipe support an engineered flood control structure?	Is the affected area or site within an ACEC boundary?	Does the affected area include Priority Habitat of Rare Species (PH) or Estimated Habitat of Rare Wildlife (WH)?	Are there any restricted sites upstream of this site (site number)?	Ownership of the site (public vs. private)
HA-1	205.62 / 420.27	YES (municipal)	YES	YES	NO	NO	YES (PH, WH)	YES (HA-2,3,4)	PUBLIC
HA-2	192.28 / 406.93	YES (municipal)	YES[1]	YES	NO	NO	YES (PH, WH)	YES (HA-3,4)	PUBLIC
HA-3	Unable to determine	YES (municipal)	YES	YES	NO	NO	YES (PH, WH)	NO[2]	PRIVATE
HA-4	0.0 / 13.84	NO	YES	NO[3]	NO	NO	YES (PH, WH)	NO	PUBLIC
HA-5	0.0 / 1.85	NO	NO	NO	NO	NO	NO	NO	PUBLIC
HA-6	8.87 / 9.77	YES (municipal)	NO	YES	NO	NO	NO	YES (HA-7)	PUBLIC
HA-7	5.54 / 5.54	YES (municipal)	NO	YES	NO	NO	NO	NO	PUBLIC
HA-8/ CH-1	3.0 / 3.0	YES (private)	YES	YES	NO	NO	NO	NO	PUBLIC
HA-9/ CH-7	2.73 / 18.07	YES (municipal)	YES	YES[4]	NO	YES	NO	NO	PUBLIC

[1] Shellfish occur in the Herring River south of Route 28, site HA-2. Therefore all sites in the Herring River system are considered to support a shellfish resource area.
[2] Study is needed to determine whether flow in the channel at site HA-3 passes through site HA-4 as well. Using aerial photography, the main channel of the river appears to be the only contributor of flow through HA-4.
[3] Though part of the Herring River system, this channel is not directly connected to the upstream ponds of the system that are the likely target area for the anadromous fish.
[4] Muddy River historically supported an anadromous fish run. It is not believed to be currently active.

HARWICH

Lower County Road restriction of the Herring River

Site HA-1



Upstream Affected Area (acres): SM – 205.62; SS – 27.48; M – 187.17.

Site Description

The Herring River flows through West Harwich, making two infrastructure crossings (sites HA-1 and HA-2) south of the extensive Herring River Marshes. Lower County Road crosses the river approximately one-quarter mile north of its mouth on Nantucket Sound. The bridge has a span of 90 feet. The road and bridge appear to be in good condition.

The Herring River is tidally influenced as far upstream as the Great Western Reservoir where flow is controlled by a dam and the first of several fish ladders is installed[1]. Upstream of site HA-1 this Atlas identified three sites where infrastructure appears to be restrictive of salt marsh (sites HA-2 to HA-4). Additionally, there are five upstream infrastructure crossings of the river that were not considered restrictive (see Appendix B, sites HA-a through HA-e). The Herring River supports an active anadromous fish run and supports shellfish as far upstream as Route 28 (site HA-2).

General Information

The river is approximately 120-150 feet wide both seaward and upstream of the Lower County Road Bridge. Visual indicators of a restriction include seaward and upstream scouring and bank erosion, as well as minor vegetation die off upstream of the bridge. The upstream affected area of this site includes 13.34 acres of salt marsh that lie between HA-1 and HA-2, plus a combined 406.93 acres of salt marsh, shallow marsh, and shrub swamp upstream of site HA-2.

- Restriction width – 90 feet
- Restriction length – 36 feet
- Upstream salt marsh – 205.62 acres

Lower County Road crosses the Herring River via this 90-foot bridge.

Comments

Although the river is wider than the bridge span, this site did not exhibit dramatic visual signs of restriction. However, as the seaward-most infrastructure crossing of the Herring River, and because of the importance and extent of the upstream tidal system, site HA-1 should be considered in any remediation plans of a Herring River site. Limited tidal information collected in 2000 seems to indicate little dampening in the tidal signal up to Lothrop Road (site HA-4) and the Great Western Reservoir.[2] Further tidal information would help to resolve how much of a restriction sites HA-1 and HA-2 create on this system.

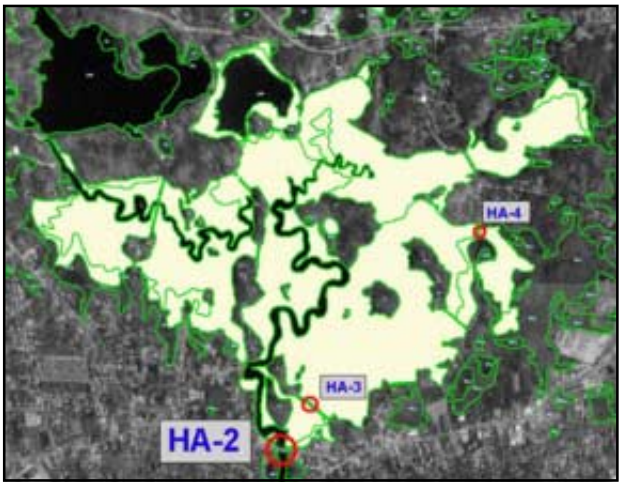
Seen at low tide, the upstream river bank is lined with mud and salt marsh, whose edges near to the bridge exhibit minor vegetation die off.

[1] Horsley & Witten, Inc., June 2000.
[2] id.

HARWICH

Route 28 restriction of the Herring River

Site HA-2



Upstream Affected Area (acres): SM – 192.28; SS – 27.48; M – 187.17.

Site Description

Route 28 crosses the Herring River approximately one mile north of its mouth on Nantucket Sound, and upstream of site HA-1. The Route 28 bridge has a span of 155 feet. The road and bridge are in good condition. Upstream sites HA-3 and HA-4 also appear to be restrictive of salt marsh. Additionally, there are five upstream infrastructure crossings of the river that were not considered restrictive (see Appendix B, sites HA-a through HA-e). The Herring River flows through West Harwich and is tidally influenced as far upstream as the Great Western Reservoir, where river flow is dammed and the first of several fish ladders is installed. The Herring River supports an active anadromous fish run and supports shellfish resource areas to the seaward side of site HA-2.

General Information

The seaward river channel is approximately equal to the bridge span. Immediately upstream of the bridge the river channel branches, with the main channel remaining at approximately 150 feet and a second 20 to 30-foot channel feeding an extensive salt marsh area off to the east. Visual indicators of a restriction are minor at this site. In fact, the bridge span to channel width ratio closely resembles natural, free-flowing river conditions. However, minor signs of restriction are present including upstream bank erosion, scour, and vegetation die off. There is a minor amount of *Phragmites* concentrated along the Route 28 berm.

- Restriction width – 155 feet
- Restriction length – 50 feet
- Upstream salt marsh – 192.28 acres

This 155-foot bridge span carries Route 28 across the Herring River.

Comments

It is because of the importance of the Herring River system as a whole, and this site's location as an integral link in it, that site HA-2 is included in this Atlas. Limited tidal information collected in 2000 seems to indicate little dampening in the tidal signal up to Lothrop Road (site HA-4) and the Great Western Reservoir.[1] Further tidal information would help to resolve how much of a restriction sites HA-1 and HA-2 create on this system.

Minor scour, bank erosion, and vegetation die off are visible on the upstream river banks near the bridge.

[1] See Horsley & Witten, Inc., June 2000.

HARWICH

Salt Meadow Lane restriction of channel off the Herring River

Site HA-3

Site Description

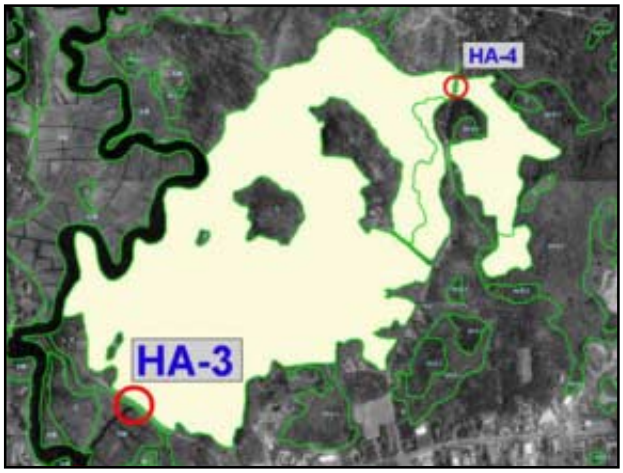
Salt Meadow Lane, a private, dirt road, provides access to a single home located on small piece of upland within the Herring River Marshes. This site lies just upstream of site HA-2, the Route 28 crossing of the main river channel. Salt Meadow Lane crosses this channel via a 20-foot wooden board bridge. Both the dirt road and bridge are in excellent condition. The Herring River supports an anadromous fish run and shellfish resource area.

General Information

The seaward channel is approximately 15-20 feet wide and is scarred by visual indicators of restriction including major souring, bank erosion, and vegetation die off. The seaward marsh area exhibits low marsh slumping. Upstream of the bridge the channel narrows to 10-15 feet. Visual indicators of a restriction occur there as well including significant scour, bank erosion, and vegetation die off. There was no *Phragmites* observed in the upstream affected area.

- Restriction width – 20 feet
- Restriction length – 15 feet
- Upstream salt marsh – 116.22 acres

Vegetation die off is visible on the edges of this upstream channel as it flows into the extensive Herring River Marshes visible beyond.



Upstream Affected Area (acres): SM – unable to determine.

Large rocks support this 20-foot bridge, decreasing the area for water to flow and increasing the size of the restriction. Scour, erosion, and vegetation die off are all evident in this channel.

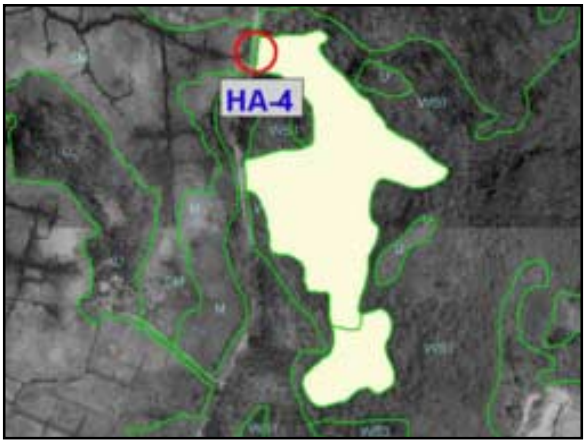
Comments

Tidal flow also reaches the upstream affected salt marsh via channels further upstream along the Herring River. Therefore, to equate the acreage of upstream salt marsh with the upstream affected area would likely be a gross overestimation of area directly affected by flow passing through site HA-3. Additional studies are needed to determine the marsh area affected by this infrastructure crossing and the relationship of site HA-3 to the greater area of the Herring River Marshes.

HARWICH

Lothrop Road restriction of a tributary to the Herring River

Site HA-4



Upstream Affected Area (acres): SS – 2.41; M – 11.43.

Site Description

Lothrop Road crosses a tributary of the Herring River and separates approximately 13.84 acres of the Herring River marsh system from the whole. A 20-inch corrugated plastic pipe passes flow under the road. The pipe is in fair condition. Its upstream opening was blocked by reeds and mud and was submerged at an incoming, mid tide. This channel flows into the Herring River, which does support shellfish resources south of the Route 28 crossing (site HA-2).

General Information

The seaward channel is approximately four feet wide, with the upstream channel actually wider, measuring five to six feet. The vegetation changes significantly from the seaward to upstream area. Salt marsh dominates seaward, while *Phragmites* dominates the upstream marsh area. There is some *Phragmites* present on the seaward side of Lothrop Road near this culvert that extends for about 15 feet from the roadway berm. Other visual indicators of restriction observed here include minor bank erosion.

- Restriction width – 20 inches
- Restriction length – 36 feet
- Upstream salt marsh – 0 acres

The top of the 20-inch pipe is barely visible here; although Phragmites lines the seaward channel near the roadway berm, salt marsh dominates the seaward area.

Phragmites dominates the upstream marsh area and old reeds block the pipe opening just below the Lothrop Road guard rail.

Comments

Although observed during an incoming tide cycle, water was flowing seaward. The Herring River does support an anadromous fish run, however, it is unlikely that spawning fish attempt to use this Lothrop Road channel where only a small marsh area with no ponds are located upstream.

HARWICH

Kildee Road restriction of channel off Allens Harbor/Doanes Creek

Site HA-5

Upstream Affected Area (acres): SS – 0.86; M – 0.99.[1]

Site Description

Tidal flow to the site is from Nantucket Sound via Doanes Creek and Allens Harbor. Flow first crosses under Lower County Road (see Appendix B, site HA-f) and then under Kildee Road via two parallel 18-inch corrugated plastic pipes. These pipes are in good condition, though partially clogged by silt and debris. This tidal system does not support shellfish or act as an anadromous fish run.

General Information

The seaward channel is 10 feet wide narrowing to approximately 6 feet upstream of Kildee Road. Water appeared stagnant and both pipes were submerged at mean high tide. No scour and only very minor upstream bank erosion were observed. Salt marsh was delineated to the seaward side of Kildee Road, however *Phragmites* was the dominant vegetation type observed within approximately 10 yards of the pipes. The upstream affected area (which lies south of Route 28) consists of shallow marsh and shrub swamp with *Phragmites* observed as the significant type of vegetation.

- Restriction width – two 18-inch pipes
- Restriction length – 45 feet
- Upstream salt marsh – 0 acres

Two pipes are barely visible through the stagnant, murky waters by Kildee Road; Phragmites lines the seaward channel.

Comments

The Kildee Road Wetland was selected and studied by the Army Corps of Engineers in 1996. The study area included this site and non-tidally restricted sites HA-f and HA-g (see Appendix B). Site HA-f was found to be non-restrictive. Additionally, it found that "there appears to be very little restriction at high tide caused by either Kildee Road or Route 28 [site HA-g] culverts…. The relatively high existing vegetation diversity suggests that the tidal exchange at the marsh should not be altered without careful consideration of the existing tidal dynamics and vegetation composition" (ACOE, *Cape Cod Wetlands Investigation*, June 1996, p. 95). Present conditions observed during fieldwork conducted for this Atlas warrant a new look at this site.

Lawn and shrubs line the upstream channel near the restriction, but Phragmites, seen in the distance, is the significant vegetation type in this upstream affected area.

[1] Wetland was observed at this site and in aerial photography that was not delineated by the Wetlands Conservancy Program. Therefore, this acreage calculation of upstream affected area is believed to be an underestimation.

HARWICH

Uncle Venies Road restriction of channel off the Red River

Site HA-6

Upstream Affected Area (acres): SM – 8.87; SS – 0.90.

Site Description

Located in South Harwich near the Harwich/Chatham town line, this channel flows west off of the Red River, running just north of Wharf Road and the Red River Beach parking area. It crosses under Uncle Venies Road via a 2.5-foot concrete pipe. The seaward side of the pipe was not visible, however the upstream side was visible and was neither broken nor clogged. This site lies seaward of site HA-7. This channel does not support shellfish. The Red River does support an anadromous fish run en route to Skinequit Pond, however it is unlikely that spawning fish attempt to use this side channel.

General Information

Channel widths were estimated to be 10-15 feet wide seaward and 20-30 feet wide upstream of the restriction. Upstream affected area includes 3.33 acres of salt marsh and 0.90 acres of shrub swamp plus an additional 5.54 acres of salt marsh further upstream of site HA-7. Visual indicators of restriction include minor vegetation die back near the upstream opening and significant scour and erosion near the seaward and upstream openings. There was also a significant amount of *Phragmites* in the upstream area.

- Restriction width – 2.5 feet
- Restriction length – 122 feet
- Upstream salt marsh – 8.87 acres

Even through the clear water the seaward pipe opening is not visible, however scouring is visible on the sides and bottom of the channel.

View of the upstream salt marsh at high tide with the 2.5 foot concrete pipe nearly submerged in the channel.

Comments

The concrete pipe juts out into the upstream channel, uncovered for approximately 10 feet, increasing the length of the restriction beyond that of just the roadway berm. When visited during high tide, the difference in water levels between the seaward and upstream area was dramatically different and made it hard to approximate channel width. Most of the tidal flow in this channels' system was trapped upstream of site HA-6 but seaward of HA-7 (see site HA-7 for an illustration).

HARWICH

Wharf Road restriction of channel off the Red River

Site HA-7

Site Description

Located in South Harwich near the Harwich/Chatham town line, this channel flows west off of the Red River, running just north of the Red River Beach parking area. It crosses under Uncle Venies Road (site HA-6) and then under Wharf Road via a 20-inch concrete pipe. The pipe was not broken or clogged. This channel does not support shellfish. The Red River does support an anadromous fish run en route to Skinequit Pond, however it is unlikely that spawning fish attempt to use this side channel.

General Information

The channel is approximately 15-20 feet wide seaward of Wharf Road and narrows to approximately 4 feet just upstream of it. Visual indicators of restriction include significant scour with minor bank erosion of the channel near the seaward opening, as well as minor erosion and scour near the upstream opening. *Phragmites* growth is significant seaward of this site (likely due to the restriction at HA-6) but is only minor in this site's upstream affected area.

- Restriction width – 20 inches
- Restriction length – 130 feet
- Upstream salt marsh – 5.54 acres

The 20-inch seaward side opening of the concrete pipe is almost submerged at high tide.

Upstream Affected Area (acres): SM – 5.54.

The difference in the amount of water at high tide within the seaward salt marsh (left) versus that within the affected area upstream of Wharf Road (right) is striking.

Comments

The concrete pipe juts out into the upstream channel, uncovered for approximately 10 feet, increasing the length of the restriction beyond that of just the roadway berm. When visited during high tide, the difference in water levels between the seaward and upstream area was dramatically different. Most of the tidal flow in this channels' system was trapped in the wetland area between sites HA-6 and HA-7.

HARWICH/CHATHAM

Deep Hole Road restriction of the Red River

Site HA-8/CH-1

Site Description

The Red River forms the boundary between Harwich and Chatham and discharges into Nantucket Sound. Deep Hole Road crosses the Red River, passing its flow via a 16-inch corrugated metal pipe set in a concrete headwall. The pipe appears to be in good condition – it is not broken or clogged. The seaward opening is submerged at mean high tide. Tidal restriction sites HA-6 and HA-7 lie on a channel of the Red River that is located seaward of Deep Hole Road, and they are therefore not connected to site HA-8/CH-1. The Red River does support shellfish resources and is used by anadromous fish en route to Skinequit Pond in South Harwich.

General Information

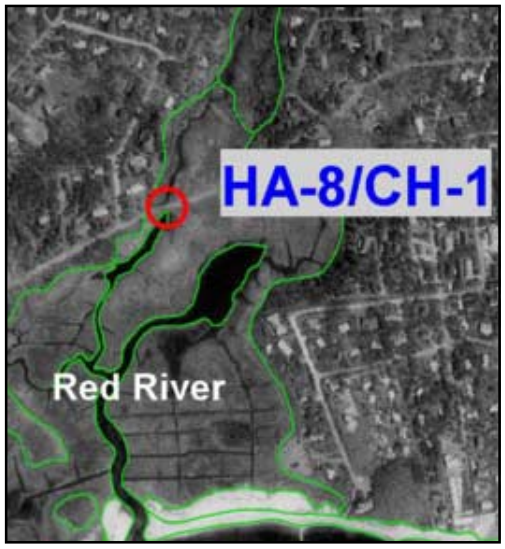
The seaward channel is approximately 10 to 15 feet wide, narrowing upstream to 2 to 5 feet. Visual indicators of a restriction on the seaward side of the road include minor bank erosion and minor vegetation die back. A scour pool is also evident near the upstream pipe opening. Cattails are present seaward of the roadway berm and become more prevalent upstream. *Phragmites* was also observed in the upstream affected area.

- Restriction width – 16 inches
- Restriction length – 26 feet
- Upstream salt marsh – 3 acres (estimate)

Comments

According to the Director of the Chatham Water Quality Laboratory, the area upstream of Deep Hole Road is a natural low point that collects significant fresh water drainage and is therefore a transition zone. An increase in the size of the pipe would likely not change the area affected by tidal flow, but could serve to make the existing salt marsh healthier.

[1] The Wetland Conservancy Program delineated salt marsh lying both seaward and upstream of Deep Hole Road as one continuous area, totaling 45.63 acres. The road does sever this salt marsh, which should have been delineated as two polygons. The area upstream of Deep Hole Road, estimated at 3.0 acres, could not be highlighted independently of the seaward area for this image.



Upstream Affected Area (acres): SM – 3.0.[1]

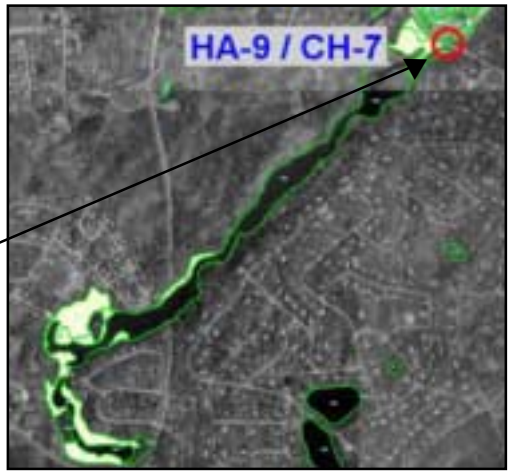
This 16-inch corrugated metal pipe set in the concrete headwall passes the flow of the Red River under Deep Hole Road.

Visual indicators in this upstream affected marsh include a small scour pool near the pipe opening and significant growth of Phragmites and cattails.

HARWICH/CHATHAM

Route 28 restriction of the Muddy River

Site HA-9/CH-7



Upstream affected area (acres): SM – 2.73; SS – 13.37; M – 1.97.

Site Description

The Muddy River, a sub-embayment of Pleasant Bay, runs generally in a southwesterly direction from its mouth to the west of Nickersons Neck in Chatham on Pleasant Bay. The river forms the town boundary between Harwich and Chatham who share responsibility for the rivers' upstream affected area. Muddy Creek flows under Route 28 via two box culverts that are approximately 2.6 feet in height and 3.7 feet in width. These culverts are set into stone slab retaining walls and placed far below the road surface. The culverts are owned and maintained by the Massachusetts Highway Department. The Muddy River historically supported an anadromous fish run – it is not active today – and does support shellfish resources near its discharge area in Pleasant Bay.

General Description

The Muddy River is approximately 75 feet wide seaward of Route 28, widening to approximately 100 feet upstream of the roadway berm. Visual indicators of a restriction include major seaward scouring, minor bank erosion, and minor vegetation die back. *Phragmites* fringes the upstream affected area.

- Restriction width – two, 2.6 by 3.7-foot box culverts
- Restriction length – 75 feet (estimate)
- Upstream salt marsh – 2.73 acres

These 2 box culverts pass the flow of the Muddy River under Route 28. The stone slab retaining wall supporting the culverts appears to be in poor condition.

Comments

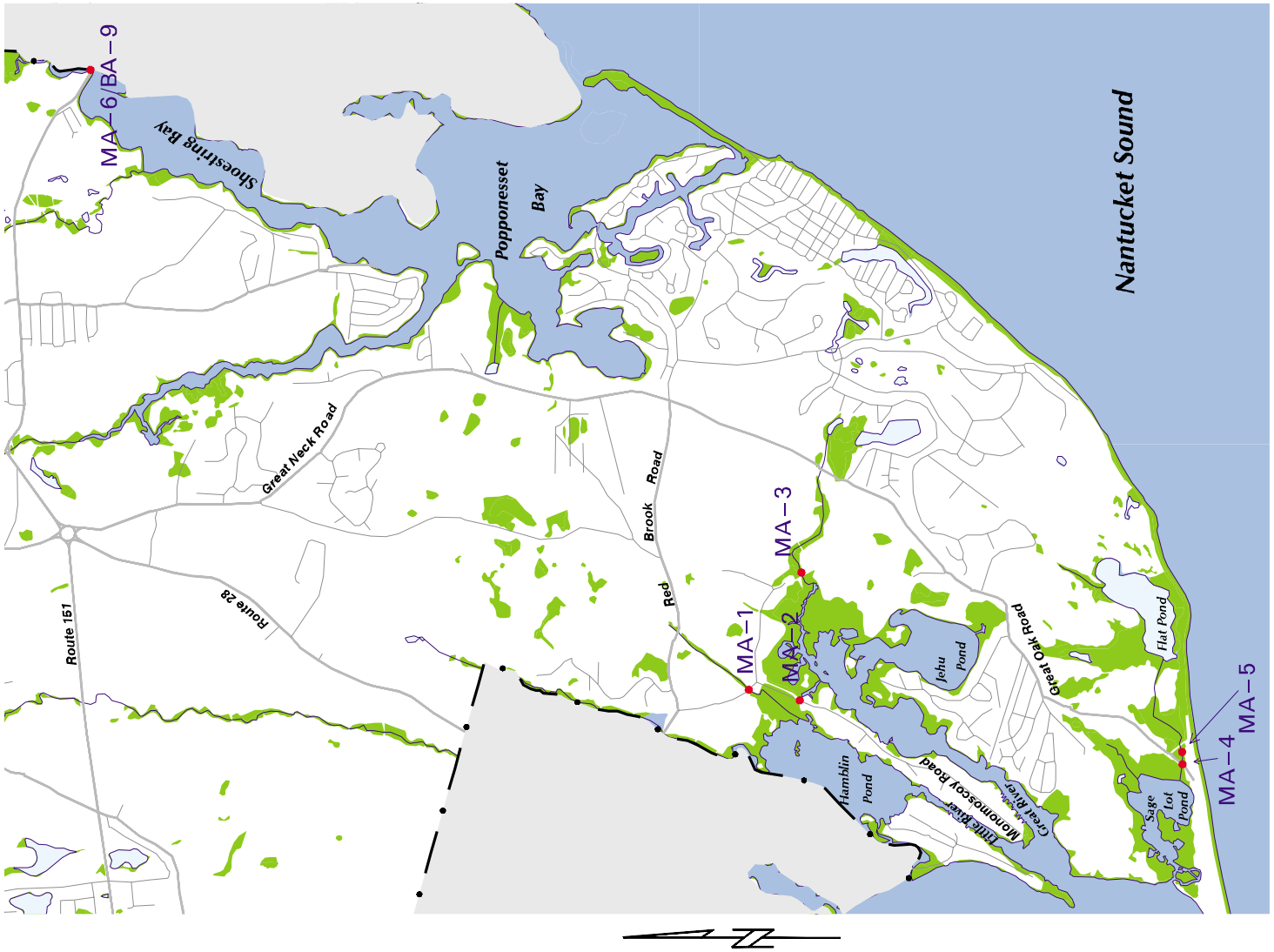
Muddy River has been studied as part of Chatham's comprehensive wastewater management study, a search for ways to improve the quality of the water in local embayments and prevent further degradation from pollution. Chatham is currently working on a Restoration Management Plan for the Muddy River through the Pleasant Bay Alliance. Muddy River has been considered for conversion into a fresh water system as one way to address its poor water quality. This system's conversion would be easier than that of Frost Fish Creek because of the high embankment of Route 28 between Pleasant Bay and the river. To accomplish this, tide gates could be placed on the existing culverts. A significant environmental drawback of this option would be the loss of the existing 2.73 acres of salt marsh along the northern portion of the river upstream of the road. To avoid this loss but still achieve partial conversion, a dike could be installed upstream of the existing salt marsh.[1]

Upstream of Route 28 salt marsh exists along the banks of the Muddy River.

[1] Wood, 2001, p. 5.

TOWN OF MASHPEE

- Town Map
- Chart of Site Characteristics
- Sites 1 to 6



TOWN OF MASHPEE

Location of Selected Salt Marsh Restrictions

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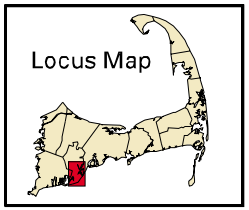
The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis.

This project was funded, in part, by the Executive Office of Environmental Affairs, Massachusetts Wetlands Restoration Program.

- MA – 1 Restriction Site
- Wetland
- Ocean
- Pond or Lake
- Local Road
- Major Route
- Stream
- Railroad



0 0.5 1

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Massachusetts State Plane Feet

Land Use ▪ Roads ▪ DCPCs ▪ Parcels ▪ Demographics ▪ Environmental Justice

Cape Cod Commission GIS Services

2001

Town of Mashpee - Site Characteristics

Site Number	Size of upstream affected area (salt marsh acres / total affected acres)	Is the upstream affected area contiguous to protected open space (ownership)?	Does this tidal channel support a shellfish resource area?	Is the channel or system part of an anadromous fish pathway?	Does the culvert/pipe support an engineered flood control structure?	Is the affected area or site within an ACEC boundary?	Does the affected area include Priority Habitat of Rare Species (PH) or Estimated Habitat of Rare Wildlife (WH)?	Are there any restricted sites upstream of this site (site number)?	Ownership of the site (public vs. private)
MA-1	0.0 / 0.73	Yes (Municipal, State)	YES	NO	NO	YES	YES (PH, WH)	NO	PUBLIC
MA-2	Unable to determined	NO	YES	NO	NO	NO	NO	NO	PUBLIC
MA-3	2.26 / 4.38	YES (Municipal, State)	NO	NO	NO	YES	NO	NO	PUBLIC
MA-4	14.68 / 16.43	YES (Municipal, State)	YES	YES	NO	YES	YES (PH, WH)	YES (MA-5)	PUBLIC
MA-5	12.62 / 14.37	Yes (Municipal)	YES	YES	NO	YES	YES (PH, WH)	NO	PUBLIC
MA-6/ BA-9	11.07 / 29.77	No	YES	YES	NO	NO	NO	NO	PUBLIC

MASHPEE

Monomoscoy Road restriction of Dutchmans Creek

Site MA-1

Upstream Affected Area (acres): SS – 0.73.

Site Description

Dutchmans Creek crosses under Monomoscoy Road approximately 400 feet north of its mouth at Hamblin Pond. The creek passes under the road via a 1-foot diameter concrete and metal pipe. The pipe is in fair condition; it is not broken but is partially clogged by muck and debris. There are no other tidal restrictions along Dutchmans Creek. The seaward opening of the pipe is set low and is submerged at mean high tide. Hamblin Pond, the receiving water body for Dutchmans Creek, does support shellfish resources and hosts several State shellfish grants, however the northern half of the pond is closed to shellfishing.

General Information

The seaward and upstream channels measure 2 and 3 feet respectively. Because both are smaller than the 1-foot opening, natural flow is restricted. Salt marsh extends to the seaward opening. *Phragmites* and cattails are present in the seaward marsh. Scour and erosion are minimal in the channels. The upstream affected area contains only shrub swamp.

- Restriction width – 1 foot
- Restriction length – 45 feet
- Upstream salt marsh – 0 acres

Phragmites and shrubs are taking hold in the salt marsh near the seaward opening of the pipe.

Comments

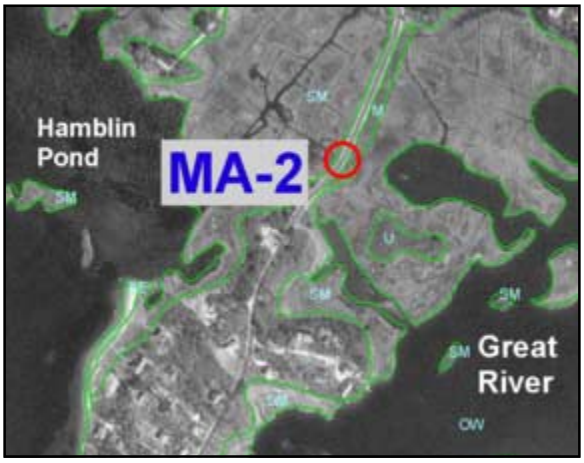
The upstream affected area is located on the edge of the Mashpee National Wildlife Refuge. There is very little development adjacent to it (approximately 3 single-family house lots). Tidal waters reaching Hamblin Pond must first pass through Waquoit Bay and then enter the pond through two channels – the Little River and a man-made channel. Neither is a restricted site considered in this Atlas. Because this site lies far inland the velocity of the approaching and receding tides is low, likely accounting for the minimal scour and erosion observed at this site.

View into the 0.73 acres of shrub swamp located upstream of site MA-1.

MASHPEE

Monomoscoy Road restriction of channel between Hamblin Pond and the Great River

Site MA-2



Upstream Affected Area (acres): SM – unable to determine.

Site Description

Just before Monomoscoy Road enters the private development on Monomoscoy Island it passes through an extensive area of salt marsh forming the boundary between Hamblin Pond to the west and the Great River to the east. A small channel passes under the road via a 2-foot diameter concrete pipe. The pipe is structurally in good condition but is partially clogged by muck and debris. This site was intentionally excluded from the boundary of the Waquoit Bay Area of Critical Environmental Concern, which was drawn to exclude Monomoscoy Island and part of its access road. The southern portion of Hamblin Pond does support shellfish resources and hosts several State shellfish grants, however the northern half of the pond (near this site) is closed to shellfishing.

General Information

Local officials have observed incoming tidal flow entering this pipe from both the east and the west depending upon the prevailing winds. Therefore, seaward and upstream "sides" are not appropriate labels for this location. The channel extending to the road from Hamblin Pond is approximately 2 feet wide. The channel extending to the road from the Great River is approximately 4 feet wide. There is minor bank erosion and small scour pools near both ends of the pipe. *Phragmites* grows along the eastern side of the road.

- Restriction width – 2 feet
- Restriction length – 35 feet
- Upstream salt marsh – unable to determine

Phragmites grows in the marsh east of the road near this 4-foot channel connecting to the Great River.

Visual indicators of a restriction seen near the western end of the pipe include this small scour pool and pooling/ponding water.

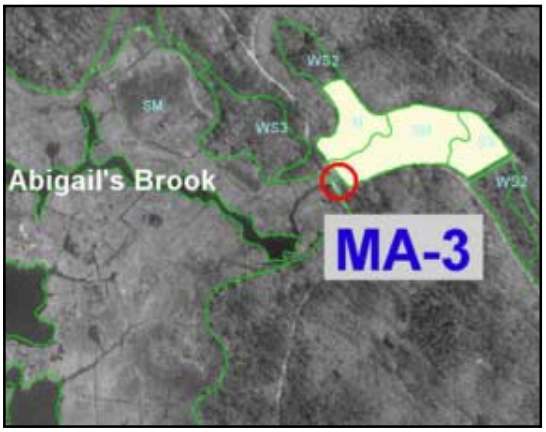
Comments

The town replaced this pipe in 1999, and therefore no work is likely to be undertaken at this site in the near future. No hydrologic study was conducted to determine the appropriate size for this pipe; rather the reconstruction replicated the previously approved engineering specifications from the 1950's. This was done in order to expedite replacement of the collapsed pipe. To redesign and resize the pipe would have involved extensive permitting, an endeavor that the town was not willing to undertake at that time.

MASHPEE

Great Hay Road restriction of Abigail's Brook

Site MA-3



Upstream Affected Area (acres): SM – 2.26; SS – 0.91; M – 1.21.

Site Description

Abigail's Brook passes under Great Hay Road via a 30-inch diameter corrugated metal pipe. This crossing is near the mouth of the brook at the upper reaches of the Great River. Great Hay Road is a limited access, narrow dirt road located within the Mashpee National Wildlife Refuge. When observed during mid, incoming tide the seaward pipe opening was nearly submerged. The pipe itself was in good condition and was not clogged. Abigail's Brook does not support an anadromous fish pathway, nor does it support any shellfish resources.

Seen during mid, incoming tide water flows over the channel banks and pools at the roadway berm; the top of the pipe is barely visible under a clump of grass (opening circled in photo above).

General Information

The10-foot wide seaward channel flows through salt marsh in the upper reaches of the Great River to this culvert. *Phragmites* and cattails are scattered in this marsh area. Adjacent to the seaward pipe opening, a significant scouring basin and severe bank erosion scar the channel. Vegetation has begun to die back at its edges. The upstream channel is only 5 feet wide, half the seaward width. It also exhibits significant bank scouring and erosion. *Phragmites* growth is significant in the upstream affected area and shrubs are visibly taking hold.

- Restriction width – 30 inches
- Restriction length – 17 feet
- Upstream salt marsh – 2.26 acres

Upstream of the Great Hay Road restriction the land is part of the Mashpee National Wildlife Refuge. Phragmites growth is extensive toward the rear of this affected area.

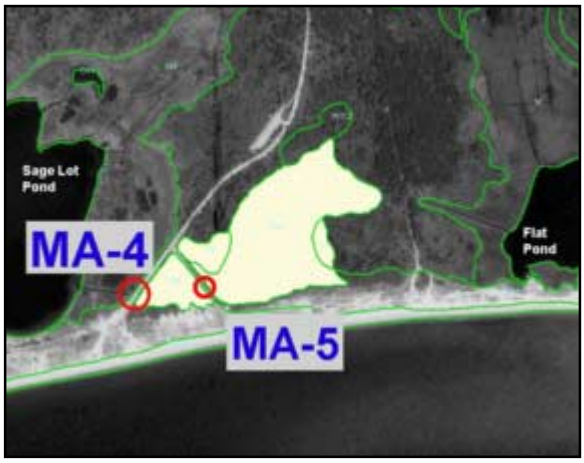
Comments

Vehicle access to this site was limited due to the poor condition of the narrow dirt road. The area upstream of the site is part of the Mashpee National Wildlife Refuge, a cooperative project between the Town Conservation Commission and the State of Massachusetts. Most of the land area of the Refuge is excluded from the Waquoit Bay Area of Critical Environmental Concern (ACEC), however Abigail's Brook and this restriction site are within the ACEC boundary.

MASHPEE

Great Oak Road restriction of channel from Sage Lot Pond to Flat Pond

Site MA- 4



Upstream Affected Area (acres): SM – 14.68; SS – 1.75.

Site Description

Great Oak Road provides access to South Cape Beach State- and Town-owned parklands. Near its southern terminus the road forks to two parking areas, each fork restricting the tidal creek that connects Sage Lot Pond with Flat Pond. Site MA-4 is on the western fork, lying seaward of site MA-5 and site MA-d (see Appendix B). At this site the roadway is a one lane, dirt road. The restriction is a 4-foot diameter concrete pipe that is in fair condition – although the pipe has fractured and split on each side of the road, flow is not impeded by these breaks. This channel serves as an anadromous fish pathway between Waquoit Bay and Flat Pond specifically used by white perch. Eelgrass grows in Sage Lot Pond just seaward of MA-4. Shellfish resources are abundant in Waquoit Bay near the mouth of this channel, although subject to seasonal closures. Sage Lot Pond also supports shellfish resources.

The seaward opening is seen nearly submerged during this mid, incoming tide. Large boulders have been placed by the culvert to help prevent erosion of the dirt berm.

General Information

The seaward and upstream channels are approximately 10 feet wide. Stream flow is partially dammed by the roadway berm as water tries to flow through the 4-foot diameter pipe. The upstream channel flows approximately one-eight of a mile before reaching upstream site MA-5, where flow is again restricted. Minor scour basins are present on either side of the pipe. *Phragmites* growth in the vicinity of this site is minor.

- Restriction width – 4 feet
- Restriction length – 45 feet
- Upstream salt marsh – 14.68 acres

Looking into the upstream channel scour pools are visible, as is the clean break in the exposed pipe.

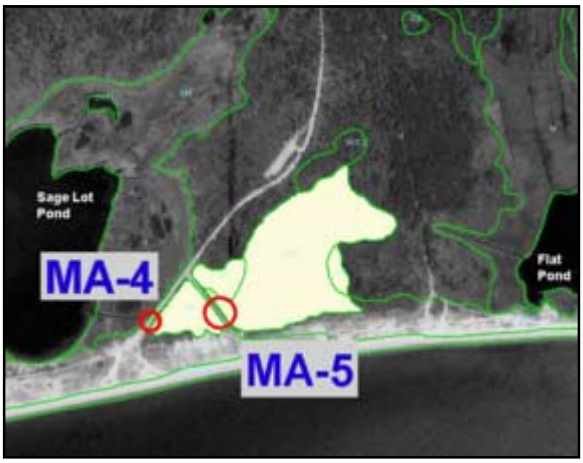
Comments

While this restriction is not egregious, the channel width-to-culvert opening ratio does not allow free flow and does not resemble natural stream conditions. While the pipe is broken in such a way that the severed segments remain in place, there is cause for future concern. Should these segments shift or roll from their *in situ* break they could contribute further to the restriction. The Massachusetts Wetlands Restoration Program is currently studying this site for potential future restoration.

MASHPEE

Great Oak Road restriction of channel from Sage Lot Pond to Flat Pond

Site MA- 5



Upstream Affected Area (acres): SM –12.62; SS – 1.75.

Site Description

Great Oak Road provides access to South Cape Beach State- and Town-owned parklands. Near its southern terminus the road forks to two parking areas, each fork restricting the tidal creek that connects Sage Lot Pond with Flat Pond. Site MA-5 is on the eastern fork, lying upstream of site MA-4. Flow passes under the paved road via a 4-foot diameter concrete pipe that is in good condition – the pipe is neither broken nor clogged. This channel serves as an anadromous fish pathway between Waquoit Bay and Flat Pond specifically used by white perch. Shellfish resources are abundant in Waquoit Bay near the mouth of this channel, although subject to seasonal closures. Sage Lot Pond also supports shellfish resources.

Pavement extends out over this seaward pipe directing roadway runoff into the tidal channel and likely adding to the erosion seen occurring around this pipe.

General Information

The seaward channel varies between 5 and 10 feet and small scour pools and minor bank erosion are visible near the pipe opening. The seaward opening becomes submerged at mean high tide. The upstream channel is approximately 5 feet wide. The storm water drainage from a paved parking lot adjacent to this site appears to be directed straight into this channel. *Phragmites* growth is minimal in the upstream affected area.

- Restriction width – 4 feet
- Restriction length – 32 feet
- Upstream salt marsh – 12.62 acres

Phragmites and shrubs are seen encroaching into the marsh near the upstream pipe opening.

Comments

This unnamed tidal channel continues east from this site into Flat Pond by first crossing site MA-d (see Appendix B). The three infrastructure crossings along this unnamed channel must be considered jointly in any remediation discussions. The Massachusetts Wetlands Restoration Program is currently studying this site for potential future restoration.

MASHPEE/BARNSTABLE

Quinaquissett Road/School Street restriction of the Santuit River

Site MA-6/BA-9

Site Description

The Santuit River forms the town line between Mashpee and Barnstable. Commonly known as the School Street bridge, this site links Quinaquissett Road in Mashpee with School Street in Cotuit, Barnstable. The 45-foot long by 25-foot wide bridge spans the river at its mouth on Shoestring Bay. The upstream banks of the Santuit are largely undeveloped. A narrow strip of salt marsh lines the eastern bank, becoming a larger upstream marsh area comprised of salt marsh, shallow marsh, and shrub swamp. The Santuit River supports an annual herring run. Shellfish are present in Shoestring Bay near this bridge, though shellfishing is prohibited.

General Information

The seaward side of the bridge parallels the northern extent of Shoestring Bay, therefore a channel measurement is not relevant. The Santuit River begins on the upstream side of the bridge and is approximately 100 to 150 feet wide – clearly wider than the 45-foot bridge span. Long bridge abutments were built out from the natural banks to decrease the need for construction of a wider span – obvious contributors to the tidal restriction. Minor scour is visible in the river and bay near the opening. Cattails (seaward and upstream) and *Phragmites* (seaward only) are present along the riverbanks.

- Restriction width – 45 feet
- Restriction length – 25 feet
- Upstream salt marsh – 11.07 acres

Comments

Reconstruction of the bridge began in the fall of 2000. The project is intended to widen the bridge and increase its height above the Santuit River. Unfortunately, reconstruction did not include increasing the width of the span to allow increased tidal flow.

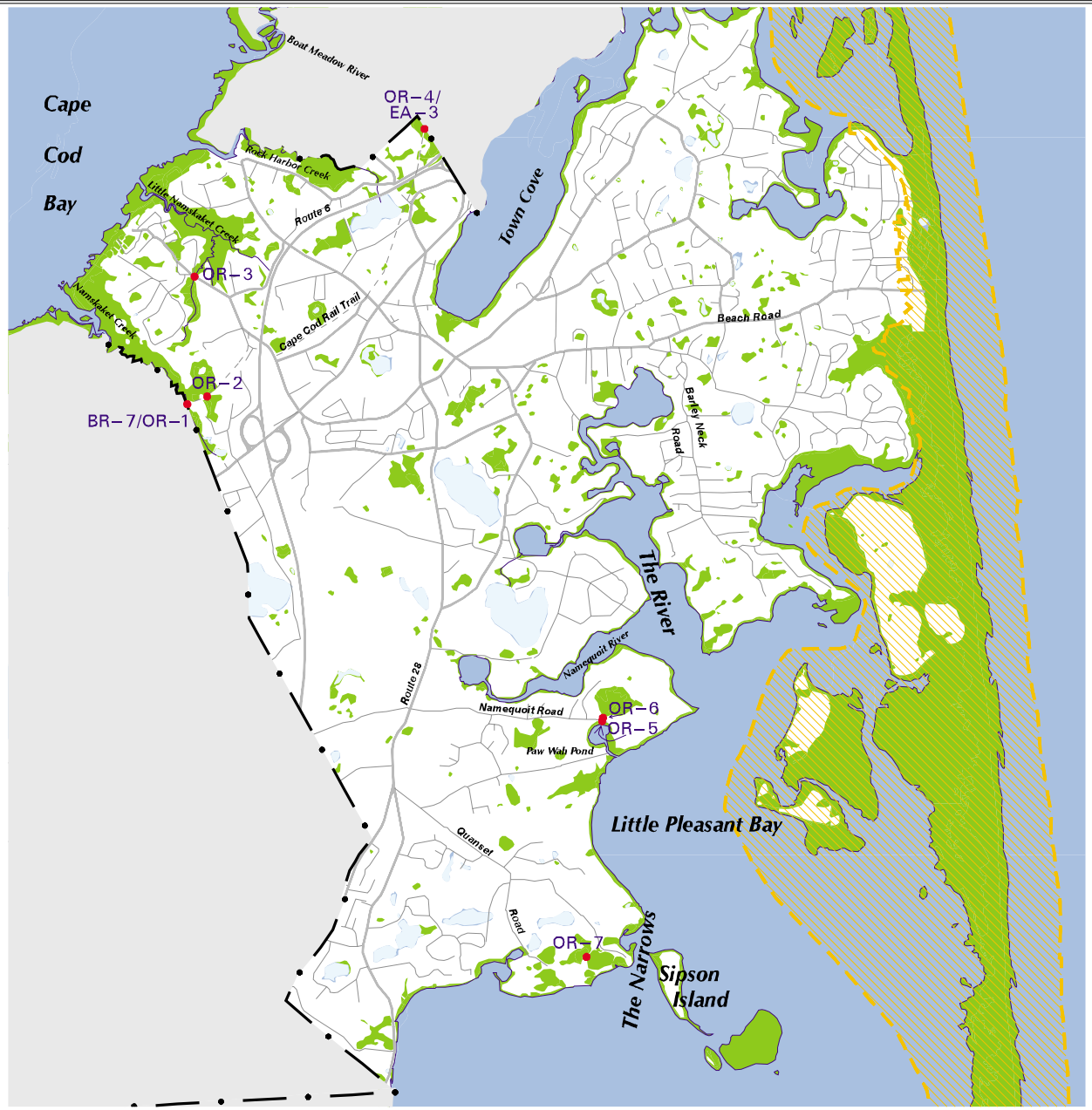
Upstream Affected Area (acres): SM – 11.07; SS – 1.19; M – 17.51.

Construction underway on the Santuit River bridge to widen and raise the roadway; unfortunately plans do not include alleviating the restriction.

Upstream of the bridge salt marsh lines the eastern riverbank while development is visible on the western bank.

TOWN OF ORLEANS

- Town Map
- Chart of Site Characteristics
- Sites 1 to 7



TOWN OF ORLEANS

Location of Selected Salt Marsh Restrictions

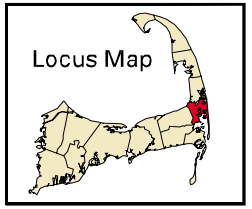
This map was produced by the Cape Cod Commission Geographic Information System office, with digital data from MassGIS and the Cape Cod Commission, 2001.

The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis.

This project was funded, in part, by the Executive Office of Environmental Affairs, Massachusetts Wetlands Restoration Program.

- OR–1 Restriction Site
- Wetland
- Ocean
- Pond or Lake
- CC National Seashore
- Local Road
- Major Route
- Bike Trail
- Stream

Locus Map



Miles
0 0.5 1
0 2,500 5,000
Massachusetts State Plane Feet
North American Datum – 1927

Cape Cod Commission
Land Use ▪ Roads ▪ DCPCs ▪ Parcels ▪ Demographics ▪ Environmental ▪ IRRs
GIS Services

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2001

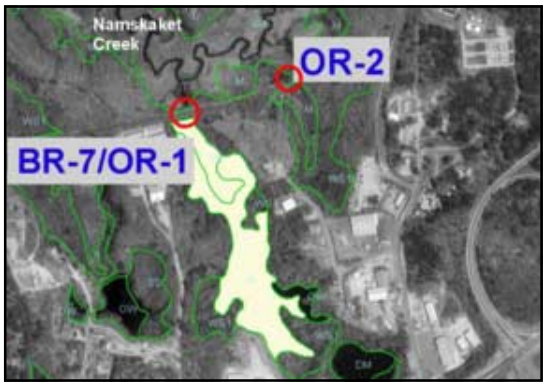
Town of Orleans –Site Characteristics

Site Number	Size of upstream affected area (salt marsh acres / total affected acres)	Is the upstream affected area contiguous to protected open space (ownership)?	Does this tidal channel support a shellfish resource area?	Is the channel or system part of an anadromous fish pathway?	Does the culvert/pipe support an engineered flood control structure?	Is the affected area or site within an ACEC boundary?	Does the affected area include Priority Habitat of Rare Species (PH) or Estimated Habitat of Rare Wildlife (WH)?	Are there any restricted sites upstream of this site (site number)?	Ownership of the site (public vs. private)
BR-7/ OR-1	1.12 / 6.94	YES (state)	YES	NO	NO	YES	YES (PH, WH)	NO	PUBLIC
OR-2	0.0 / 0.96	NO	YES	NO	NO	YES	YES (PH, WH)	NO	PUBLIC
OR-3	0.0 / 7.69	NO	YES	NO	NO	YES	YES (PH, WH)	NO	PUBLIC
OR-4/ EA-3	5.20 / 16.94	YES (private)	YES	NO	NO	YES	YES (PH, WH)	YES (EA-4)	PUBLIC
OR-5	0.0 / 10.03	YES (municipal, private)	YES	NO	NO	YES	YES (PH, WH)	YES (OR-6)	PRIVATE
OR-6	0.0 / 10.03	YES (municipal, private)	YES	NO	YES (stoplogs)	YES	YES (PH, WH)	NO	PRIVATE
OR-7	1.99 / 3.74	NO	NO	NO	NO	YES	NO	NO	PRIVATE

BREWSTER/ORLEANS

Cape Cod Rail Trail restriction of Namskaket Creek

Site BR-7/OR-1



Upstream Affected Area (acres): SM – 1.12; M – 5.82.

Site Description

The Cape Cod Rail Trail bike path crosses the Namskaket Creek at the Brewster-Orleans town line causing a major tidal restriction. Access to the site is via the bike path only. One 1-foot pipe was found here, however there might be additional pipes that were not visible. This pipe is so egregiously undersized and the site degraded that tidal flow is effectively cut off from the upstream marsh area. This site is located within the boundaries of the Inner Cape Cod Bay Area of Critical Environmental Concern, owned and managed by the state Department of Environmental Management (DEM).

An eroding retaining wall helps support the Cape Cod Rail Trail that is restricting tidal flow in Namskaket Creek – water is seen bubbling out from under a pile of rocks that covers the 1-foot pipe.

General Information

The site is in serious disrepair. The seaward pipe opening was obscured and buried under a pile of rocks. After some digging a 1-foot metal pipe was uncovered. Upstream of the bike path, water is flowing down into a hole below ground where the pipe is presumed to be – the pipe itself is not visible. The creek banks at the site are extremely eroded, with vegetation die off and major scouring pools scarring the upstream site. The width of Namskaket Creek varies between 6 and 10 feet both seaward and upstream of the Rail Trail. *Phragmites* dominates the upstream affected area. The restriction has persisted for so long that the upstream system has become mainly a freshwater marsh.

- Restriction width – 1 foot (estimated)
- Restriction length – 62 feet
- Upstream salt marsh – 1.12 acres

Phragmites and shrubs are seen taking over the once salt marsh upstream of the Rail Trail.

Comments

A joint restoration effort is underway by the Natural Resources Conservation Service (NRCS), DEM, Orleans and Brewster local officials, the state Wetlands Restoration Program, and MA Coastal Zone Management. At the time of this writing inventory and assessment, a needs assessment, and cost estimates for materials and services have been completed. The restoration project is currently in the permitting process and work is expected to begin in Fall 2002.

ORLEANS

Cape Cod Rail Trail restriction of Namskaket Creek

Site OR-2

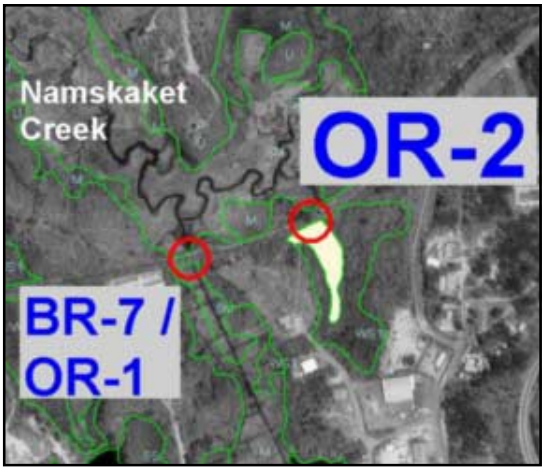
Site Description

The Cape Cod Rail Trail bike path crosses the Namskaket Creek to the east of site BR-7/OR-1 on the Brewster-Orleans town line. Access to this site is via the bike path only. A 1-foot wooden-framed pipe crosses under the bike path. Flow through this deteriorated structure appeared to be minimal to none. This pipe is so egregiously undersized and the site degraded that tidal flow is effectively cut off from the upstream marsh area. This site is located within the boundaries of the Inner Cape Cod Bay Area of Critical Environmental Concern, owned and managed by the state Department of Environmental Management (DEM). Namskaket Creek supports abundant shellfish resources that are closed to shellfishing.

General Information

The width of the seaward creek channel is approximately 5 feet, while the upstream creek is approximately 1 to 3 feet wide. The entire site is in serious disrepair. The seaward pipe opening was barely visible and covered by a stone block as well as other debris and mud. Upstream of the bike path the 1-foot opening is visible submerged in a stagnant pool and clogged by dead *Phragmites* reeds and muck. Visual indicators of a restriction are numerous including major seaward scouring and erosion and significant upstream scouring and erosion. *Phragmites* dominates both the seaward and upstream vegetation. This restriction has persisted for so long that the upstream affected area has become mainly a freshwater marsh.

- Restriction width – 1 foot
- Restriction length – 45 feet
- Upstream salt marsh – 0 acres



Upstream Affected Area (acres): M – 0.96.

The berm of the bike trail is a severely eroded, slick mud bank. This stone slab marks the pipe's opening.

Reeds and high stagnant water block the upstream opening from view.

ORLEANS

Namskaket Road restriction of Little Namskaket Creek

Site OR-3

Upstream Affected Area (acres): SS – 5.0; M – 2.69.

Site Description

Little Namskaket Creek flows southeasterly from its mouth on the Cape Cod Bay. Namskaket Road crosses the creek via a 15-inch concrete pipe that is submerged at mean high tide. The pipe appears to be in poor condition – its seaward end is visibly broken and clogged. Large pieces of debris (old docks and floats) now rest on the eroded berm near the pipe. Little Namskaket Creek is within the Inner Cape Cod Bay Area of Critical Environmental Concern. While the creek does support extensive shellfish resources they are closed to shellfishing.

General Information

The seaward creek channel is approximately 5 feet wide, narrowing upstream to approximately 2 to 5 feet wide. Visual indicators of a restriction include major scouring and erosion on the seaward side and minor scour and erosion upstream. *Phragmites* growth is significant both seaward and upstream of this restricted site.

- Restriction width – 15 inches
- Restriction length – 55 feet
- Upstream salt marsh – 0 acres

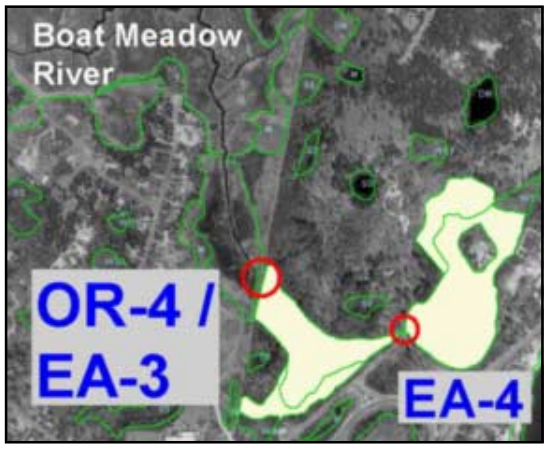
Erosion scars the area near the pipe opening, which is blocked by this piece of dock and other debris.

Phragmites and shrubs are visible in the upstream area as seen from the upstream side of the pipe.

ORLEANS/EASTHAM

Cape Cod Rail Trail restriction of Boat Meadow River

Site OR-4/EA-3



Upstream Affected Area (acres): SM – 5.20; SS – 2.31; M – 9.43.

Site Description

Boat Meadow River runs in an easterly direction from its mouth on the Cape Cod Bay. Prior to reaching the Cape Cod Rail Trail, the river flows under Bridge Road, via a 57-foot unrestricted bridge (see site EA-a, Appendix B). Upstream of that Boat Meadow River is conveyed under the bike trail via a 36-inch concrete pipe. The pipe is in serious disrepair. The trail's side slope embankments are eroding and its paved surface is being undermined. Restricted site EA-4 lies upstream. Boat Meadow River is within the Inner Cape Cod Bay Area of Critical Environmental Concern. While the river does support extensive shellfish resources, they are closed to shellfishing.

General Information

Seaward of this site the river channel is approximately 15 feet wide, narrowing to approximately 5 feet upstream. Visual indicators of a restriction are severe at this site including major scouring and erosion both seaward and upstream. Vegetation die off and ponded water are significant in the adjacent seaward marsh area. The vegetation changes noticeably from the seaward to upstream sides of the bike path with minor *Phragmites* growth seaward becoming significant on the fringes and in the rear of the upstream affected area. An exposed length of seaward pipe is broken off in several sections. The opening is jammed by large logs, pieces of docks, and other debris that have washed up the river and collected at this site.

- Restriction width – 36 inches
- Restriction length – 45 feet
- Upstream salt marsh – 5.20 acres

Debris marks the seaward opening of this culvert under the bike trail. Pieces of the pipe have broken off and lie in the deep scour pool in front of the opening.

Comments

An Environmental Notification Form (ENF) (EOEA file number 12421) for Cape Cod Rail Trail Safety Improvements was filed in January 2001, stating that the pipe is a tidal restriction reducing critical upstream habitat for fish and invertebrates and that the vegetative community suffers as well. Massachusetts Coastal Zone Management (MCZM) has examined this site as part of the US Environmental Protection Agency sponsored Salt Marsh Assessment Project. This project calls for replacement of the existing 36-inch pipe with a 6 by 4-foot precast concrete box culvert. Restoration work at this site has now been funded by the Massachusetts Wetlands Restoration Program's Corporate Wetlands Restoration Partnership, the National Fish and Wildlife Federation, the Department of Environmental Management and MCZM. At this time all permits have been approved and construction bids received.

Upstream of the bike trail the bank has eroded away from this 36-inch pipe. Scour and erosion scar the area.

ORLEANS

Restrictions of Paw Wah Pond by:

Namequoit Road
Site OR-5

and

Earthen Berm
Site OR-6

Upstream Affected Area (acres): SS – 10.03.

Site Descriptions

Paw Wah Pond is located on the western shore of Little Pleasant Bay. This salt pond and its upstream wetland area are within the Pleasant Bay Area of Critical Environmental Concern. At the northeast corner of the pond, a 1-foot corrugated plastic pipe conveys flow under Namequoit Road (site OR-5). Approximately 70 feet upstream is site OR06, where flow passes under a dirt berm via an 8-inch clay pipe with an upstream structure for the placement of water-tight stoplogs. Upstream of these two restrictions lies 10.03 acres of shrub swamp. Site OR-5 appears to be in good condition and fairly new. Site OR-6, while apparently structurally sound, appears to be neglected and defunct. Paw Wah Pond supports shellfish resources that are conditionally open for shellfishing, however a semi-circular closure is always in effect around the direct discharge area of this pipe.

General Information

A short, 3-foot channel conveys flow from Paw Wah Pond to site OR-5. Between sites OR-5 and OR-6 the5-foot wide, 70-foot long channel is contained within steep, forested banks. Upstream of OR-6 the channel meanders off into the wetland area and is approximately 5 feet wide. Visual indicators of a restriction at site OR-5 include significant seaward scouring and minor erosion and minor upstream scouring with significant bank erosion. Indicators at site OR-6 include minor seaward scouring and significant erosion both seaward and upstream.

This channel runs between sites OR-5 and OR-6, ending abruptly at the dirt berm where the 8-inch clay pipe is seen poking out at the bottom.

View of the seaward opening of site OR-5 – scour and erosion are present at this 12-inch opening.

Site OR-5
- Restriction width – 1 foot
- Restriction length – 40 feet
- Upstream salt marsh – 0 acres

Site OR-6
- Restriction width – 8 inches
- Restriction length – 15 feet (estimate)
- Upstream salt marsh – 0 acres

Comments

The upstream affected wetland area and some adjacent upland is owned by the Orleans Conservation Trust. This upstream area was historically used for cranberry farming and the berm and sluiceway are remnant of that. The area close to the culvert has reverted to shrub swamp, with old growth cedar taking hold toward the rear of the wetland area. The Trust hopes that partial restoration could occur, restoring some salt marsh area nearest to the culvert while preserving the cedar swamp.

ORLEANS

Cranberry Bog Berm restriction of creek off The Narrows

Site OR-7

Site Description

Extending inland from The Narrows, which is a channel running between the mainland of South Orleans and Sipson Island, is a small, unnamed tidal creek that feeds approximately 13 acres of salt marsh. This creek and its associated wetland areas are within the Pleasant Bay Area of Critical Environmental Concern. The main creek forms two branches – one heading south and crossing under a dirt driveway (see Appendix B, site OR-e). One branch flows in a northwesterly direction under an old cranberry bog berm that segregates 1.99 acres of salt marsh. At this site a 1-foot clay pipe passes tidal flow under the berm. The pipe appeared to be in good condition and, although flow was observed, was partially blocked by some debris. This tidal creek does not support known shellfish resource areas or anadromous fish.

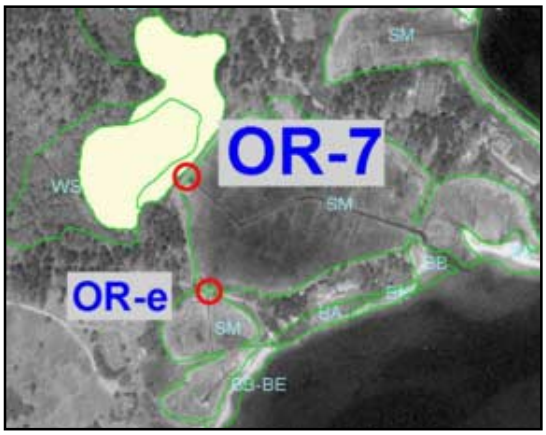
General Information

Both the seaward and upstream channels are approximately 5 feet wide. Visual indicators of a restriction that scar the area seaward of the berm include a large, deep scour pool, major erosion, and minor *Phragmites* growth. Visual indicators of a restriction upstream of the berm include significant scouring and minor bank erosion. *Phragmites* growth is significant upstream of the berm.

- Restriction width – 1 foot
- Restriction length – 15 feet
- Upstream salt marsh – 1.99 acres

Comments

This site and the upstream affected area are privately owned. The Orleans Conservation Trust is aware of its presence and would likely be able to assist in relationships with the private landowners in any remediation conversation. Cranberry bogs that once existed upstream of this berm are now defunct.



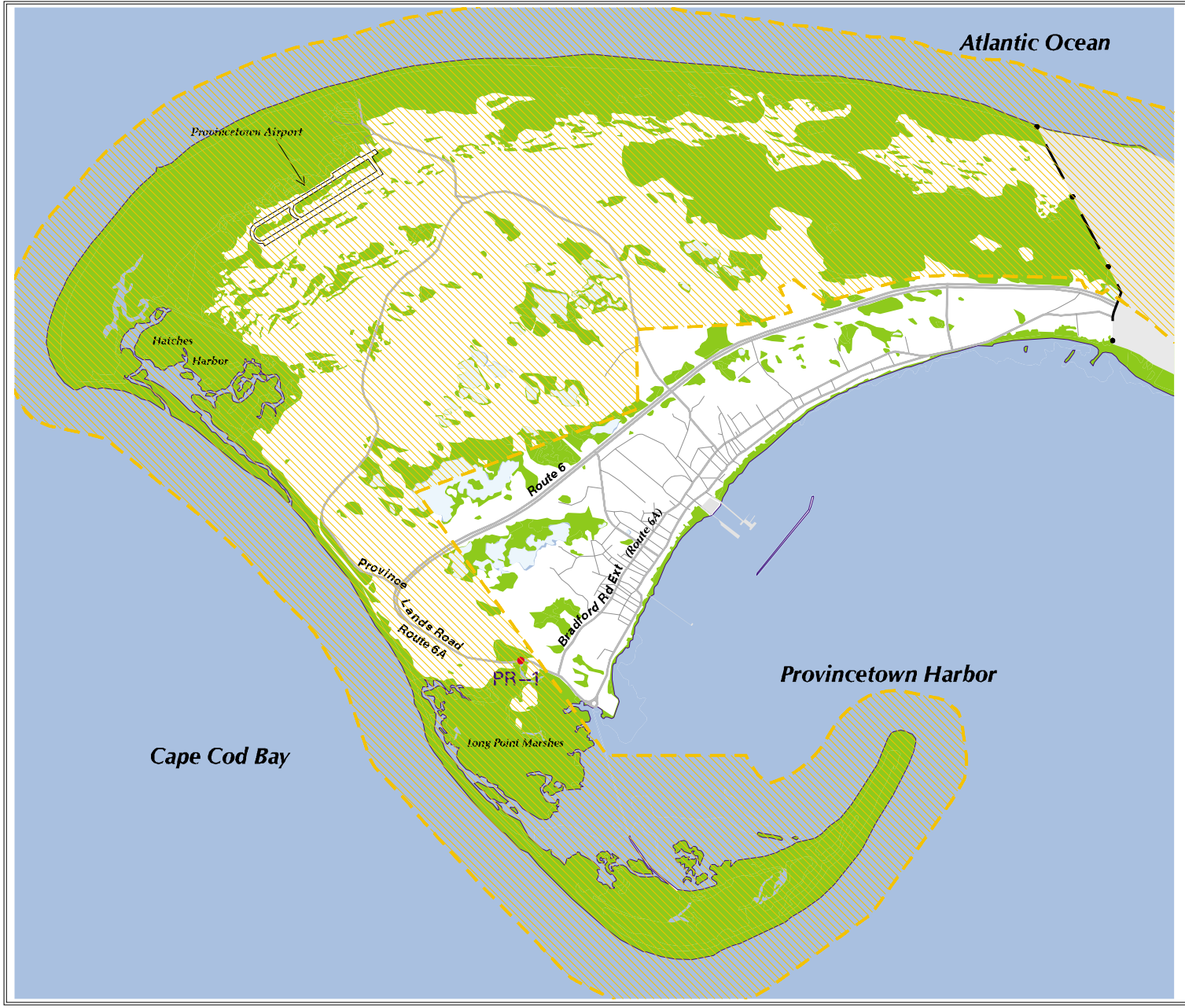
Upstream Affected Area (acres): SM – 1.99; SS – 1.75.

The seaward side of the berm is subject to severe scouring and erosion. The submerged 1-foot clay pipe is seen here during an outgoing, low tide cycle.

A significant amount of Phragmites growth is observed here upstream of the old cranberry bog berm. Salt marsh is visible in the distance.

TOWN OF PROVINCETOWN

- Town Map
- Chart of Site Characteristics
- Site 1



TOWN OF PROVINCETOWN

Location of Selected Salt Marsh Restrictions

This map was produced by the Cape Cod Commission Geographic Information System office, with digital data from MassGIS and the Cape Cod Commission, 2001.

The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis.

This project was funded, in part, by the Executive Office of Environmental Affairs, Massachusetts Wetlands Restoration Program.

- PR – 1 Restriction Site
- Wetland
- Ocean
- Pond or Lake
- CC National Seashore
- Local Road
- Major Route
- Stream
- Railroad

Locus Map

Miles
0 0.5 1
0 2,500 5,000
Massachusetts State Plane Feet
North American Datum – 1927

Land Use ▪ Roads ▪ DCPCs ▪ Parcels ▪ Demographics ▪ Environment ▪ Lake DRIs
Cape Cod Commission
GIS Services

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2001

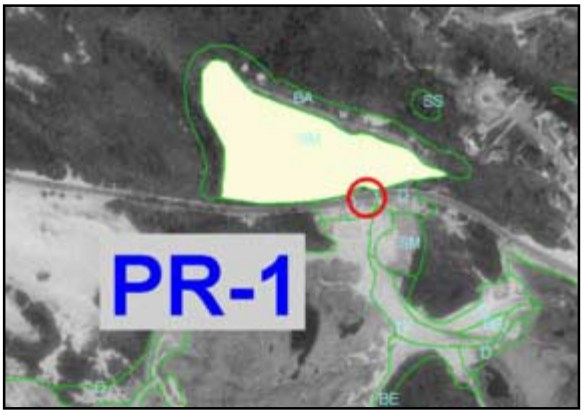
Town of Provincetown –Site Characteristics

Site Number	Size of upstream affected area (salt marsh acres / total affected acres)	Is the upstream affected area contiguous to protected open space (ownership)?	Does this tidal channel support a shellfish resource area?	Is the channel or system part of an anadromous fish pathway?	Does the culvert/pipe support an engineered flood control structure?	Is the affected area or site within an ACEC boundary?	Does the affected area include Priority Habitat of Rare Species (PH) or Estimated Habitat of Rare Wildlife (WH)?	Are there any restricted sites upstream of this site (site number)?	Ownership of the site (public vs. private)
PR-1	5.22 / 5.22	YES (federal)	NO	NO	NO	NO	YES (PH, WH)	NO	PUBLIC

PROVINCETOWN

Province Lands Road/Route 6A restriction of unnamed channel

Site PR-1



Upstream Affected Area (acres): SM – 5.22 acres.

Site Description

Province Lands Road/Route 6A crosses a small tidal channel between its intersections with Route 6 and Bradford Street Extension. This channel connects upstream salt marsh and a salt pond with the Long Point Marshes. Three 30-inch concrete culverts, set within a concrete headwall, convey flow under Province Lands Road/Route 6A. They are partially submerged at mean high tide and appear to be in good condition. Some structural erosion was observed seaward of the road. This channel does not appear to support shellfish resources or anadromous fish.

General Information

There is no distinct and measurable seaward channel – sandy flats extend to the roadway berm. Both seaward and upstream of the culvert tidal flow pools in large scour basins. Upstream tidal flow travels a short distance into a salt pond. Visual indicators of a restriction include significant scouring and bank erosion seaward and significant scouring upstream of the culvert. *Phragmites* is not visible in the upstream affected salt marsh. The upstream area is surrounded by coastal bank, which would act to contain any increase in tidal flow that may be introduced to the area.

- Restriction width – 7.5 feet (3 at 30 inches)
- Restriction length – 52 feet
- Upstream salt marsh – 5.22 acres

A large scour pool is visible in front of these three 30-inch culverts. Water marks and debris left by high water are visible on top of this headwall.

Visible in the foreground is a corner of the large, upstream scour pool along with the algae-covered salt pond in the rear. Coastal bank is clearly containing this upstream affected area.

TOWN OF SANDWICH

- Town Map
- Chart of Site Characteristics
- Sites 1 to 13

TOWN OF SANDWICH

Location of Selected Salt Marsh Restrictions

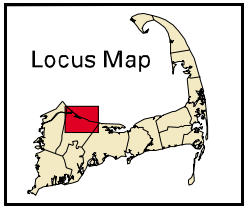
This map was produced by the Cape Cod Commission Geographic Information System office, with digital data from MassGIS and the Cape Cod Commission, 2001.

The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis.

This project was funded, in part, by the Executive Office of Environmental Affairs, Massachusetts Wetlands Restoration Program.

- SA – 1 Restriction Site
- Wetland
- Ocean
- Pond or Lake
- Local Road
- Major Route
- Stream
- Railroad

Locus Map



Miles
0 0.5 1
0 2,500 5,000
Massachusetts State Plane Feet
North American Datum – 1927

Land Use • Roads • DCPCs • Parcels • Demographics • Environmental • DRIs
Cape Cod Commission
GIS Services

2001

N
W CCC E
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Town of Sandwich –Site Characteristics

Site Number	Size of upstream affected area (salt marsh acres / total affected acres)	Is the upstream affected area contiguous to protected open space (ownership)?	Does this tidal channel support a shellfish resource area?	Is the channel or system part of an anadromous fish pathway?	Does the culvert/pipe support an engineered flood control structure?	Is the affected area or site within an ACEC boundary?	Does the affected area include Priority Habitat of Rare Species (PH) or Estimated Habitat of Rare Wildlife (WH)?	Are there any restricted sites upstream of this site (site number)?	Ownership of the site (public vs. private)
SA-1	13.48 / 24.96	YES (municipal)	NO	YES	NO	NO	YES (PH)	YES (SA-2)	PUBLIC
SA-2	12.31 / 23.25	YES (municipal)	NO	YES	NO	NO	YES (PH)	NO	PUBLIC
SA-3	0.0 / 0.20	NO	NO	NO	NO	NO	NO	NO	PUBLIC
SA-4	3.81 / 5.88	NO	NO	YES	NO	NO	NO	YES (SA-5)	PUBLIC
SA-5	0.0 / 2.07	NO	NO	YES	YES (tide gate)	NO	NO	NO	PUBLIC
SA-6	5.50 / 6.97	NO	NO	NO	NO	NO	NO	NO	PUBLIC
SA-7	4.21 / 5.86	NO	NO	NO	NO	NO	NO	NO	PUBLIC
SA-8	4.27 / 9.08	YES (municipal)	NO	NO	NO	NO	NO	NO	PRIVATE
SA-9	0.0 / 79.71	NO	YES	NO	YES (tide gate; stoplogs)	YES	NO	NO	PUBLIC
SA-10	211.80 / 258.76	YES (municipal, state)	YES	YES	NO	YES	YES (PH)	YES* (SA-11, SA -12)	PUBLIC
SA-11	1.37 / 2.43	NO	YES	NO	NO	NO	NO	NO	PUBLIC
SA-12	17.89 / 33.89**	NO	YES	NO	NO	YES	YES (PH)	NO*	PUBLIC
SA-13 / BA-1	17.89 / 33.89**	NO	YES	NO	NO	YES	YES (PH)	NO*	PUBLIC

* Scorton Creek (Sandwich) flows east to join with Scorton Creek (Barnstable) that is flowing west. It may be correct to include site SA-13/BA-1 as an upstream site of SA-10. However the vegetation, as delineated by the Wetlands Conservancy Program, sizes of channels, and proximity of SA-13/BA-1 to Scorton Creek's (Barnstable) tidal entrance at Barnstable Harbor visually indicate that tidal flow mixes somewhere between sites SA-12 and SA-13/BA-1. Therefore, this Atlas will consider site SA-12, but not SA-13/BA-1, as upstream of site SA-10. Sites SA-12 and SA-13/BA-1 are considered to share the same upstream affected area.

** Because the size of the upstream affected area is ambiguous (without conducting tidal range studies) this affected salt marsh acreage is likely to be an overestimation.

SANDWICH

Penn Central Railroad restriction of Mill Creek

Site SA-1

Site Description

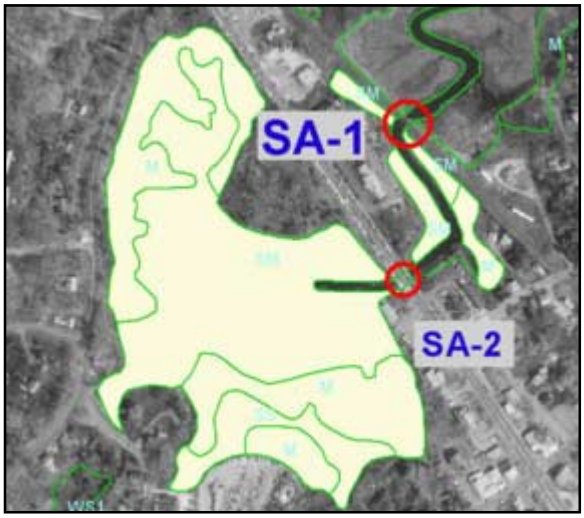
The Penn Central Railroad bed crosses over Mill Creek via a 20-foot bridge span. This bridge is located directly behind the Sandwich Police Station on Route 6A. It is constructed of concrete and wood pylons with stone embankments. It is in excellent condition. This site lies approximately 500 feet seaward of restricted site SA-2. Mill Creek supports an anadromous fish run.

General Information

Water is detained upstream of the bridge due to an approximate 3-foot rise from the seaward to upstream creek-bed elevation caused by rocks built up under the bridge. The stream is approximately 30 feet wide on the seaward side narrowing to 20 feet wide upstream of the bridge. Visual indicators of a restriction include a significant scouring basin and significant bank erosion on the upstream side, as well as minor scour and erosion seaward of the bridge. *Phragmites* is not present in the seaward marsh area however, it fringes salt marsh upstream of the bridge.

- Restriction width – 20 feet
- Restriction length – 22 feet
- Upstream salt marsh – 13. 48 acres

The upstream affected salt marsh, seen here at high tide, is fringed by Phragmites.



Upstream Affected Area (acres): SM – 13.48; SS – 1.99, M – 9.49.

This 22-foot bridge span enables the Penn Central Railroad to cross Mill Creek.

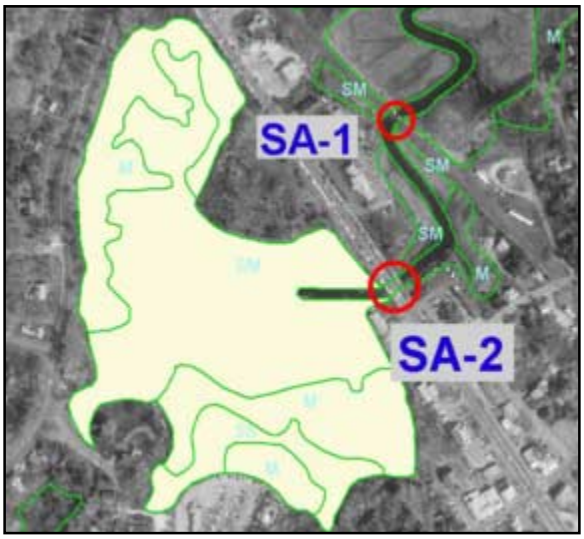
Comments

Currently, this railroad track (causing three restricted sites in Sandwich) is used daily by the trash-hauling train as well as by a seasonal tourist train. Mill Creek supports an active anadromous fish run that utilizes the Shawme and Upper Shawme Ponds. Mill Creek makes four infrastructure crossings on its way to these ponds, including this site, restricted site SA-2 and non-restricted site SA-b.

SANDWICH

Route 6A restriction of Mill Creek

Site SA-2



Upstream Affected Area (acres): SM – 12.31; SS – 1.99; M – 8.95.

Site Description

Mill Creek flows under Route 6A via a 45-foot bridge span. The bridge is supported by concrete pylons set in the stream bed with rock-armored abutments. It was recently renovated (1994) and is in excellent condition. This restriction lies approximately 500 feet upstream of restricted site BA-1. Mill Creek supports an anadromous fish run into the Shawme and Upper Shawme Ponds.

General Information

The channel width both seaward and upstream of the bridge is approximately 30 feet. Therefore the channel to opening ratio is not indicative of a restriction. Additionally, common visual indicators of a restriction such as scour and erosion were not observed to a remarkable degree near this bridge. However, the salt marsh on the seaward side of the bridge is suffering from minor vegetation die-off and low marsh slumping. *Phragmites* is growing on both the seaward, which is the upstream area of restricted site SA-1, and upstream sides of this site.

- Restriction width – 45 feet
- Restriction length – 36 feet
- Upstream salt marsh – 12.31 acres

View of Mill Creek flowing under the Route 6A bridge at high tide.

Phragmites thickly fringes the salt marsh upstream of the Route 6A bridge over Mill Creek.

Comments

The Sandwich Conservation Officer stated that, while visual indicators of restriction are minor, this site does restrict tidal flow and affects upstream salt marsh. Because seaward site SA-1 is restrictive of flow it is likely that, should natural flow be restored there, this site would not be wide enough to accommodate any newly increased flow. Aerial photography from 1993 reveals significant upstream scour at this crossing.

SANDWICH

Boardwalk Road restriction of channel from Dock Creek

Site SA-3

Site Description

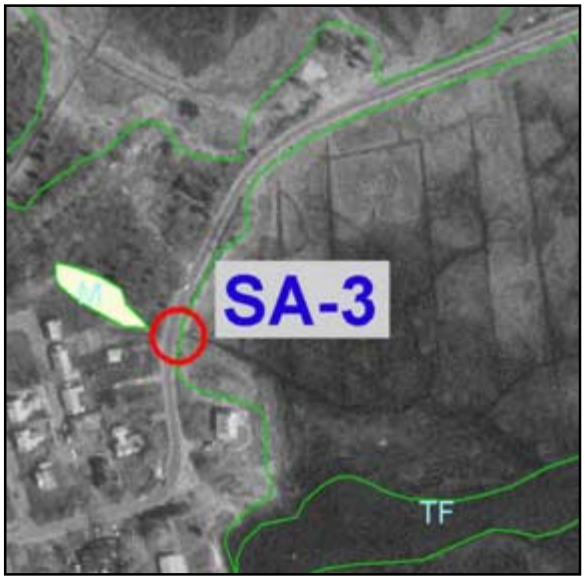
A channel off of Dock Creek flows under Boardwalk Road via a 20-inch concrete pipe. This crossing is located approximately one-quarter mile south of the parking lot for the boardwalk accessing Town Neck. The pipe is in fair condition. The seaward opening is clogged with dirt, sand, and muck and is consistently submerged at mean high tide.

General Information

The seaward channel varies from 2-to-4 feet wide with minor scouring and erosion scaring its banks near the pipe opening. The upstream channel is approximately the same width as the culvert. Healthy, extensive salt marsh exists just to the seaward edge of the road while *Phragmites* dominates upstream.

- Restriction width – 20 inches
- Restriction length – 60 feet
- Upstream salt marsh – 0 acres

Phragmites dominates the upstream affected area just across the street from extensive salt marshes.



Upstream Affected Area (acres): M – 0.2.

Salt marsh dominates the view from Boardwalk Road; a scour pool and erosion are visible in the foreground where this channel tries to pass through the 20-inch pipe.

Comments

While Boardwalk Road is town owned, most of the upstream affected area is private property. Although the affected area is only a small patch of shallow marsh (0.2 acres) this site was included in this Atlas because of the clear change in vegetation caused by Boardwalk Road.

SANDWICH

Dewey Avenue restriction of Dock Creek

Site SA-4

Site Description

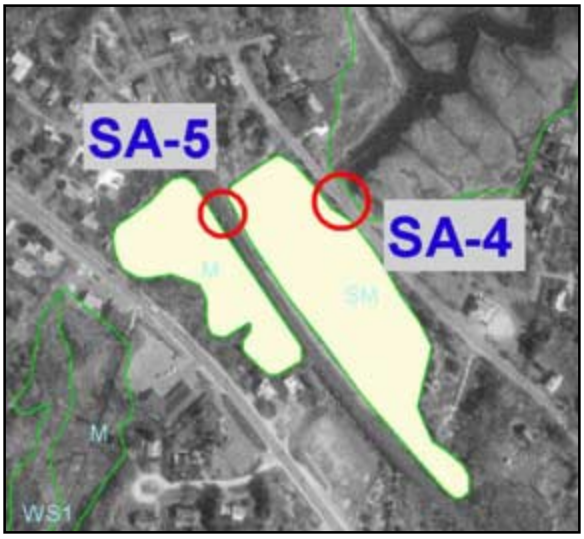
Dock Creek passes under Dewey Avenue via a 6-foot wide concrete box culvert with wing walls. This site lies within a historic district of Sandwich near the site of a former glass factory. The culvert is in excellent condition. Dock Creek flows under two additional infrastructure crossings including upstream restricted site SA-5 and non-restricted site SA-c. Dock Creek does not appear to support shellfish but does support a brown trout (salter) run.

General Information

The channel width remains consistent (approximately 8 feet) from the seaward to upstream side of Dewey Avenue. Minor pooling, erosion, and scouring basins occur on both the seaward and upstream ends of the culvert. The presence of *Phragmites* is significant in the upstream affected area. It fringes the affected area and grows in scattered patches throughout the salt marsh.

- Restriction width – 6 feet
- Restriction length – 40 feet (approximate)
- Upstream salt marsh – 3.81 acres

In the upstream salt marsh Phragmites fringes the marsh as well as growing in scattered patches. The railroad bed, which causes further restriction of the creek, is visible in the background.



Upstream Affected Area (acres): SM – 3.81; M – 2.07.

This 6-foot box culvert passes the flow of Dock Creek under Dewey Avenue.

Comments

Sandwich rebuilt this culvert in 1998. It remains tidally restrictive. Currently, it provides improved tidal flow however, Dewey Avenue is still subject to flooding during storm tides.

SANDWICH

Penn Central Railroad restriction of Dock Creek

Site SA-5

Site Description

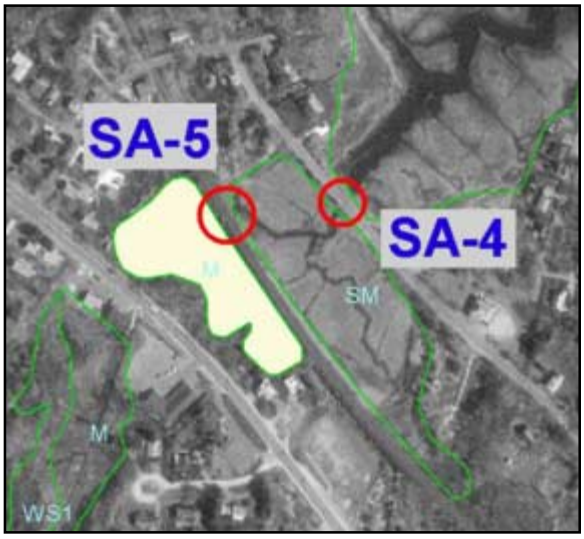
The Penn Central railroad bed crosses Dock Creek approximately 200 feet upstream of the Dewey Avenue restriction (site SA-4). A 3-foot pipe passes flow under the railroad bed. However, the seaward opening is covered by a metal flapper-type tide gate, in effect restricting flow to only a 6-inch gap between the pipe and gate. The tide gate is rusted in place and submerged at mean high tide. The railroad bed is in need of repair—railroad ties are rotting and the stabilizing bank is seriously eroding.

General Information

Dock Creek varies in width from 5 to 10 feet on both sides of this restriction. Visual indicators of a restriction (aside from the tide gate) include scouring and bank erosion. *Phragmites* dominates the affected area upstream of the pipe—what was salt marsh on the seaward side, fringed and scattered with *Phragmites*, quickly changes to nothing but *Phragmite*s upstream of the railroad bed.

- Restriction width – 3 feet (effectively 6 inches)
- Restriction length – 36 feet
- Upstream salt marsh – 0 acres

Phragmites dominates the upstream affected area of site SA-5.



Upstream Affected Area (acres): M – 2.07.

The flapper gate which covers the 3-foot pipe, is set low, below a deteriorating retaining wall.

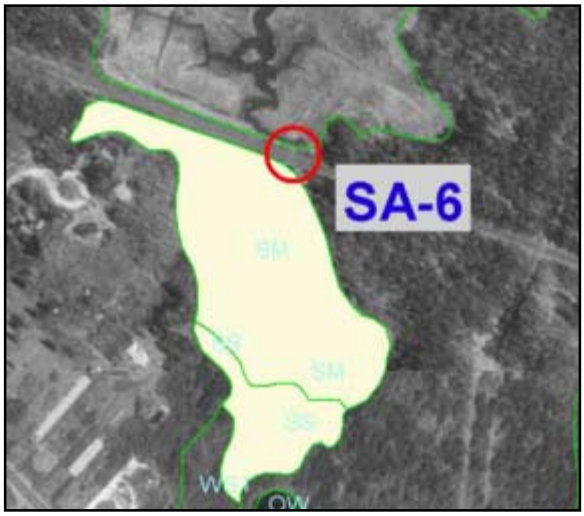
Comments

According to the Sandwich Conservation Officer, cranberry bogs historically occurred upstream of this site, possibly necessitating the placement of a tide gate to prevent saltwater inflow. Cranberry production no longer occurs in this vicinity however, the state operates a fish hatchery upstream of the site. This as well as low-lying development in the area might be affected by removal of the flapper gate.

SANDWICH

Penn Central Railroad restriction of Ox Pasture Creek

Site SA-6



Upstream Affected Area (acres): SM – 5.5; SS – 1.47.

Site Description

Ox Pasture Creek flows in a northerly direction from south of Route 6A, joins with Old Harbor Creek, and discharges to Cape Cod Bay through Sandwich Harbor. This crossing lies approximately one-eight of a mile west of the end of Ox Pasture Road and to the north of Mount Hope Cemetery. Ox Pasture Creek flows under the Penn Central Railroad bed via a 3-foot concrete pipe set within a rock and boulder headwall. The pipe is in good condition. The creek does not appear to support shellfish or anadromous fish.

General Information

The creek is approximately 7 to 10 feet wide seaward, narrowing to approximately 5 feet upstream of the railroad bed. Visual indicators of a restriction include a major scouring basin and erosion scaring the channel near the seaward opening. Additionally, minor scouring is visible near the upstream opening. *Phragmites* fringes the upstream affected salt marsh.

- Restriction width – 3 feet
- Restriction length – 50 feet
- Upstream salt marsh – 5.5 acres

The 3-foot pipe is nearly submerged on this mid tide and is dwarfed by the pool of water detained by the railroad bed and this undersized culvert.

The upstream salt marsh is still flooded during this mid tide cycle. Phragmites is visible fringing the back extent of the affected area.

SANDWICH

Penn Central Railroad restriction of Pine Island Creek

Site SA-7

Site Description

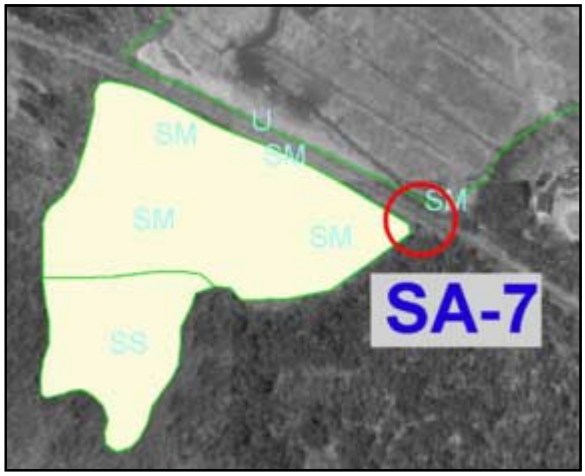
Pine Island Creek flows in a northerly direction from north of Route 6A, joins with Old Harbor Creek, and discharges to Cape Cod Bay through Sandwich Harbor. The creek crosses under the railroad approximately 700 feet west of the intersection of Great Island Road and the railroad bed. Pine Island Creek flows under the Penn Central Railroad bed via a 3-foot stone box culvert that is in good condition. The creek does not appear to support shellfish or anadromous fish.

General Information

The creek channel is approximately 3 feet wide on the seaward side, widening to 5 feet upstream of the railroad (typically, channels narrow upstream of a restriction). While the culvert itself is structurally intact, the conditions of the channel and banks around it are poor. Significant scouring has formed a large pool near the seaward opening and constant scouring is eroding the railroad bed above and around both stone culvert openings. Scour and erosion scar the upstream channel. *Phragmites* does not have a major presence in the upstream affected area but is present on its fringes.

- Restriction width – 3 feet
- Restriction length – 40 feet
- Upstream salt marsh – 4.21 acres

View of the upstream end of the box culvert through which the flow of Pine Island Creek must pass.



Upstream Affected Area (acres): SM – 4.21; SS – 1.65.

The top stone of the box culvert is just visible above the water and erosion is seen behind it eating away at the railroad bed.

SANDWICH

Foster Road restriction of Old Harbor Creek

Site SA-8

Site Description

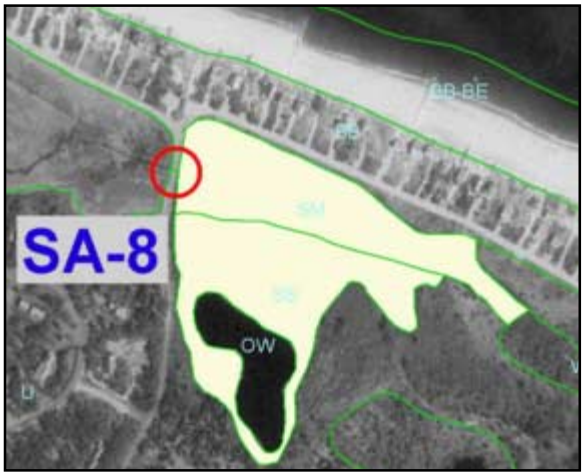
Old Harbor Creek flows parallel to Salt Marsh Road and Springhill Beach, crossing under Foster Road just south of the Forest/Salt Marsh Road intersection. Old Harbor Creek flows under Foster Road (a private dirt road) via a 16-inch diameter corrugated metal pipe. The pipe is in poor condition – it is clogged by sand, crushed, and misshapen – and erosion is undercutting the low berm in which it is set.

General Information

This crossing lies near the head of Old Harbor Creek, far from its confluence with the Cape Cod Bay (at Sandwich Harbor). Seaward of the road the channel was approximately 3 feet narrowing upstream to a barely visible 1-foot or less. The upstream area had no visible *Phragmites* and was dominated by tall grasses, scattered shrubs and trees. No water was observed moving through this culvert.

- Restriction width – 16 inches
- Restriction length – 36 feet
- Upstream salt marsh – 4.27 acres

The upstream affected area is dominated by grasses and shrubs; the stream channel is barely visible in the foreground.



Upstream Affected Area (acres): SM – 4.27; SS – 4.81.

This 16 inch pipe passes the flow of Oak Harbor Creek under Foster Road.

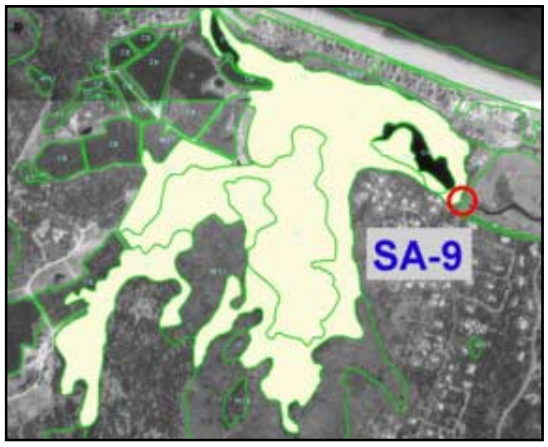
Comments

A tidal flushing study of this system was recently conducted by a private consultant (Aubrey Associates). As of April 2000, the report has not been published. Foster Road is in poor condition, but future improvements may occur. The town recently purchased land upstream of the site and, according to the Conservation Officer, hopes to acquire additional acreage.

SANDWICH

Ploughed Neck Road restriction of Long Creek/Cow River

Site SA-9



Upstream Affected Area (acres): SS – 54.95; M – 24.76.

Site Description

Ploughed Neck Road forms the divide between Long Creek and the Cow River. The Cow River flows from south of Route 6A, northward through an extensive area of cranberry bog (30.35 acres), shallow marsh, and shrub swamp, and terminates on the upstream side of Ploughed Neck Road. At this point the creek becomes known as Long Creek, which flows east to join with Scorton Creek and discharge into Cape Cod Bay at Scorton Harbor.

Tidal flow is totally restricted under Ploughed Neck Road by a tide gate, effectively shutting off the culvert. The tide gate covers a 3-foot diameter concrete culvert that is set low in an 8-foot high concrete headwall with wings. The upstream opening is fitted with a frame to support the placement of water-tight stoplogs. The structures appear to be in good condition. There is an elevation difference of approximately 4 feet between the seaward and upstream pipe openings.

This 8-foot high concrete wall houses the 3-foot pipe covered with a closed tide gate (hidden in the shadows of this picture). However, high water marks are visible well above it.

General Information

Long Creek is approximately 15 feet wide on the seaward side of this restriction. Upstream of the road and tide gate the Cow River is approximately 20 feet wide and quickly opens into a pond. *Phragmites* dominates the vegetation in the upstream affected area. *Lythrum Slicornia* was also observed in the upstream area.

- Restriction width – zero
- Restriction length – 50 feet
- Upstream salt marsh – 0 acres

Upstream the Cow River extends for a short distance from the roadway, then opens into the pond beyond. Because of the tide gate, this affected area is not receiving any tidal flow.

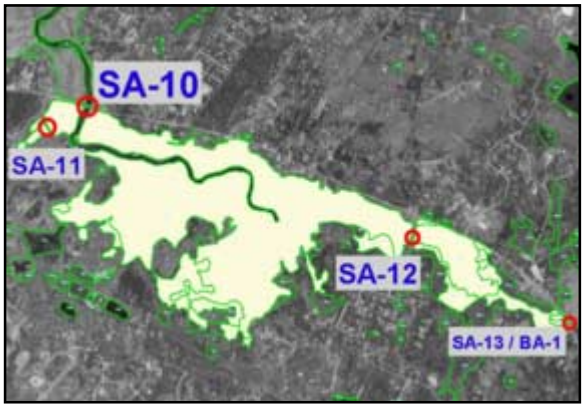
Comments

Scorton Creek is part of the Sandy Neck/Barnstable Harbor Area of Critical Environmental Concern (ACEC). However, Ploughed Neck Road delineates the ACEC boundary, with Long Creek included and the Cow River excluded from the ACEC.

SANDWICH

Route 6A restriction of Scorton Creek (Sandwich)

Site SA-10



Upstream Affected Area (acres): SM – 211.80; SS – 11.64; M – 35.32.

Site Description

Route 6A crosses Scorton Creek via a 60-foot bridge span. The bridge, which is in excellent condition, is made of stone and concrete and is supported by a center stone column. Restricted sites SA-11 and SA-12 and non-restricted site SA-e lie upstream of this crossing.[1] South of this Route 6A crossing, Scorton Creek flows east connecting with Scorton Creek (originating in Barnstable Harbor). Both Scorton Creeks and most of their affected marsh systems are included in the Sandy Neck/Barnstable Harbor Area of Critical Environmental Concern.

Shellfishing is prohibited in the numerous beds of the Scorton Creek (Sandwich) system. Historically, the creek supported active and numerous anadromous fish runs (including coho salmon, alewives, and herring) between Cape Cod Bay and Nye Pond. The salmon in particular were associated with the Massachusetts State Game Farm and fish hatchery that are located upstream of the Route 6A bridge but are no longer in operation. Today it is believed that only sea-run brown trout are using the creeks connecting to Nye Pond.

Seen close up, this erosion, slumping, and vegetation, die-off are scarring the banks seaward of the Scorton Creek bridge.

General Information

Scorton Creek is approximately 80-100 feet wide both seaward and upstream of the bridge. Visual indicators of restriction include a minor scouring basin and bank erosion upstream, as well as significant scouring, erosion, marsh slumping, and vegetation die-off seaward of the bridge. *Phragmites* is not visible either seaward or upstream of the bridge.

- Restriction width – 60 feet
- Restriction length – 25 feet (approximate)
- Upstream salt marsh – 212.60 acres

This 60-foot long stone bridge moves Route 6A traffic over Scorton Creek.

Comments

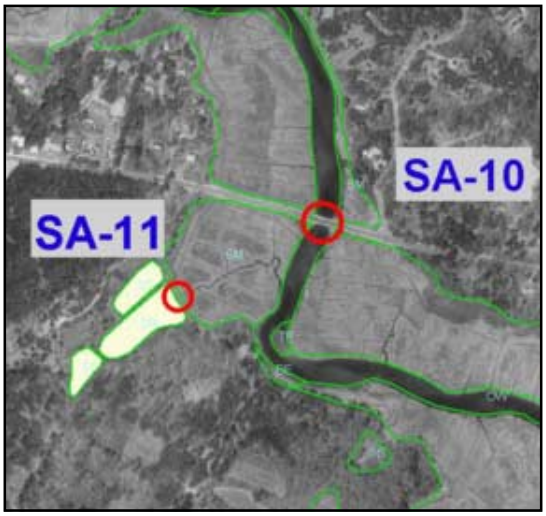
Historically, the natural entrance to Scorton Creek was located east of its current tidal entrance at Scorton Harbor (see Appendix B, site SA-f). The town is currently conducting a flushing study of the entire Scorton Creek system, with funding provided by a Cape Cod Commission technical assistance grant.

[1] It may also be correct to include site SA-13/BA-1 as an upstream site of SA-10. However the vegetation, as delineated by the Wetlands Conservancy Program, sizes of channels, and proximity of SA-13/BA-1 to Scorton Creek's (Barnstable) tidal entrance visually indicate that flow mixes somewhere between sites SA-12 and SA-13/BA-1. Therefore, this Atlas will consider site SA-12, but not SA-13/BA-1, as upstream of site SA-10. Sites SA-12 and SA-13/BA-1 are considered to share the same upstream affected area.

SANDWICH

Pine Terrace extension restriction of channel off Scorton Creek (Sandwich)

Site SA-11



Upstream Affected Area (acres): SM – 1.37; SS – 1.06.

Site Description

An extension of Pine Terrace crosses a channel off of Scorton Creek approximately 600 feet south of the creek's main channel and the Route 6A bridge (see site SA-10). The unpaved, one-lane road leads to a parking area for the Massachusetts State Game Farm. This channel connects Scorton Creek with Hoxie Pond far to the south. Flow passes under the road via an 18-inch corrugated metal pipe. The pipe is in poor condition – it is broken and clogged with debris. While Scorton Creek does support shellfish and anadromous fish, it is not known if this particular tributary and Hoxie Pond are used by anadromous fish. This crossing and its upstream affected area are not part of the Sandy Neck/Barnstable Harbor Area of Critical Environmental Concern.

A large, deep scour pool marks the opening for the 18-inch pipe that passes flow under the unpaved extension of Pine Terrace. The pipe is sited high in the berm and cannot pass the full tidal range.

General Information

Two channels, 4 and 6 feet wide, converge at the seaward side of the pipe. Two channels, 2 and 3 feet wide, work their way off into the upstream affected area. The seaward opening is inverted — set high in the roadway berm, making it impossible for lower tidal waters to pass through the pipe. A deep scour pool has formed at the seaward opening and erosion is deteriorating the channel banks. Upstream, both scour and erosion scar the site. *Phragmites* growth is significant in the upstream affected area.

- Restriction width – 1.5 feet
- Restriction length – 28 feet
- Upstream salt marsh – 1.37 acres

Phragmites, visible in the foreground, is the only thing growing in the exposed mud near this upstream pipe opening.

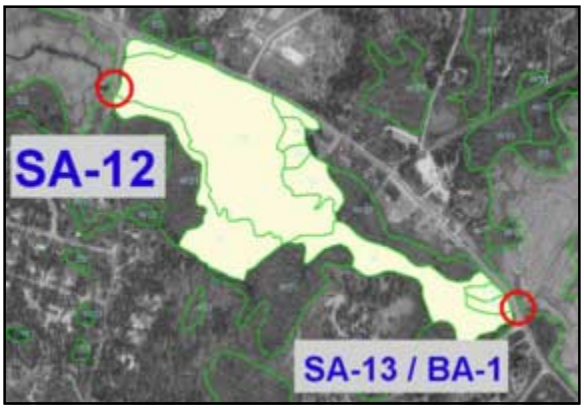
Comments

The town is currently conducting a flushing study of the entire Scorton Creek system, with funding provided by a Cape Cod Commission technical assistance grant.

SANDWICH

Jones Lane restriction of Scorton Creek (Sandwich)

Site SA-12



Upstream Affected Area (acres): SM – 17.89; M – 13.94; SS – 2.06.

Site Description

Scorton Creek flows under Jones Lane via a 6 by 6-foot concrete box culvert. The culvert was reconstructed and widened in 1998 and is in excellent condition. This site lies upstream of restricted site SA-10. The upstream affected area of this site is also the upstream affected area of site SA-13/BA-1. It is between sites SA-12 and SA-13/BA-1 that the flow of Scorton Creek (Sandwich) mixes with the flow of Scorton Creek (Barnstable). Scorton Creek (Sandwich) does support shellfish and anadromous fish. This site and its affected area are located within the Sandy Neck/Barnstable Harbor Area of Critical Environmental Concern.

This 6 by 6-foot concrete box culvert passes the flow of Scorton Creek (Sandwich) under Jones Lane.

General Information

Scorton Creek is approximately 8-10 feet wide both seaward and upstream of the culvert. Visual indicators of a restriction include seaward scour, erosion, and marsh slumping, as well as minor upstream scour and erosion. *Phragmites* is visible fringing the upstream affected area and dominating scattered upstream patches. According to the Wetlands Conservancy Programs wetland delineation, shallow marsh divides salt marsh adjacent to the upstream side of site SA-12 from salt marsh adjacent to the upstream side of site SA-13/BA-1.

- Restriction width – 6 feet
- Restriction length – 42 feet
- Upstream salt marsh – 17.89 acres

View of the upstream affected salt marsh; Phragmites is visible fringing the marsh area.

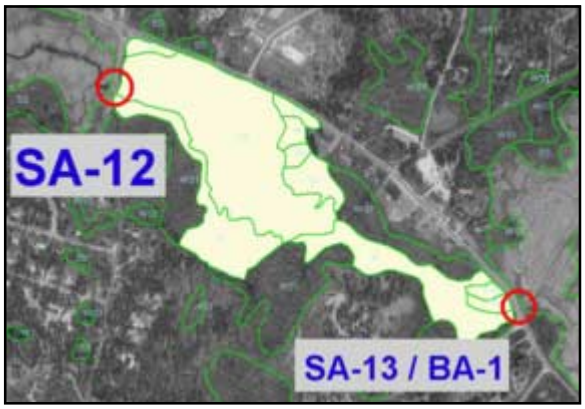
Comments

According to the Sandwich Conservation Officer, the town is seeking to acquire much of the upstream salt marsh area. The town is currently conducting a flushing study of the entire Scorton Creek system, with funding provided by a Cape Cod Commission technical assistance grant.

SANDWICH/BARNSTABLE

Route 6A restriction of Scorton Creek (Barnstable)

Site SA-13/BA-1



Upstream Affected Area (acres): SM – 17.89; M – 13.94; SS – 2.06.

Site Description

Scorton Creek (Barnstable) flows under Route 6A at the Barnstable/Sandwich town line via a 4-foot diameter concrete pipe. The pipe is in good condition – it is not broken or clogged. The upstream side of this pipe is considered to be the marsh area to the southwest of Route 6A, which is also the upstream affected area of site SA-12. It is in this affected area that the flow of Scorton Creek (Sandwich) mixes with the flow of Scorton Creek (Barnstable). Scorton Creek (Barnstable) does support shellfish and anadromous fish. This site and its affected area are located within the Sandy Neck/Barnstable Harbor Area of Critical Environmental Concern.

This 4-foot concrete pipe passes the flow of Scorton Creek (Barnstable) under Route 6A.

General Information

The seaward side of the creek is 5 feet wide and narrows to approximately 2 feet upstream of the pipe. Visual indicators of a restriction include minor scouring at both ends of the pipe and minor upstream erosion. Cattails dominate the vegetation on the seaward side of Route 6A and are significant in the upstream marsh area. *Phragmites* fringes the back extent of the upstream affected area. According to the Wetlands Conservancy Programs wetland delineation, shallow marsh divides salt marsh adjacent to the upstream side of site SA-12 from salt marsh adjacent to the upstream side of site SA-13/BA-1

- Restriction width – 4 feet
- Restriction length – 56 feet
- Upstream salt marsh – 17.89 acres

The upstream affected seen here is scattered with cattails, shrubs, trees, and Phragmites.

Comments

According to the Sandwich Conservation Officer, at the time of this writing this culvert is under consideration for remediation but requires outside funding due to the fact that the structure is within a Massachusetts Highway Department road layout. The town is currently conducting a flushing study of the entire Scorton Creek system, with funding provided by a Cape Cod Commission technical assistance grant.

TOWN OF TRURO

- Town Map
- Chart of Site Characteristics
- Sites 1 to 7

TOWN OF TRURO

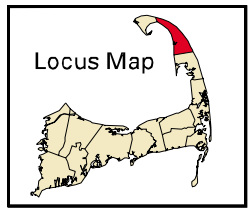
Location of Selected Salt Marsh Restrictions

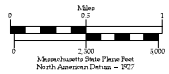
This map was produced by the Cape Cod Commission Geographic Information System office, with digital data from MassGIS and the Cape Cod Commission, 2001.

The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis.

This project was funded, in part, by the Executive Office of Environmental Affairs, Massachusetts Wetlands Restoration Program.

- TR – 1 Restriction Site
- Wetland
- Ocean
- Pond or Lake
- CC National Seashore
- Local Road
- Major Route
- Stream
- Railroad





Massachusetts State Plane Feet
North American Datum – 1927

Land Use ▪ Roads ▪ DCPCs ▪ Parcels ▪ Demographics ▪ Environmental ▪ DRIs

Cape Cod Commission GIS Services

2001

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Town of Truro – Site Characteristics

Site Number	Size of upstream affected area (salt marsh acres / total affected acres)	Is the upstream affected area contiguous to protected open space (ownership)?	Does this tidal channel support a shellfish resource area?	Is the channel or system part of an anadromous fish pathway?	Does the culvert/pipe support an engineered flood control structure?	Is the affected area or site within an ACEC boundary?	Does the affected area include Priority Habitat of Rare Species (PH) or Estimated Habitat of Rare Wildlife (WH)?	Are there any restricted sites upstream of this site (site number)?	Ownership of the site (public vs. private)
TR-1	0.0 / 16.19	YES (federal)	YES	NO	NO	NO	NO	NO	PUBLIC
TR-2	0.0 / 13.13	NO	YES	NO	NO	NO	YES (PH)	NO	PUBLIC
TR-3	0.0 / 152.38	YES (federal)	YES	YES*	YES (tide gate)	NO	NO	YES (TR-4)	PUBLIC
TR-4	0.0 / 152.38	YES (federal)	YES	YES*	NO	NO	NO	NO	PUBLIC
TR-5	1.55 / 1.55	NO	YES	NO	NO	NO	NO	NO	PRIVATE
TR-6	0.0 / 322.05	YES (federal)	NO	YES	YES (tide gates)	NO	YES (PH, WH)	YES** (TR-7)	PUBLIC
TR-7	0.0 / 322.05	YES (federal)	NO	YES	YES (weir; stoplogs)	NO	YES (PH, WH)	YES**	PUBLIC

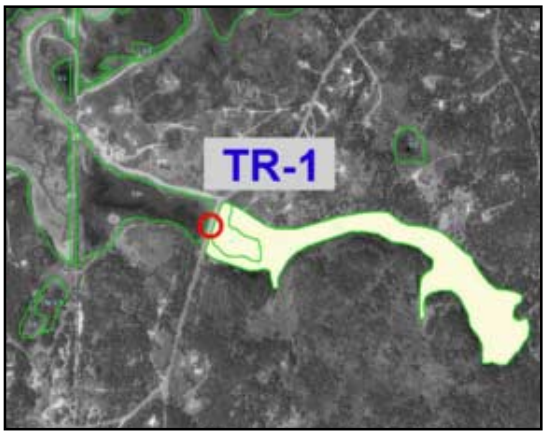
* The Pamet River is stocked with sea-run brook trout by the Massachusetts Department of Fish and Wildlife. It is known that these fish do migrate through the Pamet River system. However, the potential of the river system under present conditions to support an active and productive migratory fish population is limited.

** Upstream of Pilgrim Lake exists what was once a vast intertidal salt marsh system known as Salt Meadow, or Head of the Meadow, that is now delineated by the Wetlands Conservancy Program as 94.52 acres of shrub swamp and 50.94 acres of shallow marsh. In addition to sites TR-6 and TR-7 that restrict tidal flow into Pilgrim Lake, Salt Meadow is further restricted by two infrastructure crossings. First, by the extension of High Head Road that serves as a jeep trail to the beach, and second by a dike lying to the east of the jeep trail (see Appendix B, sites TR-d and TR-e). According to the Cape Cod National Seashore, if tidal flow is restored to the Pilgrim Lake system, most intertidal wetland benefits would be realized in the Salt Meadow wetland. Therefore, these two upstream crossings should be included in any remediation discussions.

TRURO

Old County Road restriction of Eagle Neck Creek

Site TR-1



Upstream Affected Area (acres): SS – 14.47; M – 1.72.

Site Description

Eagle Neck Creek flows under Old County Road via a 2-foot corrugated plastic pipe. The pipe was only visible on the upstream side of the road and is in need of immediate repair – rocks are visibly clogging the opening. Eagle Neck Creek is connected to tidal flow in Cape Cod Bay through Pamet Harbor. An abandoned, breached railroad bed running through the Harbor and its surrounding marshes lies seaward of this crossing. Storm tides eroded the bed that was partially breached in the late1980s and finally by the no-name storm in 1990. While Eagle Neck Creek itself does not appear to support shellfish resource areas, Pamet Harbor supports areas that are open seasonally to shellfishing. The upstream affected area of this site is within the Cape Cod National Seashore.

The seaward marsh area is degraded, displaying vegetation die off, ponded water, and a major scouring basin.

General Information

The seaward creek channel is approximately 5 feet wide, widening to 10 feet upstream of Old County Road. Seaward of this site, visual indicators of restriction are many and include major scouring and vegetation die off, significant ponding, minor bank erosion and marsh slumping, and the minor presence of *Phragmites*. Upstream of this site, visual indicators of a restriction include major scouring, significant ponding, and minor bank erosion.

- Restriction width – 2 feet
- Restriction length – 40 feet
- Upstream salt marsh – none

The berm of Old County Road partially dams Eagle Neck Creek. The upstream pipe is visible in this pool and is blocked by rocks – further restricting tidal flow.

Comments

Upon its breach, the town decided to leave the railroad dike open to tidal flow (see site TR-b, Appendix B), a decision that immediately changed the tidal range reaching this Old County Road culvert and over time has slightly changed the associated vegetation. However, the existing pipe is too small to enable salt marsh restoration upstream of this site. Originally, after the breach the town replaced the Old County Road culvert with two, side by side, 3-foot culverts. Because the supporting soils were peat, the road subsided and crushed the pipes. They were then replaced with one smaller 2-foot pipe. According to the Truro Department of Public Works, this replacement was intended to be a temporary measure however it still exists today.

TRURO

Mill Pond Road restriction of channel to Mill Pond

Site TR-2

Site Description

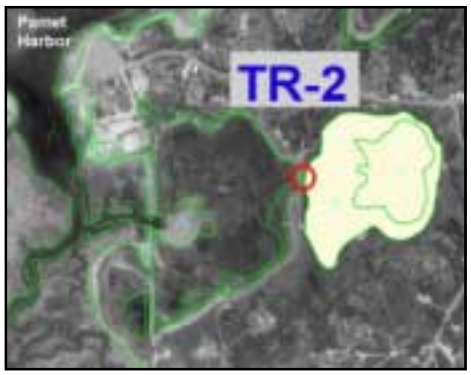
Mill Pond Road crosses the tidal channel that connects flow from the Pamet Harbor to Mill Pond. The channel flows under the road via a 3-foot corrugated plastic pipe. Both seaward and upstream openings are submerged at mean high tide. An abandoned, breached railroad bed running through the Harbor and its surrounding marshes lies seaward of this crossing. Storm tides eroded the bed that was partially breached in the late 1980s and finally by the no-name storm in 1991. While Mill Pond itself does not appear to support shellfish resource areas, Pamet Harbor supports areas that are open seasonally to shellfishing.

General Information

Seaward of the restriction the channel running to Mill Pond is approximately 10 feet wide, widening upstream to approximately 15 feet before flowing into the pond. Visual indicators of a restriction include major scouring basins and erosion both seaward and upstream. Vegetation is dying off both seaward and upstream of the site, however in this location it is caused by the reintroduction of saltwater flow rather than its absence – the vegetation observed dying off is not saltwater tolerant. Although saltwater has been reintroduced here by the breach in the railroad bed, there is evidence of flow restricted by Mill Pond Road.

- Restriction width – 3 feet
- Restriction length – 55 feet
- Upstream salt marsh – none

Dead shrubs comprise much of the vegetation currently observed in the upstream affected area – a symbol of the reintroduction of tidal flow and associated slow changes in vegetation.



Upstream Affected Area (acres): SS – 8.35; M – 4.78.

This 3-foot culvert passes tidal flow under Mill Pond Road, here water is seen rushing seaward on an outgoing tide.

Comments

The town decided to leave the railroad dikes open to tidal flow (see site TR-c, Appendix B), a decision that immediately changed the tidal range reaching the Mill Pond Road culvert and over time changed the associated vegetation and ecosystems. Because flow reaching the road increased and overwashed Mill Pond Road, the breached railroad necessitated the replacement of the culvert (involving a slight raise of the roadway) in 1991 to the conditions that exist there today. The natural restoration and reversion to salt marsh is a slow process and visual conditions in Mill Pond are unfavorable – with dead and dying vegetation and exposed mud flats, which appears to local residents as blighted and unsightly. A natural side effect of the tidal inflow was that saltwater killed what had become a well-developed community of freshwater wetland shrubs and herbs. This caused unpleasing odors and spurred complaints from local residents.[1] However today, the odors have ceased and new saltwater plant communities are beginning to take hold.

[1]Portnoy, 2002, p. 5.

TRURO

Restrictions of the Pamet River by:

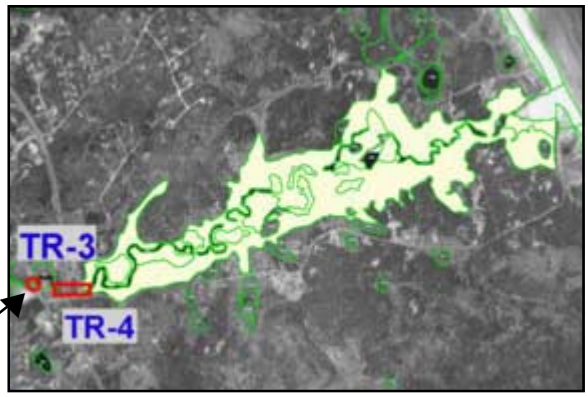
Truro Center Road/Route 6A (Wilder Dike)

Site TR-3

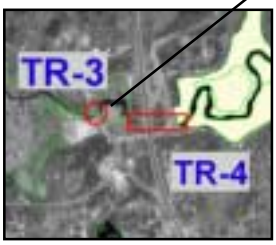
and

Route 6

Site TR-4



Upstream Affected Area (acres): SS – 119.72; M – 32.66.



Site Descriptions

The Pamet River runs east/west, its eastern end and non-tidal headwaters originating behind coastal bank on the Atlantic Ocean near Ballston Beach. It flows across the Cape, discharging through Pamet Harbor into Cape Cod Bay. The river and its associated wetlands effectively split Cape Cod into north and south sections. The river is divided into two hydrologically different sections, one estuarine and one freshwater river system, by two tidal restrictions that occur approximately half way along its length. Site TR-3, the seaward lying restriction, occurs at the Wilder Dike that supports Truro Center Road/Route 6A. The dike is fitted with a clapper valve (tide gate) at the seaward end of a 3-foot metal pipe. Site TR-4 lies just upstream of TR-3 where a 4-foot concrete culvert conveys the Pamet River under Route 6.

The total upstream affected marsh area totals 152.38 acres, delineated by the Wetlands Conservancy Program as 32.66 acres of shallow marsh and 119.72 acres of shrub swamp. Pamet Harbor supports shellfish resource areas that are open seasonally to shellfishing. This system does support a limited population of anadromous fish. Most of the upstream affected area of the Pamet River system is within the Cape Cod National Seashore.

The 3-foot metal pipe and clapper gate set within this headwall (visible below the water line) pass only the seaward flow of the Pamet River under Wilder Dike (Truro Center Road/Route 6A).

The 3-foot pipe opening is visible here upstream of Wilder Dike.

General Information

Wilder Dike was built in 1869 to replace a bridge and was fitted with the culvert and clapper valve. This profoundly changed the upstream salt-tolerant vegetation. Further alterations to the water management system in the Pamet River came in 1952 when Route 6 was built. The 4-foot culvert quickly showed signed of inadequacy, though it still remains today.[1]

[1]Portnoy, 2002, p. 3.

(continued on page T6)

(continued from page T5)

Restrictions of the Pamet River by:

Truro Center Road/Route 6A (Wilder Dike)

Site TR-3

and

Route 6

Site TR-4

The Pamet River channel is approximately 20 feet wide seaward of Wilder Dike and 30 feet wide upstream of Route 6. Visual indicators of a restriction at site TR-3 and TR-4 include minor bank erosion. *Phragmites* growth is significant seaward of site TR-3. *Phragmites* and cattails dominate the marsh area between TR-3 and TR-4, delineated as 2.55 acres of shrub swamp.

Site TR-3
- Restriction width – 3 feet (with clapper valve)
- Restriction length – 60 feet
- Upstream salt marsh – none

Site TR-4
- Restriction width – 4 feet
- Restriction length – 375 feet
- Upstream salt marsh – none

After crossing underground for approximately 375 feet the Pamet River emerges upstream of Route 6 through this 4-foot opening in the concrete headwall.

Once upstream of both restrictions the banks of the Pamet River take on a freshwater, riverine appearance.

Comments

Storm surges have overwashed the barrier dune system at Ballston Beach inundating the freshwater portion of the Pamet River system with saltwater three times in recent decades. Salt water can be retained in the upstream system for days because the large volume of overwash water can only exit the system during a low tide due to the pressure on the clapper valve and is further restricted by the size of the culvert under Route 6.[2] Because the retention of storm tides has the potential for serious disturbance of both ecological and social values in the flood plain, removal of the tidal restrictions at sites TR-3 and TR-4 is being considered.

In 1996 the Cape Cod National Seashore and the Town of Truro initiated a study, conducted by the Cape Cod Commission (CCC) and the Army Corps of Engineers (ACOE). The ACOE determined that enlarged culverts (6 by 16 feet) at Route 6 and Wilder Dike could provide sufficient cross-sectional area to allow overwash water to exit the upper Pamet in less than two days. This resizing and removal of the tide gate would also allow enough regular seawater flooding to cause salt marsh restoration through much, but not all, of the upper Pamet.[3] The CCC Water Resources Office evaluated the potential groundwater impacts associated with removal of the clapper valve at Wilder Dike (site TR-3). One primary concern of removal is the potential impact on private wells and septic systems in the upper Pamet River valley. The CCC study concluded that, with removal, the tidal ranges within the river will have minimal effect on groundwater levels in the river valley and that saltwater flow from the river into the surrounding groundwater lenses will be prevented, indicating that wells and septic systems will not be adversely impacted.[4]

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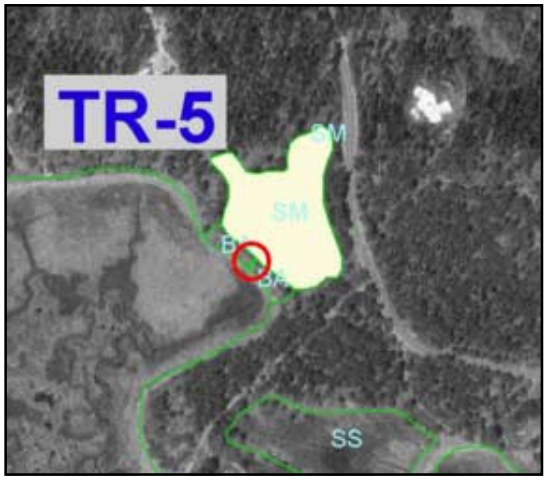
[2] ACOE, 1998, p. ii.
[3] id. pp. ii-iii.
[4] Cape Cod Commission, 1997, pp. E-2 and 36-37.

TRURO

Dirt berm crossing of unnamed channel in the Pamet Marshes

Site TR-5



Upstream Affected Area (acres): SM – 1.55.

Site Description

A contiguous 154.04 acres of salt marsh lies along the north bank of the Pamet River. A small piece of this salt marsh area (1.55 acres) is separated from the whole by a dirt berm. Access to the berm is off of Castle Road via a driveway leading to two private homes on Cat Island. Tidal flow under the dirt berm is via a 10-inch square cement culvert that appears to be encased in wooden boards. The pipe is in serious disrepair and is submerged at mean high tide. While this small salt marsh area does not support shellfish resources Pamet Harbor, which lies upstream, does and has resources that are open seasonally to shellfishing.

The small concrete, wooden-framed pipe that conveys flow under the berm is visible in the foreground. The seaward marsh area exhibits vegetation die off and major erosion.

General Information

The channel seaward of the restriction varies between approximately 5 and 15 feet. Upstream of the berm it dramatically shrinks to about 2 feet. Visual indicators of a restriction on the seaward side include major scouring and erosion, and significant vegetation die off. Upstream of the berm scouring is reduced, likely due to a lack of flow. However, major back erosion has occurred. There is no *Phragmites* present in the upstream affected area.

- Restriction width – 10 inches
- Restriction length – 35 feet
- Upstream salt marsh – 1.55 acres

Major bank erosion occurs around the upstream side of this small pipe – a 10-inch opening framed by wooden boards and a retaining wall.

TRURO

Restrictions of Pilgrim Lake by:

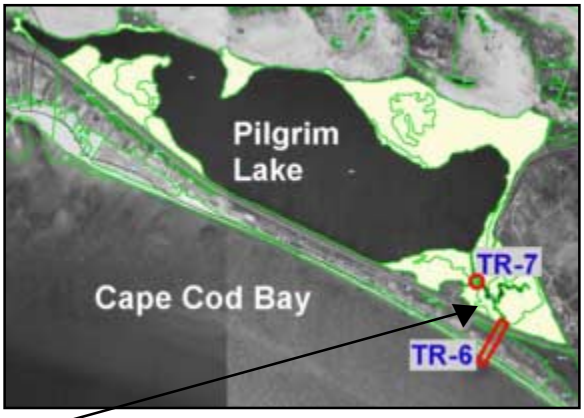
Route 6A and Route 6

Site TR-6

and

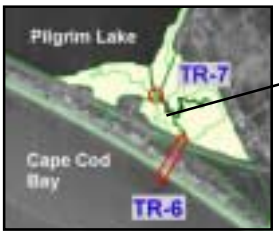
High Head Road

Site TR-7



Total Upstream Affected Area (acres): SS – 221.32: M – 100.73.

Site Descriptions



A small channel located at the southeast corner of Pilgrim Lake is the lake's only tidal connection to Cape Cod Bay. This channel and its flow are controlled by various engineering structures that serve as the lake's present water control system. There are two restriction sites between the Bay and lake. The seaward site, site TR-6, consists of a culvert with two clapper valves (located in linear series) that extends along Beach Point from Cape Cod Bay under Route 6A and Route 6. Upstream site TR-7 has a weir and box culvert constructed under High Head Road. Upstream of Pilgrim Lake are two further restrictions that affect flow into Salt Meadow/Head of the Meadow (see Appendix B, sites TR-d and TR-e). Pilgrim Lake suffers from eutrophication, and does not support any known shellfish resources. Anadromous fish use Pilgrim Lake. The lake and all upstream affected areas are within the Cape Cod National Seashore, but Truro owns and manages the channel.

General Information

The marsh area that exists between sites TR-6 and TR-7 was delineated by the Wetlands Conservancy Program as shallow marsh and shrub swamp. When observed during fieldwork a dominant monoculture of *Phragmites* with scattered shrubs was visible. Upstream of site TR-7 the vegetation changes to also include cattails. Other usual visual indicators of a restriction are not present at either TR-6 (upstream) or TR-7, such as scour, erosion, and vegetation die off. The 3-foot opening in the headwall on the upstream side of TR-6 was submerged, though measurable through the water. Dead reeds and other debris were collecting at this opening. The weir, located on the upstream side of TR-7, was submerged and not visible through the murky water. The water-tight stoplogs are not in place today, however the lake does not drain.

(continued on page T9)

Set far below the roadway of Route 6, this concrete headwall marks the upstream opening of the pipe conveying flow from Cape Cod Bay all the way under Routes 6A and 6 – crossing length estimated at one-eight of a mile. The pipes' opening is submerged beneath stagnant water and obscured by dead reeds.

A weir controlling the flow under High Head Road is protected from possible vandalism by this chain link fence.

(continued from page T8)

Restrictions of Pilgrim Lake by:

Route 6A and Route 6

Site TR-6

and

High Head Road

Site TR-7

These photos reveal the monoculture of Phragmites that grows in the affected marsh area upstream of site TR-6 (photo on left) and seaward of High Head Road and site TR-7 (photo on right).

Site TR-6

- Restriction width – seaward is inaccessible; upstream is 3 feet (two tide gates)
- Restriction length – one-eight of a mile (approximate)
- Upstream salt marsh – none

Site TR-7

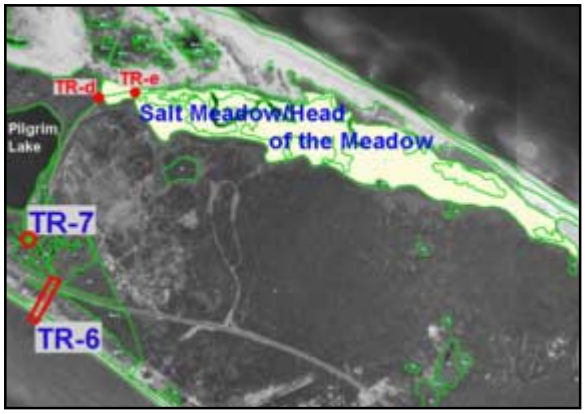
- Restriction width – 10 feet (weir with water-tight stoplogs)
- Restriction length – 30 feet
- Upstream salt marsh – none

Comments

Pilgrim Lake was historically not a lake, but an embayment called East Harbor that was connected to Cape Cod Bay by a tidal inlet. It was deep enough to serve as the winter quarters for the Provincetown fishing fleet. However, in 1868 the embayment was effectively cut off from tidal flow and Pilgrim Lake was formed when a dike was constructed across the inlet.[1]

In 1956 the state installed the lake's present water control system – the culvert with two clapper valves (site TR-6) and the upstream weir and box culvert (site TR-7). The Cape Cod National Seashore is faced with an enormous management issue regarding Pilgrim Lake – while the Seashore has responsibility for the lake and its associated wetland areas, they do not have control over the inlet and tidal flow.

From the northeast corner of Pilgrim Lake a channel flows into a wetland area known as Salt Meadow, or Head of the Meadow. As was the lake, this wetland area was historically connected to tidal flow in Cape Cod Bay and was a vast intertidal salt marsh system. However, today it is comprised of 94.52 acres of shrub swamp and 50.94 acres of shallow marsh. Salt Meadow is severed by infrastructure in two places – first by the extension of High Head Road that serves as a jeep trail to the beach, and second by a dike lying to the east of the jeep trail (see Appendix B, sites TR-d and TR-e). These culverts were not accessible during fieldwork. According to the Cape Cod National Seashore, if tidal flow was restored the Pilgrim Lake system would realize most of its intertidal wetland benefits in the Salt Meadow area. Therefore, these two infrastructure crossings (identified in the image below) should be included in any remediation discussions.



Salt Meadow/Head of the Meadow Upstream Affected Area (acres): SS – 94.52; M – 50.94.

[1]Lum, 2001.

TOWN OF WELLFLEET

- Town Map
- Chart of Site Characteristics
- Sites 1 to 6

TOWN OF WELLFLEET

Location of Selected Salt Marsh Restrictions

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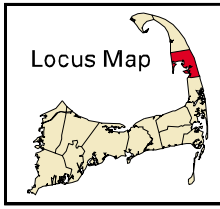
- WE–1 Restriction Site
- Wetland
- Ocean
- Pond or Lake
- CC National Seashore
- Local Road
- Major Route
- Bike Trail
- Stream

Locus Map



Miles
0 0.5 1
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Massachusetts State Plane Feet
North American Datum – 1927

Cape Cod Commission
Land Use ▪ Roads ▪ DCPCs ▪ Parcels ▪ Demographics ▪ Environmental ▪ DRIs
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2001

Town of Wellfleet – Site Characteristics

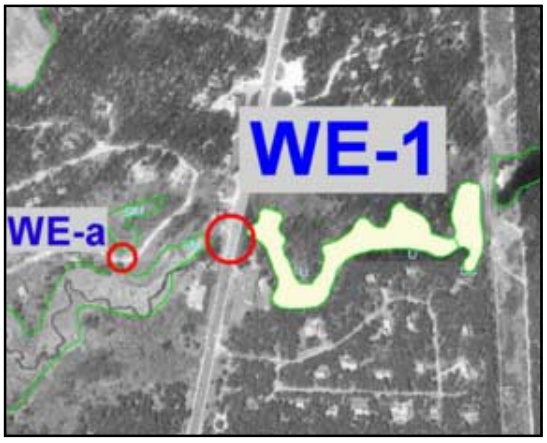
Site Number	Size of upstream affected area (salt marsh acres / total affected acres)	Is the upstream affected area contiguous to protected open space (ownership)?	Does this tidal channel support a shellfish resource area?	Is the channel or system part of an anadromous fish pathway?	Does the culvert/pipe support an engineered flood control structure?	Is the affected area or site within an ACEC boundary?	Does the affected area include Priority Habitat of Rare Species (PH) or Estimated Habitat of Rare Wildlife (WH)?	Are there any restricted sites upstream of this site (site number)?	Ownership of the site (public vs. private)
WE-1	0.0 / 3.94	YES (federal, private)	YES	NO	NO	NO	YES (PH, WH)	NO	PUBLIC
WE-2	0.55 / 0.55	NO	YES	NO	NO	NO	NO	NO	PUBLIC
WE-3	4.16 / 17.33	YES (federal, private)	YES	NO	NO	NO	YES (PH, WH)	NO[1]	PUBLIC
WE-4	0.0 / 6.69	NO	YES	NO	NO	YES	YES (PH, WH)	NO	PRIVATE
WE-5	0.0 / 19.33	YES (municipal, private)	YES	NO	YES (flapper gate)	YES	NO	NO	PUBLIC
WE-6	0.81 / approximately 1000 acres[2]	YES (municipal, state, federal)	YES	YES	YES (2 flapper gates; 1 sluice gate)	YES	YES (PH, WH)	YES[3]	PUBLIC

[1] Under the present conditions at site WE-3, upstream site WE-d is not considered tidally restrictive of salt marsh because it is adequately sized to pass the quantity of tidal flow that reaches it (see Appendix B). Should work to improve tidal flow through site WE-3 ever be undertaken, then non-tidally restricted site WE-d should be reevaluated.
[2] A recently completed study of the Herring River system stated that the diking of the Herring River has resulted in the conversion of hundreds of hectares of original inter-tidal, salt marshes (Spaulding, 2001, p.i). According to the Cape Cod National Seashore the area affected by this restriction is approximately 1000 acres (~ 400 hectares).
[3] There are several infrastructure crossings upstream of site WE-6 throughout the Herring River system. High Toss Road is the first infrastructure crossing encountered upstream of Chequessett Neck Road. Because of the nature and magnitude of the restriction at site WE-6, project staff did not attempt to collect or present information on the Herring River's upstream sites.

WELLFLEET

Route 6 restriction of Fresh Brook

Site WE-1



Upstream Affected Area (acres): SS – 0.87; M – 3.07.

Site Description

Fresh Brook flows in a westerly direction from east of Route 6 and discharges into Wellfleet Harbor. Fresh Brook travels under Route 6 for approximately 120 feet via a 2-foot (approximate) pipe set under a stone headwall. This culvert is in poor condition. The seaward opening was submerged in murky water during a low, outgoing tide cycle and obscured by a significant volume of trash and debris that collected at the Route 6 berm. Fresh Brook does support shellfish resource areas but does not act as an anadromous fish pathway. The boundary of the Wellfleet Harbor Area of Critical Environmental Concern runs parallel to Route 6 at this site and does not incorporate it or its upstream affected area.

A large quantity of debris has collected near this seaward headwall and partially blocks the pipe, which is submerged beneath the brown murky water and located just to the left of a Route 6 drainage pipe (clearly visible here to the right of the stone headwall).

General Information

Seaward of Route 6, Fresh Brook is approximately 20 feet wide, narrowing upstream to approximately 5 to 10 feet. The Wetlands Conservancy Program delineated salt marsh adjacent to the seaward side of the culvert, however within 15 yards of the Route 6 berm the vegetation observed was mainly forest-like. Upstream of the berm, shallow marsh and shrub swamp were delineated. Other visual indicators of restriction include minor scouring and major erosion both seaward and upstream of Route 6. *Phragmites* was not present on the seaward side, however once the upstream channel passes through a forested section it opens into an area with extensive *Phragmites* growth.

- Restriction width – 2 feet (approximate)
- Restriction length – 120 feet (approximate)
- Upstream salt marsh – 0.0 acres

The upstream area is forested near the Route 6 berm, however a large area of Phragmites is visible a short distance from the culvert.

Comments

Upstream of this site Fresh Brook passes under the Cape Cod Rail Trail. (The railroad right-of-way is visible to the left of the highlighted affected area in the GIS image above/to the right.) According to the Cape Cod National Seashore, the brook passes under the Rail Trail via an 8-inch culvert that is reportedly collapsed, resulting in the development of a freshwater wetland system upstream of the railroad bed. Work on this culvert will not be undertaken until the blockage of Fresh Brook by the restricted Route 6 culvert is addressed.

WELLFLEET

Route 6 restriction of unnamed channel south of Blackfish Creek

Site WE-2

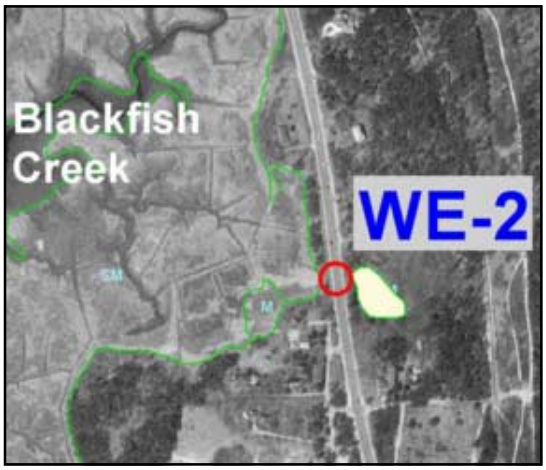
Site Description

South of Blackfish Creek and to the west of Route 6 lies an extensive salt marsh known as the Blackfish Creek Marshes. One channel traverses this marsh area to the south of Blackfish Creek and passes under Route 6 via a 2-foot concrete culvert. This restricted culvert is submerged at mean high tide and appears to be in good condition. While it does not appear to be broken, it is visibly clogged by sand and debris. Blackfish Creek, with which this unnamed channel shares its discharge area, supports productive shellfish resources and is not believed to be an active anadromous fishway. The boundary of the Wellfleet Harbor Area of Critical Environmental Concern runs parallel to Route 6 at this site and does not incorporate it or its upstream affected area.

General Information

The seaward channel is approximately 2 feet wide, narrowing to approximately 1-foot upstream. Flow appeared to be minimal in both channels. A large sand bar has formed near the upstream culvert opening. Visual indicators of restriction include minor scouring both seaward and upstream and a minor amount of vegetation die off along the seaward channel banks. The Wetlands Conservancy Program delineated salt marsh adjacent to the seaward side of Route 6 and 0.55 acres of salt marsh upstream. There was no *Phragmites* observed in the upstream affected area, however a minor amount was visible along the edge of the marsh lying seaward of Route 6.

- Restriction width – 2 feet
- Restriction length – 150 feet (estimate)
- Upstream salt marsh – 0.55 acres



Upstream Affected Area (acres): SM – 0.55.

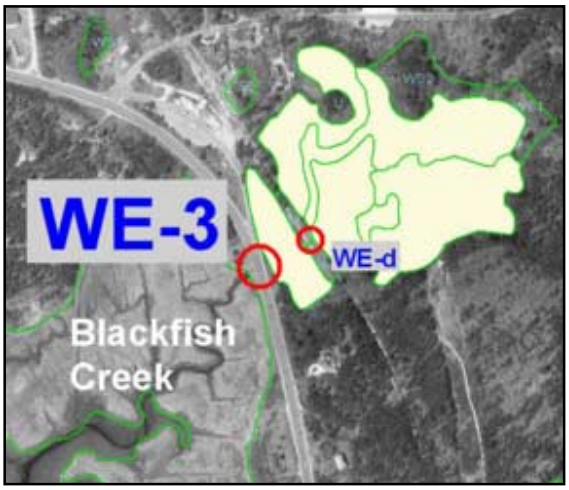
This 2-foot diameter concrete culvert passes tidal flow under Route 6, but it first must pass through the seaward channel that is clogged with dead grasses.

Upstream of Route 6, channel width is reduced to approximately 1-foot. A large sand bar has formed near this opening and silt and sand partially clog the culvert.

WELLFLEET

Route 6 restriction of Blackfish Creek

Site WE-3



Upstream Affected Area (acres): SM – 4.16; SS – 8.14; M – 5.03.

Site Description

Blackfish Creek flows in a southwesterly direction from east of the Cape Cod Rail Trail, with its headwaters on lands located within the boundaries of the Cape Cod National Seashore. The creek flows under the Rail Trail (see Appendix B, site WE-d) and under Route 6, discharging into Wellfleet Harbor to the east of Drummer Cove. Blackfish Creek passes under Route 6 via a 2-foot diameter metal pipe set under a stone slab headwall. The pipe appears to be in fair condition and is not visibly clogged by debris. Blackfish Creek supports productive shellfish resources and is not believed to be an active anadromous fishway. The boundary of the Wellfleet Harbor Area of Critical Environmental Concern runs parallel to Route 6 at this site and does not incorporate it or its upstream affected area.

This stone headwall houses the 2-foot metal pipe that conveys Blackfish Creek under Route 6. Erosion of the roadway berm is seen above and around this seaward headwall.

General Information

The seaward channel is approximately 15 to 25 feet wide, narrowing upstream to approximately 5 to 10 feet. This site is severely degraded and visual indicators of a restriction were numerous. On both sides of Route 6 scouring, erosion, and vegetation die off are major. Marsh slumping is major on the seaward side and minor within the upstream affected area. There was no *Phragmites* observed. 4.16 acres of salt marsh lie upstream of this site, with 1.96 acres found between Route 6 and upstream site WE-d and 2.20 acres upstream of site WE-d.

- Restriction width – 2 feet
- Restriction length – 125 feet (estimate)
- Upstream salt marsh – 4.16 acres

(continued on page W6)

continued from page W5

Route 6 restriction of Blackfish Creek

Site WE-3

Comments

Under the present conditions at site WE-3, upstream site WE-d is not considered tidally restrictive of salt marsh (see Appendix B) because it is adequately sized to pass the quantity of tidal flow that reaches it. Should work to improve tidal flow through site WE-3 ever be undertaken, then the size of the opening of WE-d should be reevaluated. It is likely that the two, 4-foot culverts that are in place would be adequate.

When standing on Route 6, looking into the 1.96 acres of salt marsh that lie between it and the Rail Trail, the view is dominated by these badly degraded channel banks and marsh surface. Circled in the rear of this photo are the 2 culverts (site WE-d) that pass the flow of Blackfish Creek under the trail.

Looking from the culvert into the seaward salt marsh area several visual indicators of a restriction dominate the view, including vegetation die off, scouring, erosion, and marsh slumping.

WELLFLEET

Earthen dike restriction of channel within the Indian Neck Marshes

Site WE-4

Site Descriptions

The Indian Neck Marshes lie to the south of Pilgrim Spring Road and to the east of Indian Neck. At the northern side of that marsh area an earthen dike segregates 6.69 acres of shrub swamp from the extensive salt marsh on the dike's seaward side. This site and its upstream affected area are within the Wellfleet Harbor Area of Critical Environmental Concern. Tidal flow passes under the dike via a 1-foot diameter corrugated metal pipe, which is in fair condition. A segment of pipe on the seaward side, which was exposed through erosion, has broken off and a large piece sits in the channel bed. Visual indicators suggest that the seaward opening is submerged at mean high tide. The upstream side appears to have a culvert invert problem, which would limit tidal flushing. The dike itself is severely eroding. Shellfish resources are present in the Indian Neck Marshes.

General Information

Both the seaward and upstream channels are approximately 2 feet wide. Visual indicators of restriction include significant scouring and erosion both seaward and upstream of the dike, with conditions slightly more degraded on the upstream side. The vegetation change is dramatic when crossing the dike – changing from seaward salt marsh to upstream shrub swamp with significant *Phragmites* growth.

- Restriction width – 1 foot
- Restriction length – 30 feet
- Upstream salt marsh – 0 acres

Upstream Affected Area (acres): SS – 6.69.

The vegetation changes dramatically from the seaward side (left), where salt marsh dominates the view, to the upstream side (right), where shrub swamp and Phragmites dominate the view.

This 1-foot pipe passes tidal flow through the berm, which has suffered from major erosion on this upstream side. This pipe appears to be set too high in the dike to pass the full tidal range.

WELLFLEET

Commercial Street restriction of Mayo Creek

Site WE-5

Site Description

Mayo Creek flows southeasterly from north of Chequessett Neck Road, under Commercial Street discharging into Duck Creek Harbor. The discharge pipe is located under the Commercial Street berm just north of the parking area on Shirtail Point and the town pier. Mayo Creek flows under Commercial Street for 90 feet via a 30-inch diameter corrugated metal pipe. A flapper gate on the seaward opening prevents tidal flow from entering the Mayo Creek system. The seaward opening is submerged at mean high tide. The upstream opening was submerged during a low, outgoing tide cycle and was buried by a pile of dead reeds. Duck Creek supports shellfish resources that are subject to seasonal closures. This site and its upstream affected area are within the Wellfleet Harbor Area of Critical Environmental Concern.

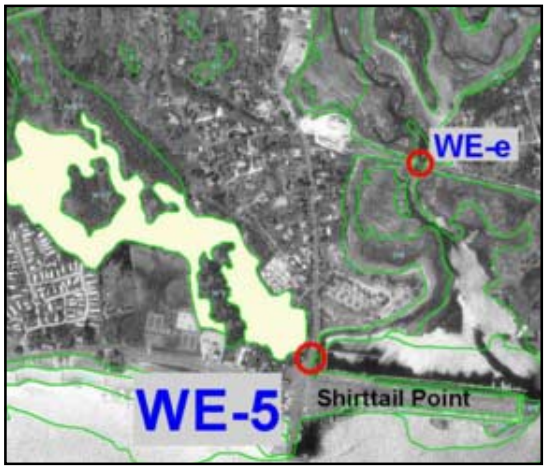
General Information

Mayo Creek is approximately 10 feet wide upstream of Commercial Street. Visual indicators of a restriction include the flapper gate on the seaward opening and significant scouring and erosion near the upstream opening. The portion of Commercial Street that abuts Duck Creek Harbor is armored by large boulders – therefore no scouring or erosion were visible near the seaward pipe opening. *Phragmites* dominated the upstream affected area.

- Restriction width – 30 inches (flapper gate)
- Restriction length – 90 feet
- Upstream salt marsh – 0 acres

Comments

The upstream affected area, as defined by this Atlas, totals 19.33 acres of shallow marsh. Note however that the affected floodplain extends upstream of Chequesset Neck Road onto Wellfleet Conservation Trust land.



Upstream Affected Area (acres): M – 19.33.

When standing on Commercial Street above the culvert, the view is of town pier and Duck Creek Harbor. The tide gate and pipe are visible in the foreground below the rock wall.

Phragmites dominates the upstream affected area. Dead reeds and debris have collected near the upstream opening, obscuring the pipe from view.

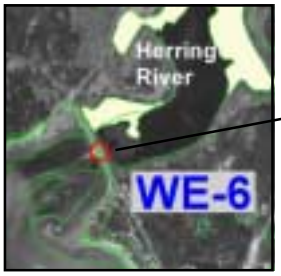
WELLFLEET

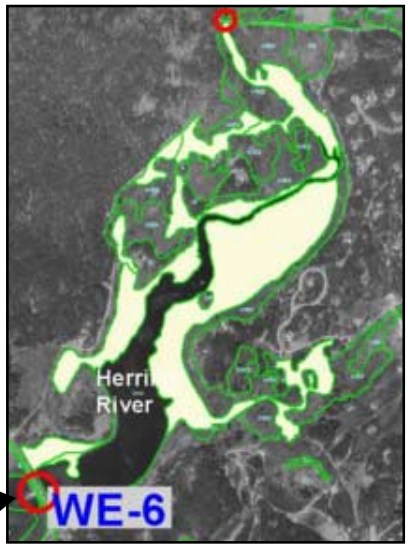
Chequessett Neck Road restriction of the Herring River

Site WE-6

Site Descriptions

In 1908 a dike, now supporting Chequessett Neck Road, was constructed across the entrance to the Herring River and its associated marsh system. Three box culverts measuring 6, 7, and 7 feet wide, were placed to enable limited salt and fresh water exchange between the river and harbor. The two 7-foot culverts have flapper-type tidal gates and the 6-foot culvert supports an adjustable sluice gate. Historically, the Herring River and its upstream river systems were directly connected to tidal flow in Cape Cod Bay at both Duck Harbor and Bound Brook by Ryder Beach. The barrier beaches between these rivers and the Bay have since closed off and eliminated those estuaries, leaving the only option for a tidal connection at the Chequessett Neck Road dike. The Herring River and Wellfleet Harbor support vast shellfish resource areas. The Herring River is an active anadromous fishway. Both the river and its associated marsh system are located within the Wellfleet Harbor Area of Critical Environmental Concern.





This image shows the upstream affected area (as it is defined for this Atlas) between Chequessett Neck Road and High Toss Road. Note that the total affected area is approximately 1000 acres. Upstream Affected Area (acres): SM – 0.81; SS – 57.71; M – 7.07.[2]

General Information

The Wetlands Conservancy Program delineated salt marsh adjacent to the seaward side of the Herring River dike. A 0.81 acre patch was the only salt marsh delineated upstream of the dike. According to a recent study, "[t]he restriction in flow imposed by the hydraulic control structures has resulted in the conversion of hundreds of hectares of the original inter-tidal, salt marshes into upland vegetation eliminating habitat for estuarine plants and animals, including fish and shellfish. In addition it has resulted in subsidence of the wetlands."[1] Analysis showed that site WE-6 "reduced the mean tidal range from 2.53 meters in the bay to 0.56 meters in the river.

These 3 box culverts viewed from the seaward side of Chequessett Neck Road, two fitted with flapper gates and one with a sluice gate, control the exchange of salt and fresh water between the Herring River and Wellfleet Harbor.

(continued on page W10)

[1] Spaulding, 2001, p.i.

[2] Spaulding's study indicate that hundreds of hectares of the original inter-tidal, salt marshes have been affected by the restriction at site WE-6 (Spaulding, 2001, p.1).

continued from page W9

Chequessett Neck Road restriction of the Herring River

Site WE-6

This is a reduction of a factor of 4.52 in the tidal range across the dike."[3] *Phragmites* growth was significant upstream of the dike and fringed most of the visible marsh area.

- Restriction width – two 7-foot culverts with flapper gates; one 6-foot culvert with sluice gate
- Restriction length – 44 feet
- Upstream salt marsh – 0.81 acres

Looking upstream from Chequessett Neck Road a small patch of salt marsh is visible, along with Phragmites that lines the Herring River banks.

Comments

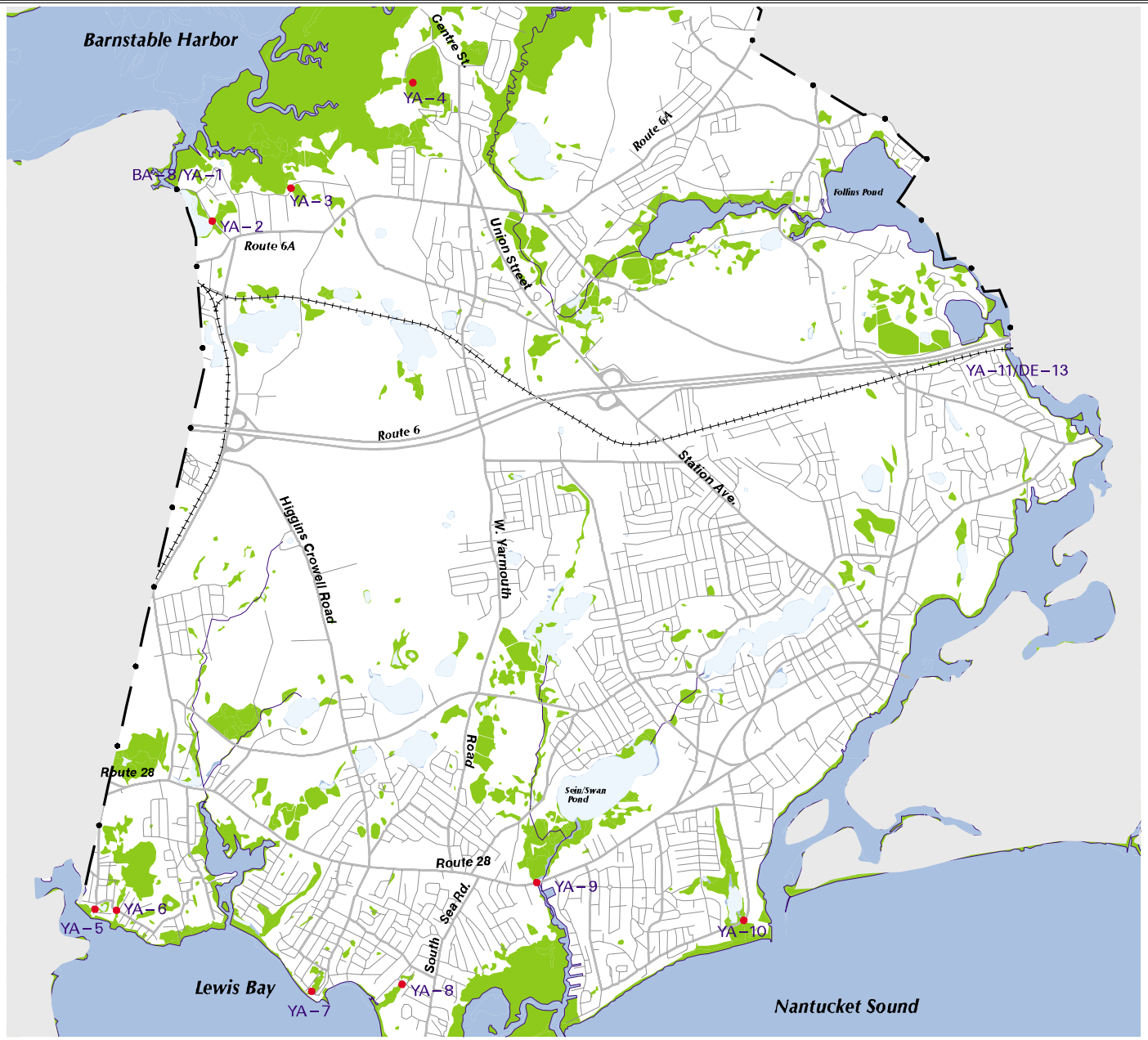
A recent study points out that "[a]lthough approximately 80% of the flood plain directly affected by [site WE-6] is within Cape Cod National Seashore boundaries, and nearly all of this land is federally owned, two homes, a golf course, and the dike at the entrance to the system are outside National Park Service's control."[4] This fact presents serious, though hopefully not insurmountable, management issues for the Herring River system.

Restoration of the Herring River's natural free-flowing system has been discussed for years. The most recent study done on this system concluded that, "[r]estoration of pre-existing conditions in Herring River, defined as similar tidal ranges up and downstream of the dike, will require increasing the width of the opening to at least 30 meters."[5] According to the National Seashore, a 30-meter opening could equate to approximately 600 acres of potentially restored area.

[3] Spaulding, 2001, p.i.
[4] id., p.1.
[5] id., p.42.

TOWN OF YARMOUTH

- Town Map
- Chart of Site Characteristics
- Sites 1 to 11



TOWN OF YARMOUTH

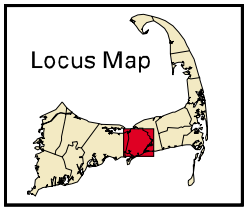
Location of Selected Salt Marsh Restrictions

This map was produced by the Cape Cod Commission Geographic Information System office, with digital data from MassGIS and the Cape Cod Commission, 2001.

The information depicted on this map is for planning purposes only. It is not adequate for legal boundary definition, regulatory interpretation, or parcel level analysis.

This project was funded, in part, by the Executive Office of Environmental Affairs, Massachusetts Wetlands Restoration Program.

- YA – 1 Restriction Site
- Wetland
- Ocean
- Pond or Lake
- Local Road
- Major Route
- Stream
- Railroad



Miles
0 0.5 1
0 2,500 5,000
Massachusetts State Plane Feet
North American Datum – 1927

Land Use ▪ Roads ▪ DCPCs ▪ Parcels ▪ Demographics ▪ Environmental Data
Cape Cod Commission
GIS Services

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2001

Town of Yarmouth – Site Characteristics

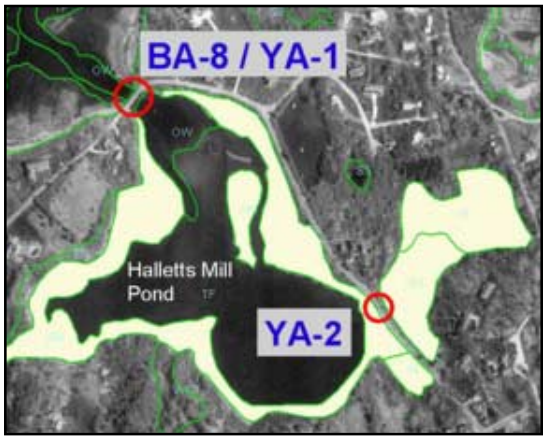
Site Number	Size of upstream affected area (salt marsh acres / total affected acres)	Is the upstream affected area contiguous to protected open space (ownership)?	Does this tidal channel support a shellfish resource area?	Is the channel or system part of an anadromous fish pathway?	Does the culvert/pipe support an engineered flood control structure?	Is the affected area or site within an ACEC boundary?	Does the affected area include Priority Habitat of Rare Species (PH) or Estimated Habitat of Rare Wildlife (WH)?	Are there any restricted sites upstream of this site (site number)?	Ownership of the site (public vs. private)
BA-8/ YA-1	15.10 / 19.20	NO	YES	NO	NO	NO	NO	YES (YA-2)	PUBLIC
YA-2	2.55 / 6.08	NO	NO	NO	NO	NO	NO	NO	PUBLIC
YA-3	2.90 / 3.92	NO	YES	NO	NO	NO	NO	NO	PUBLIC
YA-4	26.86 / 35.34	YES (municipal)	NO	NO	NO	NO	YES (PH&WH)	NO	PUBLIC
YA-5	1.06 / 1.06	YES (municipal)	YES	NO	NO	NO	YES (PH)	NO	PUBLIC
YA-6	1.38 / 1.38	YES (private)	NO	NO	NO	NO	NO	NO	PUBLIC
YA-7	2.49 / 4.37	YES (municipal)	NO	NO	NO	NO	NO	NO	PUBLIC
YA-8	0.0 / 1.06	NO	NO	NO	NO	NO	NO	NO	PUBLIC
YA-9	21.11 / 35.18	YES (municipal)	YES	YES	NO	NO	NO	NO	PUBLIC
YA-10	0.75 / 23.01	YES (municipal)	NO	NO	NO	NO	NO	NO	PUBLIC
YA-11/ DE-13	19.54 / 31.71	YES[1] (municipal)	YES	YES	NO	NO	NO	NO	PUBLIC

[1] Conservation lands are scattered along the banks of the Bass River. In total there are four parcels identified in Yarmouth and Dennis as conservation lands contiguous to the upstream affected area of site YA-11/DE-13.

BARNSTABLE/YARMOUTH

Keveney Lane/Mill Lane restriction of Mill Creek and Hallets Mill Pond

Site BA-8/YA-1



Upstream Affected Area (acres): SM – 15.10; M – 4.10.

Site Description

Mill Creek and Hallets Mill Pond form the Barnstable/Yarmouth town line. The creek flows south from Cape Cod Bay, passes under Keveney/Mill Lane, and flows into Hallets Mill Pond. A bridge spans the river in two sections that are separated by a wide stone center support, in effect acting as two box culverts measuring twelve and thirteen feet wide. The bridge is in good condition. This site lies seaward of restricted site YA-2, which is located at the upstream extent of Hallets Mill Pond. This tidal system supports a shellfish resource area.

General Information

Mill Creek, which is approximately 150 feet wide, must pass through the two openings of the bridge that together total 25 feet. Water is detained upstream of the bridge in Hallets Mill Pond due to an obvious rise in elevation from the seaward to upstream streambed caused by rocks built up under the bridge. Near the bridge, the banks of the pond exhibit visual signs of tidal restriction including minor scour and significant bank erosion, however because much of the bank is armored by rock walls visual indicators are not reliable.

- Restriction width – 25 feet (divided into two sections)
- Restriction length – 12 feet
- Upstream salt marsh – 15.10 acres

Water is detained upstream in Hallets Mill Pond due to rocks built up in the streambed underneath the Keveny/Mill Lane Bridge.

Comments

The upstream affected area lies within both towns, therefore each would need to be involved in any restoration discussion and efforts. According to the Yarmouth Conservation Administrator, Hallets Mill Pond receives about one-third of the flow received in Barnstable Harbor.

At low tide water flows downhill out of Hallets Mill Pond and seaward via Mill Creek into Cape Cod Bay.

YARMOUTH

Mill Lane restriction of Hallets Mill Pond

Site YA-2

Site Description

A small creek flows under Mill Lane via a 2-foot diameter concrete pipe that is set in a stone headwall. This creek connects Hallets Mill Pond with upstream salt marsh and shallow marsh. Hallets Mill Pond is restricted at its mouth (see site YA-1/BA-8). The pipe itself is in good condition, it is not broken or clogged, however erosion is undermining both the seaward and upstream stone headwalls in which the pipe is set. Hallets Mill Pond supports a shellfish resource area that does not exist upstream of this site.

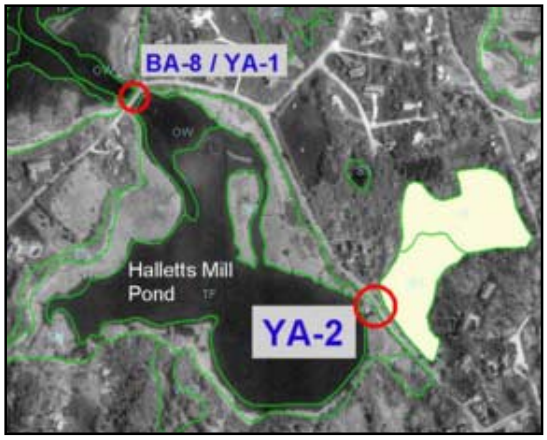
General Information

The stream channel is approximately 5 feet wide both seaward and upstream of the Mill Lane culvert and its flow is restricted as it tries to pass through the 2-foot pipe. The seaward end of the pipe is set approximately one foot above the streambed, therefore excluding early low tide flow from passing into the upstream salt marsh area. Visual signs of a restriction include scouring and erosion near both pipe openings. Growing in the rear of the upstream affected area is a significant amount of *Phragmites*.

- Restriction width – 2 feet
- Restriction length – 50 feet
- Upstream salt marsh – 2.55 acres

Comments

Because the seaward end of the pipe is set higher than the stream bed it is likely that during cycles of extremely low tides tidal waters may not rise high enough to pass upstream. The Yarmouth Conservation Administrator believes that while the upstream area is fairly well flushed it is clearly restricted. To avoid confusion, it is important to note that two streams in Yarmouth are named Mill Creek. The "other" Mill Creek is connected to Lewis Bay on the south side of town and is not tidally restrictive of salt marsh.



Upstream Affected Area (acres): SM – 2.55; M – 3.53.

This concrete pipe runs under Mill Lane — it is set high above the streambed and scouring and erosion are undermining the headwall.

Phragmites and shrubs are seen invading the upstream affected area of site YA-2.

YARMOUTH

Thacher Shore Road restriction of Short Wharf Creek

Site YA-3

Site Description

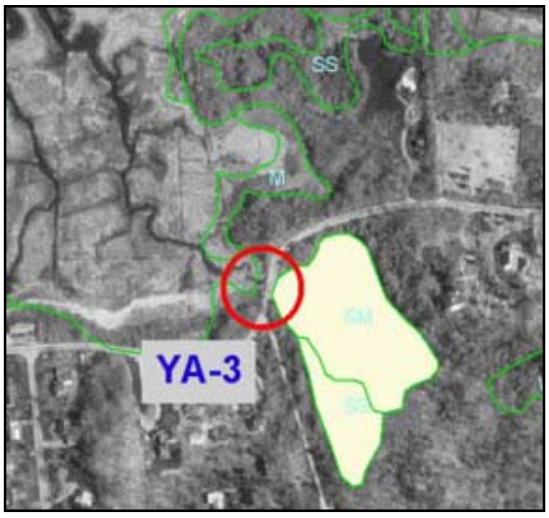
Short Wharf Creek flows southward out of Cape Cod Bay and under Thacher Shore Road in Yarmouthport. A 2-foot diameter concrete pipe, set within a rock headwall, conveys the tidal flow. The seaward headwall, apparently subject to repeated scour, is deteriorating and is significantly eroded. There are no other tidal restrictions along Short Wharf Creek, nor does the creek support an anadromous fish run. The mouth of Short Wharf Creek supports extensive shellfish beds that are closed seasonally by town ordinance.

General Information

The upstream channel is 5 feet wide narrowing to 3 feet upstream of the culvert. Minor bank erosion occurs on the upstream side, likely due to a low volume and velocity of water passing under Thacher Shore Road. The seaward side exhibits clear indications of tidal restriction including scour, bank erosion, low marsh slumping, and vegetation die back.

- Restriction width – 2 feet
- Restriction length – 50 feet (approximate)
- Upstream salt marsh – 2.90 acres

The upstream side of the Thacher Shore Road pipe is not deteriorating, likely due a low volume and velocity of tidal waters able to pass through it.



Upstream Affected Area (acres): SM – 2.90 ; SS – 1.02.

Erosion and scour are deteriorating the banks of the channel adjacent to the seaward opening of the pipe.

Comments

Cattails are present in the seaward marsh area – suggesting a natural change in salinity not associated with the restriction. While the upstream affected area is privately owned the seaward salt marsh is part of a larger area held as town conservation land. Thacher Shore Road is in need of repair, possibly presenting the town with an opportunity to appropriately resize this culvert.

YARMOUTH

Walking trail restriction of Bass Creek

Site YA-4

Site Description

Several public walking trails are located within Yarmouthport's town conservation area and specifically in the Callery-Darling Conservation Area. One such trail crosses Bass Creek. The trailhead is on Alms House Road, an unpaved road beginning at Center Street. A 4-foot diameter corrugated metal pipe conveys flow through the earthen dike on top of which the trail passes. The upstream affected area does include Priority Habitat of Rare Species and Estimated Habitat of Rare Wildlife.

General Information

Bass Creek is 10 feet wide seaward of the berm narrowing to approximately 5 feet just upstream of it. The pipe itself is in good condition (it is not cracked, broken, or clogged). However, the berm, channels, and marsh adjacent to the pipe are all severely degraded due to the undersized pipe. Visual indicators of a restriction on the seaward side include major scour, bank erosion, low marsh slumping, and vegetation die off. Major scour and bank erosion is present upstream of the pipe as well. Vegetation changes significantly from one side of the dike to the other, except for the presence of *Phragmites* that grows on both sides. Adding to the conditions at this site is an earthen dam approximately 300 feet seaward. It has breached and is now an open waterway but should be considered in any remediation work at this site.

- Restriction width – 4 feet
- Restriction length – 40 feet
- Upstream salt marsh – 26.86 acres

Severe erosion is washing away the berm around the pipe, which is not clogged allowing this clear view upstream.

Upstream Affected Area (acres): SM – 26.86; SS – 8.48.

Vegetation die off and erosion, evident at this site, are caused by scour and pooling as Bass Creek attempts to pass through this 4-foot pipe.

Scour and erosion are degrading the upstream channel while reduced tidal flow has caused a significant change in this upstream salt marsh vegetation.

Comments

Conditions are so egregious that this site appears to be the most degraded tidal restriction in Yarmouth as well as exhibiting amongst the worst erosion and scour observed at tidal restriction sites Cape-wide. This walking trail is a dedicated Cape Cod Pathway, as well as an integral link in a north to south trail route presently being developed by the Town.

YARMOUTH

Bayview Street restriction of unnamed channel into salt pond

Site YA-5

Upstream Affected Area (acres): SM – 1.06.

Site Description

Off of Lewis Bay at the entrance to the Hyannis Inner Harbor, a small channel winds around the backside of the sand of Bay View Beach. This seaward channel ends abruptly at a headwall where it goes underground prior to reaching the roadway itself. Flow passes through an 18-inch concrete pipe set in a concrete headwall. The pipe is in fair condition, however the headwall serves as a collection point for silt and debris. This channel system does not support anadromous fish. The inner harbor does support shellfish, though none lie adjacent to the mouth of this channel. Shellfishing is prohibited in the inner harbor.

The seaward channel winds from Lewis Bay and across Bay View Beach to end abruptly at this concrete headwall. Trash and silt collect near the opening.

General Information

The seaward channel is approximately 10 feet wide, narrowing to approximately 3 feet upstream of the road. The total length of the crossing was measured at 210 feet. There is little to no vegetation seaward, only some sparse beach grass, as the channel runs through area delineated as beach. Significant scour scarred the sandy channel where flow is detained by the headwall and 18-inch pipe. Upstream of Bayview Street a 3-foot channel flows for approximately 50 yards before opening into a salt pond. The channel banks and edges of the salt pond are dominated by *Phragmites*. Low-lying development surrounds the salt pond and upstream affected salt marsh. The salt pond suffers seasonally from extensive algae blooms.

- Restriction width – 18 inches
- Restriction length – 210 feet
- Upstream salt marsh – 1.06 acres

Phragmites lines the upstream channel that flows into the salt pond, seen here in the distance.

Comments

An abandoned restaurant, The Captain's Chair, sits on Bayview Street adjacent to the upstream affected area. Local permitting has been obtained for a project involving the demolition of this building, construction of an elevated two-family house, and vegetation work intending to remove *Phragmites*.

YARMOUTH

Park Avenue restriction of unnamed creek

Site YA-6

Site Description

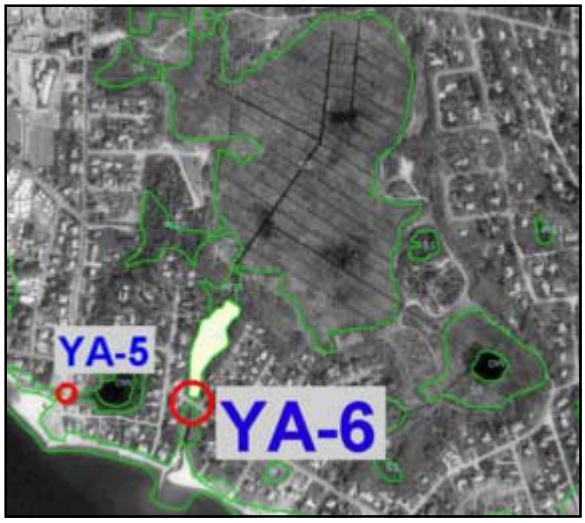
In the southwest corner of Yarmouth, near Hyannis, an unnamed creek flows between Lewis Bay and the inactive Bayview Cranberry Bogs owned by the Cape Cod Hospital. The creek passes under Park Avenue via a 3.5-foot concrete pipe set within a concrete headwall. Both are generally in good condition however the pipe is clogged with silt and debris. This site lies about 50 yards upstream of the Lewis Bay shoreline.

General Information

The seaward channel is 6 feet wide narrowing to 3 feet just upstream of Park Avenue. There is a significant change in vegetation observed from the seaward to upstream sides with *Phragmites* covering a large portion of the upstream affected area. Aside from the change in vegetation and channel width, there are no other visual indicators of a restriction.

- Restriction width – 3.5 feet
- Restriction length – 45 feet
- Upstream salt marsh – 1.38 acres

Although delineated as salt marsh, Phragmites has a significant presence in this upstream affected area.



Upstream Affected Area (acres): SM – 1.38.

Roadway runoff is directed to the channel at the seaward opening of the pipe under Park Avenue.

Comments

The Bayview Bogs are no longer in production. The Cape Cod Hospital was ordered by the U.S. Environmental Protection Agency to cease cranberry bog operations and restore the area to freshwater habitat. The bogs were delineated by the Wetlands Conservancy Program as 34.21 acres of shrub swamp.

YARMOUTH

Shore Road restriction of an unnamed channel (Connecticut Avenue)

Site YA-7

Site Description

In the Englewood neighborhood of Yarmouth, Shore Road parallels the shoreline of Lewis Bay. A 1-foot concrete pipe, approximately 170 feet long, connects Lewis Bay with a salt marsh upstream of the road. On a street map, it appears that Connecticut Avenue runs through this marsh, lying between New Hampshire Avenue and Vermont Avenue. However, Connecticut Avenue is a paper street only – the tidal channel runs where Connecticut Avenue would be. The pipe is in immediate need of repair. It is consistently clogged by the shifting sands of the beach and, at the time fieldwork was conducted, was blocked by a cave-in of roadway and culvert structural material. Lewis Bay does support vast shellfish resources, and some lie at the mouth of this channel.

General Information

The seaward pipe opening lies within the tidal range of Lewis Bay and is inundated by daily high tides and sand. The Cape Cod Mosquito Control Office performs constant maintenance at the site to dig it out of the sand. The upstream channel is approximately 5 feet wide and runs through the delineated salt marsh that is contained by low-lying development. Shrubs appear to be taking hold in the vegetation. No *Phragmites* was visible. At the time fieldwork was conducted, the area around the upstream pipe opening, and part of Shore Road, were flooded. According to an on-site Mosquito Control officer the culvert had been filled in with gravel.

- Restriction width – 1 foot
- Restriction length – 170 feet
- Upstream salt marsh – 2.49 acres

The upstream opening of this culvert is clogged by the crumbling roadway and culvert structure causing Shore Road to flood under normal conditions.

Upstream Affected Area (acres): SM – 2.49; SS – 1.88.

This hole was just dug in the sand to expose the 1-foot seaward opening of the pipe.

The hole in the sand marks the pipe's outlet, seen here at low tide, showing its relationship to Lewis Bay – obviously the pipe is regularly submerged at high tide.

Comments

According to the Yarmouth Director of Natural Resources, elevation of Shore Road may be necessary in order to alleviate flooding and reset the seaward pipe opening.

YARMOUTH

Lewis Bay Road restriction of unnamed creek

Site YA-8

Site Description

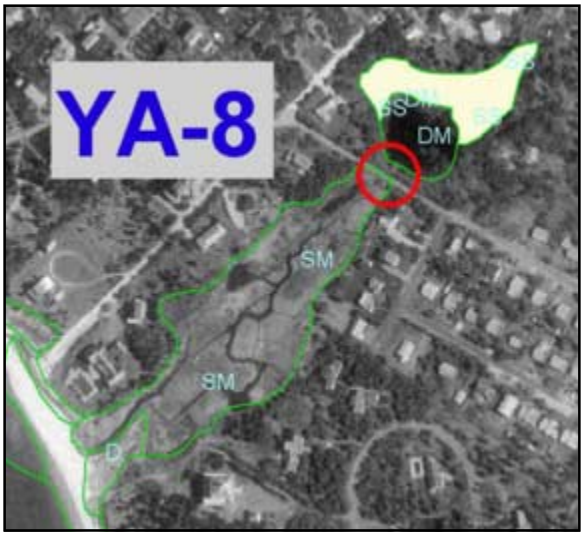
In the Englewood section of Yarmouth, an unnamed stream flows north from Lewis Bay, crossing under an unpaved section of Lewis Bay Road via a 1-foot diameter concrete pipe. The pipe is in poor condition; the seaward opening is partially buried while the upstream opening is totally buried by silt and muck. There are no other tidal restrictions along this small creek and it does not support anadromous fish. Lewis Bay supports vast shellfish resources.

General Information

The stream channel remains a consistent 2 feet both seaward and upstream of the restriction – possibly caused by dredging for mosquito control. Minor scour and bank erosion scar the seaward channel and minor erosion is visible upstream. *Phragmites* has taken over as the dominant vegetation type adjacent to the seaward opening and in the majority of the upstream affected area.

- Restriction width – 1 foot
- Restriction length – 45 feet
- Upstream salt marsh – 0 acres

Phragmites visibly dominates the upstream affected area.



Upstream Affected Area (acres): SS – 1.06.

The seaward opening of the pipe (visible here) is submerged and partially blocked by silt; Phragmites invades the area around its opening.

Comments

As this Atlas was being created, this culvert collapsed, completely blocking flow and causing flooding in the upstream area. Reconstruction of this culvert is planned with the goal of resizing the culvert in order to properly restore the tidal prism as well as control flooding upstream

YARMOUTH

Route 28 restriction of Parker's River

Site YA-9

Upstream Affected Area (acres): SM – 21.11; SS – 14.07.

Site Description

The Parker's River flows through West Yarmouth connecting Seine Pond and Long Pond with Nantucket Sound. South of Seine Pond Route 28 crosses the river, which flows under the road through an 18-foot wide stone and concrete bridge. The bridge is in good condition. Parker's River supports an active anadromous and catadromous fish run and shellfish resource area.

General Information

The main river channel is approximately 50 feet wide both seaward and upstream of the bridge. Seaward of the bridge scour and erosion are not visible because the banks are heavily armored by large boulders and concrete. Upstream of the bridge, just beyond the armoring, major scouring has formed a large pool where water collects on an outgoing tide before it can flow through the undersized bridge span. In the upstream salt marsh area minor bank erosion and vegetation die off were also observed. There is a minor amount of *Phragmites* growing along the fringes of the upstream salt marsh area, but not adjacent to the bridge itself.

- Restriction width – 18 feet
- Restriction length – 25 feet
- Upstream salt marsh – 21.11 acres

Water moves swiftly on the outgoing tide as the river squeezes itself through the undersized bridge span.

Comments

A public observation deck and fishing platform is located on the upstream side of the Route 28 bridge. Signs are posted indicating that this area is a stripped bass fishery. Parker's River is also negatively impacted by large amounts of stormwater flow that is dumped into it. Stormwater from approximately two miles of Route 28 is conveyed via a trunk line to direct outflows near this bridge.

View into the upstream salt marsh along Parker's River as it meanders north to Seine Pond.

YARMOUTH

South Shore Drive and Bass River Beach restriction of Crowell (Run) Pond

Site YA-10

Site Description

Crowell Pond connects to Nantucket Sound at the mouth of the Bass River via an 830-foot pipe. The pipe varies in width from a 4-foot seaward opening to a 33-inch upstream opening. The seaward opening is next to the public boat ramp at Bass River Beach. The pipe then runs under the Bass River Beach parking lot and South Shore Drive and opens into a small channel. Historically, what is now this 830-foot pipe was once an open, free-flowing stream. In the early 1900's Crowell Pond supported both anadromous fish and shellfish resources however, today neither is found in the pond or surrounding wetlands.

Upstream Affected Area (acres): SM – 0.75; M – 12.77; SS – 9.49.

General Information

The upstream channel is approximately 20 feet wide and 100 feet long, opening into Crowell Pond. During the field investigation the pond was matted with algae (according to local officials this is a serious, persistent problem). There was neither scour nor erosion observed near the upstream opening and channel banks. The upstream pipe is a corrugated plastic pipe set within concrete head and wing walls. *Phragmites* dominated the vegetation near the upstream opening and was scattered along the banks of the pond. On the seaward side a concrete and pebble conglomerate pipe with a 4-foot opening is set in the rock revetment supporting the Bass River Beach coastal dune at the mouth of the Bass River. Evidenced by the high water marks, this opening is fully submerged at high tide.

- Restriction width – 4 feet (seaward); 33 inches (upstream)
- Restriction length – 830 feet
- Upstream salt marsh – 0.75 acres

(continued on page Y13)

This 4-foot pipe conveys flow for 830 feet eventually opening into a short channel flowing into Crowell Pond. The tide gauge was installed for preliminary remediation studies.

continued from page Y12

South Shore Drive and Bass River Beach restriction of Crowell (Run) Pond

Site YA-10

Comments

In 1999, Yarmouth officials requested assistance from the Army Corp of Engineers to review this site for potential remediation. To date preliminary studies have been undertaken, which suggest that two 5 by10-foot culverts would restore natural tidal flow between Crowell Pond and the Bass River/Nantucket Sound. However, low-lying development in the upstream affected area now makes total flow restoration impossible. Further studies are needed and will be conducted over the next several years to develop a restoration plan that will improve the rate and quantity of flushing while eliminating the flood hazard to low-lying, developed properties.

View of the upstream 33-inch opening, with head and wing walls, near Crowell Pond.

Attempts by the town to decrease algae occurring in Crowell Pond include use of this windmill to aerate the water – over the past 3 years it has resulted in some benefits.

YARMOUTH/DENNIS

Penn Central Railroad bridge and Route 6 restrictions of Bass River

Site YA-11/DE-13

Site Description

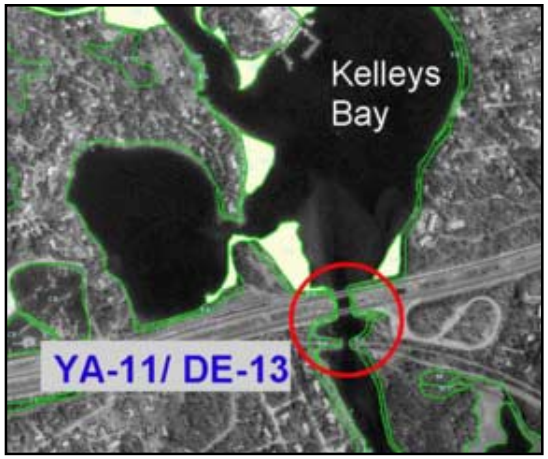
The Bass River forms the boundary between Yarmouth and Dennis. There are four locations where infrastructure crosses the Bass River including (listed from seaward to upstream) Route 28 and Highbank Road, the Penn Central Railroad, and Route 6. Yarmouth, Dennis, the railroad, and the Massachusetts Highway Department each have responsibility for some of this infrastructure. The Bass River supports an important shellfish resource area as well as anadromous and catadromous fish pathways. Follins Pond supports the largest white perch fishery in Yarmouth and productive commercial shellfishing, whose use is classified as conditional, hinging upon rainfall.

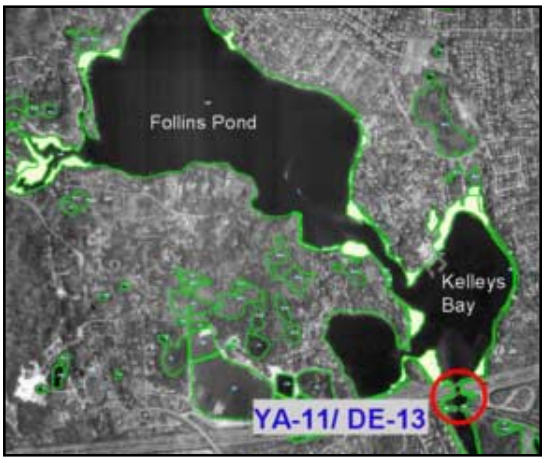
This site actually encompasses two distinct infrastructure crossings that are situated approximately 200 feet apart. Coastal bank, but not wetlands, exist between them. Approximately 200 feet south of the Mid-Cape Highway (Route 6) the Penn Central railroad bed crosses the Bass River. Berms were constructed out into the river leaving only 63 feet open to accommodate flow. Just upstream, two bridges support the four lanes of Route 6 as it crosses the Bass River. Measurements could not be taken on Route 6.

General Information

These crossings cause the river to take on a double hour-glass shape, with a large pool between the two restrictions. The river channel seaward of the railroad bridge was estimated to be between 150 and 200 feet wide – or approximately 2 to 3 times wider than the bridge span. Upstream of the Route 6 bridges the river becomes a series of interconnected bays and ponds collectively known as the Upper Bass River, a condition that made it hard to estimate the upstream width of the river. Scour was observed on

(continued on page Y15)





Upstream Affected Area (acres): SM – 19.54; M – 10.35; SS – 1.82.

The bridges of Route 6 crossing the Bass River as seen from the top of the railroad bed.

continued from page Y14

Penn Central Railroad bridge and Route 6 restrictions of Bass River

Site YA-11/DE-13

the riverbanks both seaward and upstream of the railroad bridge. No *Phragmite*s was visible in the vicinity of this site. This site was included in this Atlas even though salt marsh is not contiguous to its seaward side. Salt marsh exists in isolated patches scattered along the Upper Bass River banks.

Railroad bridge:
- Restriction width - 63 feet
- Restriction length - 50 feet (approximate)
- Upstream salt marsh - 19.54 acres

Route 6 bridges:
- Restriction width - inaccessible
- Restriction length - 200 feet (approximate)
- Upstream saltmarsh - 19.54 acres

The now unused railroad bed is seen restricting the Bass River, only allowing water to flow through a 63-foot opening.

Water pools between the railroad bed and Route 6 causing bank and riverbed scour.

Comments

Trains no longer use this section of the railroad track — use is terminated at the Yarmouth transfer station, 2.5 miles west of this site — however this railroad bridge is a historic structure and is slated for future use as part of the rail trail bike path.

In 1996, Aubrey Consulting, Inc. concluded that the "Upper Bass River tides become significantly distorted through the entrance to the system at the Railroad and Route 6 bridge constrictions." They also concluded that further information is required to "fully investigate the expected impact of improving the entrance channel to Upper Bass River at [site YA-11/DE-13]."

[1] Aubrey Consulting, Inc., 1996, pgs. 31-32.

APPENDICES

- References
- Appendix A:
  Salt Marsh Restriction Field Inspection Sheet (FIS)
- Appendix B:
  Infrastructure Crossings that do not Restrict Salt Marsh
- Appendix C:
  Latitude and Longitude of Identified Salt Marsh Restriction Sites
- Appendix D:
  GROWetlands Restoration Project Nomination Form
- Appendix E:
  List of Officials and Others Consulted
- Appendix F:
  Distribution List for the Final Draft Atlas (dated 11/20/01)

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Appendix A

Salt Marsh Restriction Field Inspection Sheet (FIS)

Field Inspection Sheet

Date: _____ ***Time:*** _____
Tidal Conditions: Low Mid/Low Mid Mid/High High **ALSO** Incoming Outgoing Change
***Weather*:** Sunny Partly cloudy OvercastRain

Location	
Town	
Site number	
Map Reference Number	USGS: Ortho: Arial:
Other sites seaward of this? Upstream of this?	
What is visible by photo interpretation? (use of the Wetlands Conservancy Program GIS data layer included)	
Water Body/ Stream name	
Street (in closest proximity)	
Landmark/ location description	
Prox to low-lying developed area	

Crossing Information
Length _____
(from seaward to upstream openings)
Latitude: N_____-_____-____
Longitude: W_____-_____-____

Type of restricting structure:
- ☐ Bridge: does span cross entire channel ____?
- ☐ Tide gate type: flapper / electric sluice gate / SRT
- ☐ Road: # of lanes____ width____ paved or dirt
- ☐ Railroad
- ☐ Other _____

Condition of crossing structure (bridge falling down?)*: _____

Culvert/ Pipe	**Seaward**	**Upstream**
Material		
Size of opening (pipe diameter/ box culvert height x width)		
Number		
opening submerged at mean high tide		XXXXXXX
Invert problem detected (culvert sited higher than low tide level – h2o trapped)	XXXXXXXXXX	
Condition*		
Culvert broken		
Culvert clogged with debris		

***Condition key:** **1=excellent 2=good 3=fair 4=poor 5=need immediate repair**

Channel	Seaward	Upstream
Estimated width of channel (fixed distance from opening)		

Visual Indicators**	Seaward	Upstream
Phragmites australis		
Cattails present		
Scouring Basin		
Bank Erosion		
Low marsh slumping		
Vegetation die back		
Ponded water by restriction		

***If yes, rank its presence: 1. Dominant/Major; 2. Significant; 3. Minor.*

Restriction Classification Scheme

	Seaward	Upstream	Channel size vs. Culvert/ Opening
1†			Channel width < opening width
2			Channel width = opening width
3			Channel width up to 2 times opening width
4			Channel width 2 to 5 times opening width
5			Channel width greater than 5 X opening width

†*Lowest score to more ideal conditions that would allow free flow.*

	Seaward	Upstream	Evidence of Flow Restriction/ Erosion
1✦			Unrestricted/ no pooling
2			Flow detained/ slight erosion
3			Minor pooling/ erosion present
4			Significant pooling/ significant erosion present
5			Major pooling/ major erosion present

✦*Lowest score to site that most closely resembles natural stream conditions.*

Appendix B

Infrastructure Crossings that do not Restrict Salt Marsh

The sites discussed in this Appendix are locations at which a crossing structure (i.e., culvert, pipe, or bridge) does not cause a tidal flow restriction that leads to the impairment of salt marsh habitat. These sites were given the acronym NTR (for *non-tidally-restrictive* of salt marsh). Inclusion below should not correlate to the conclusion that tidal flow is not restricted at these sites, only that these sites do not meet the criteria for inclusion as a restricted site *in this Atlas*.

The NTR sites were given a letter label for identification (a, b, c, etc.). For each NTR site below, a location description is given along with the reason why it wasn't considered a tidal restriction to salt marsh habitat. In most cases NTR designation was given because a site did not have seaward salt marsh contiguous to the crossing structure, or did not exhibit visual indicators of a restriction. Additionally sites, that ranked well on the Restriction Classification Scheme (or, closely resembled natural free-flowing conditions) were often found to be an NTR site.

Infrastructure crossings identified below may be discussed together if they are part of the same tidal channel or stream system. The locations of these NTR sites are recorded on the USGS quadrangle base maps provided to Executive Office of Environmental Affairs, Massachusetts Wetlands Restoration Program (MWRP) along with the Field Inspection Sheets.

References in this Appendix to delineated wetland types are based upon information from the Massachusetts Department of Environmental Protection, Wetlands Conservancy Program's (WCP) Wetlands Data Coverage. Abbreviations for different wetland types used in this Appendix are:

- "SM" for salt marsh
- "SS" for shrub swamp
- "M" for shallow marsh
- "WS" for wooded swamp
- "U" for upland

TOWN OF BARNSTABLE

BA-a
- Route 6A crossing of Smith Creek in West Barnstable.
- WCP delineated U on the seaward side of this culvert and WS upstream of Route 6A.

BA-b
- Route 6A crossing of tributary to Boat Cove Creek (between the intersections of Maple and Willow Street with Route 6A).

- WCP delineated M to the seaward side of the culvert.
- Boat Cove Creek supports an anadromous fish run.

BA-c
- In the village of Osterville, the road leading to Dowses Beach from East Bay Road crosses a channel that connects East Bay with Phinneys Bay.
- Two concrete culverts carry flow between the bays, each 30 inches in diameter.
- WCP did not delineate any wetland types upstream of the crossing, only open water.

BA-d
- Driveway or a private, unnamed extension off East Bay Road crossing of channel off East Bay, Osterville.
- When viewing the aerial photography there appears to be a driveway or berm crossing the marsh area behind houses on the north side of East Bay Road. No crossing was found during fieldwork.
- WCP delineated DM and SS upstream of the apparent berm and SM to its seaward side.

BA-e
- South Main Street crossing of the Bumps River, Centerville.
- Tidally restricted site BA-12 lies upstream of this bridge. Non-tidally restricted sites BA-f and BA-g lie upstream of this bridge.
- The Bumps River supports both shellfish and anadromous fish.
- WCP has delineated 56.26 acres of salt marsh, 7.48 acres of shrub swamp, and 17.59 acres of shallow marsh upstream of this crossing.
- The bridge span (100 feet long by 40 feet wide) was determined to be wide enough to enable natural free-flowing conditions.

BA-f
- Bumps River Road crossing of the Bumps River, north of Scudder Bay in Centerville.
- WCP delineated SM that ends before reaching the seaward end of the pipe. WS is delineated to the seaward opening. OW is delineated upstream of this 30-inch pipe.

BA-g
- Bumps River Road crossing of a tributary to Bumps River (approximately one-half mile west of BA-f). This tributary connects North Pond and West Pond to the Bumps River.
- WCP delineated SM that ends before reaching the seaward opening of the pipe. OW is delineated to the seaward opening. OW and M are delineated upstream of this 4-foot pipe.

BA-h
- South Main Street crossing of a tributary to Centerville River, near the public landing. This site is 0.4 miles east of NTR site BA-e.
- Houses and yards are present on the upstream side. *Phragmites* dominates the seaward side of the road. A 6-foot channel reaches the roadway.
- WCP delineated SM ending before reaching the seaward opening of the pipe.

BA-i
- Horseshoe Lane crossing of a tributary to the Centerville River.
- The upstream affected area is dominated by *Phragmites*.

- This site lies upstream of restricted site BA-13.
- WCP delineated WS to the seaward side of the culvert. The SM ends well before this culvert.

BA-j
- Driveway off the Broken Dike Way cul-de-sac crossing the Centerville River (private property).
- At the northern extent of the Centerville River (well upstream of restricted site BA-13) a 35-foot long wooden bridge set on pylons crosses the river.
- *Phragmites* dominates the vegetation both seaward and upstream of the bridge.

BA-k
- Estey Avenue crossing of stream connected the upstream affected area of tidal restriction site BA-18.
- USGS map and aerial photography show a crossing, however it could not be found during fieldwork.
- WCP delineated SM to the seaward side of Estey Avenue and OW and SS on the upstream side of the road.

BA-l
- Gosnold Road crossing of wetland between affected areas of restricted sites BA-18 and BA-19, located approximately 0.1 miles west of the Gosnold Road/Ocean Street intersection.
- According to the Barnstable Engineering Division, it is likely that historically this was an open channel that hydrologically connected the upstream affected areas of restricted site BA-18 and BA-19.
- *Phragmite*s dominates the vegetation on the south side of Gosnold Road (upper extent of salt marsh affected by BA-18).

TOWN OF BOURNE

BO-a
- The Cape Cod Bike Route and Route 6/Scenic Highway cross the Herring River at its mouth on the Cape Cod Canal. A small box culvert, a fish ladder, and a second, slightly larger box culvert connect the canal with the river upstream of Route 6.
- This watershed of the Herring River comprises the boundary of the Herring River Area of Critical Environmental Concern, supporting one of the most important anadromous fish runs in along the state's coastline.
- No SM was delineated by the WCP within this freshwater system.

TOWN OF BREWSTER

BR-a
- Route 6A crossing of Quivett Creek on the Dennis/Brewster town line.
- *Phragmites* is the dominant type of vegetation on the seaward side of 6A.
- Quivett Creek supports an anadromous fish run that must pass through this culvert.
- A concrete headwall houses a 2-foot concrete pipe that is in good condition, however it is clogged with sand and silt.
- The Wetlands Conservancy Program delineated shallow marsh seaward of this crossing.

- This site lies upstream of tidally restricted site BR-1. Should tidal flow be increased through this upstream site and salt marsh habitat restored, site BR-a may ultimately become restrictive of salt marsh.

BR-b
- Route 6A crossing of a channel extending south off of Quivett Creek, crossing 6A near its intersection with Stony Brook Road.
- A channel appeared on the USGS quadrangle map, however upon field investigation none was found.
- Salt marsh does not extend to the seaward side of this crossing.

BR-c
- Route 6A crossing of a channel extending south off of Quivett Creek, crossing 6A near its intersection with Newcomb Road.
- A channel appeared on the USGS quadrangle map, however upon field investigation non was found.
- Salt marsh does not extend to the seaward side of this crossing.

BR-d
- Lower Road crossing of stream flowing south out of Freemans Pond.
- Restricted site BR-4 lies upstream of Freemans Pond.
- Salt marsh does not extend to the seaward side of this crossing.

TOWN OF CHATHAM

CH-a
- Bridge Street crossing of the Mitchell River.
- The bridge is a 190-feet long and 36-feet wide and is supported on wooden pylons in the riverbed.
- There were no visual indicators of a restriction.
- The WCP delineated SM along the banks of the entire upstream area.

CH-b
- Morris Island Road crossing of channel from Stage Harbor into Toms Neck area.
- According to the Director of the Water Quality Laboratory, this site is not restrictive of salt marsh.
- The box culvert-type structure is constructed to accommodate the placement of water-tight stoplogs. The large stoplogs are kept handy on the side of the road.
- The WCP delineated 1.35 acres of SM upstream of CH-b. Non-tidally restricted sites CH-c and CH-d lie upstream of this salt marsh.
- The structure has been slated for replacement in order to fix the problem of slumping fill clogging the channel. This is not believed to be related to tidal flow, but rather to structural deficiencies. Construction will not change the size of the structure which is believed to be sufficient.

CH-c
- Morris Island Road crossing of channel from Stage Harbor into Toms Neck area. This site

lies upstream of site CH-b and adjacent to CH-d.
- The pipe is a 16-inch metal pipe set in a concrete headwall.
- According to the Director of the Chatham Water Quality Laboratory, the upstream affected area has always been a freshwater system that typically drains from the upstream to seaward side s of Morris Island Road. Therefore any increase in the size of the existing pipe would serve to drain the upstream freshwater system.
- The upstream area is owned and managed by the Chatham Conservation Foundation.
- The WCP delineated M and SS upstream and Dune seaward of this site.

CH-d
- Morris Island Road crossing of channel from Stage Harbor into Toms Neck area. This site lies upstream of site CH-b and adjacent to CH-c.
- The pipe is a 16-inch metal pipe set in a concrete headwall.
- According to the Director of the Chatham Water Quality Laboratory, the upstream affected area has always been a freshwater system that typically drains from the upstream to seaward side s of Morris Island Road. Therefore any increase in the size of the existing pipe would serve to drain the upstream freshwater system.
- The upstream area is owned and managed by the Chatham Conservation Foundation.
- The WCP delineated M and SS upstream and Dune seaward of this site.

CH-e
- Rowland Lane crossing of channel off Frost Fish Creek. Flowing east from the mouth of the creek north of the Route 28 berm.
- According to the Director of the Water Quality Laboratory, this channel only receives flow in a storm or moon tide.
- An estimated 1-foot diameter concrete culvert conveys any flow under Rowland Lane.
- The WCP delineated 0.39 acres of SM upstream of the crossing.

CH-f
- Route 28 crossing of channel from Ryder Cove to Stillwater Pond.
- The channel serves as a herring run and is one of the most active runs in Chatham.
- A stone channel on the seaward side directs flow into a 15 inch opening. It then travels under Route 28 and emerges upstream via a 28-inch metal pipe.
- This pipe is due to be replaced and possibly resized in order to accommodate the herring run and needs of the fish.
- The WCP delineated 0.70 acres of M upstream of Route 28. However, according to local officials there is SM upstream of Route 28.

TOWN OF DENNIS

DE-a
- New Boston Road crossing of Chase Garden Creek.
- The WCP delineated shallow marsh to the seaward side of the 2-foot concrete pipe.
- Cattails dominated the vegetation seaward of the crossing.

DE-b
- Cold Storage Road crossing of unnamed channel off Sesuit Harbor leading into a wetland area.

- The WCP delineated 0.99 acres of salt marsh, 0.78 acres of shrub swamp, and 8.92 acres of shallow marsh upstream of the crossing.
- This site underwent remediation in 1999. Conditions at the site were still indicative of a restriction. However, this is due the short recovery time since reconstruction and conditions are expected to continually improve. To date, town officials have noticed a decrease in the size and density of *Phragmites*.
- This site was selected and studied by the Army Corps of Engineers in 1996.
- Currently, three 30-inch corrugated plastic pipes convey flow under Cold Storage Road.

YA-g / DE-c
- Route 28 crossing of the Bass River on the Yarmouth/Dennis town line.
- Route 28 crosses the river via a 300-foot bridge span supported on pylons in the riverbed.
- There is a significant amount of salt marsh and other wetland type that occurs along the upstream banks of Bass River.
- Non restricted site YA-h/DE-d and restricted site YA-11/DE-13 lie upstream.
- There are no visual indicators of restricted tidal flow at this location. The channel width-to-opening ratio resembles natural, free-flowing conditions.
- A review of aerial photography showed no pooling on either side of the bridge; field work confirmed this analysis.
- The Bass River supports an anadromous fish run and productive shellfish resources.

YA-h / DE-d
- Highbank Road crossing of the Bass River on the Yarmouth/Dennis town line.
- This site lies upstream of YA-g/DE-c and seaward of YA-11/ DE-13.
- The road crosses the river via a 160-foot bridge span supported on pylons in the riverbed.
- The upstream area affected by this crossing includes Priority Habitat of Rare Species and Estimated Habitat of Rare Wildlife.
- The Bass River supports an anadromous fish run and productive shellfish resources.
- Visual indicators of a tidal restriction are limited too minor scouring of the riverbanks.

DE-e
- Loring Avenue crossing of Weir Creek. Weir Creek has two tributaries – one flowing to Kelleys Pond, the other to Uncle Stephans Pond.
- This sites lies seaward of restricted sites DE-4, DE-5, and DE-6.
- In 1996 the Town replaced a 4-foot culvert with a bridge measuring 22 feet.
- According to the Dennis Department of Natural Resources, this site is no longer restrictive of salt marsh.

DE-f
- Lighthouse Road crossing of tributary from Weir Creek to Uncle Stephans Pond.
- A wood pylon and stone base bridge with a span of 28-feet conveys the flow.
- The Town rebuilt this bridge in 1999 and, according to the Department of Natural Resources, removed a previously existing tidal restriction.
- Visual indicators of a restriction are still present – scour, bank erosion and vegetation die off – however, it is likely that these are old scars still remaining from before the rebuild.

DE-g
- Upper County Road Crossing of the Swan Pond River. The crossing structure is a 68-foot bridge supported by wooden pylons.

- This site lies upstream of restricted sites DE-11 and DE-12. If remediation is done at either of these sites to increase tidal flow, then the Upper County Road bridge may then become insufficient to pass flow unrestricted.
- Work is scheduled for 2001 to include dredging near the bridge and armoring of the river channels.
- Swan Pond River supports shellfish resources and serves as an anadromous fish pathway for whitefish and perch.

TOWN OF EASTHAM

EA-a
- Bridge Road crossing of Boat Meadow Creek.
- This crossing lies within the Inner Cape Cod Bay Area of Critical Environmental Concern.
- A 57-foot open span bridge passes the creek flow under it.
- There are no visual indicators of a restriction present except for very minor scouring and erosion. The tidal flow at this crossing closely resembles natural free-flowing conditions.
- NTR site EA-b, and restricted sites OR-4/EA-3, EA-4, and EA-5 lie upstream of this crossing.

EA-b
- Earthen dike crossing of a channel within the marshes of Boat Meadow River upstream of site EA-a.
- The WCP delineated 0.73 acres of SM, as well as shallow marsh and shrub swamp upstream of the dike.
- This crossing and the upstream affected wetland area is owned by the Eastham Conservation Foundation (ECF) and lies within the Inner Cape Cod Bay Area of Critical Environmental Concern.
- According to the Eastham Director of Natural Resources, approximately nine years ago the ECF decided not maintain the dike. It has since breached.

EA-c
- Governor Prence Road crossing of Abelino's Creek.
- This is the second time the creek crosses Gov. Prence Road. It lies upstream of restricted sites EA-6, EA-7, and EA-8.
- According to the ACOE 1996 study flow passes the road via a 24-inch diameter culvert.
- The WCP delineated 2.85 acres of shallow marsh, 1.97 acres of shrub swamp, and wooded swamp upstream of this crossing site.
- According to the Eastham Director of Natural Resources tidal flow does not reach this crossing. Should remediation be undertaken at all three seaward restriction sites, then this site may need to be considered at some point.

EA-d
- Earthen dike crossing of marsh behind the Coast Guard Station Center at Coast Guard Beach.
- The WCP delineated 0.70 acres of SS upstream of the dike.
- The dike, originally constructed to support a cranberry farm, has been breached and is not approximately 13 feet wide.
- *Phragmites* does dominate the upstream affected area.

TOWN OF FALMOUTH

FA-a

- Bike path crossing of the Trunk River, tidal channel to Oyster Pond. FA-b lies upstream.
- At the time of this writing construction was underway at this site (DEQE file # SE 25-2449) to widen the rock lined channel and to construct two jetty's. A 26' wide bridge spans the 21' wide channel. The length of the crossing is 10 feet.
- Site does appear restricted but conditions are due to change post-construction.
- Oyster Pond supports a herring run.

FA-b

- Surf Drive crossing of the Trunk River as it enters Oyster Pond.
- The pipe was enlarged in 1992 to four feet.
- A concrete and water tight stop log weir was installed to control tidal flow and enable Falmouth officials to select the appropriate salinity in Oyster Pond.
- Oyster Pond and the Trunk River system have been under study for about 20 years; it is believed that Oyster Pond should be "freshened" (See ACOE Wetlands Investigation, June 1996).
- Oyster Pond supports a herring run.

FA-c

- Surf Road crossing of Fresh River to Siders Pond.
- There is no upstream salt marsh, shallow marsh, or shrub swamp.
- FA-c is a 5-foot concrete pipe with a trash grate on the seaward opening intended to keep Eel Grass from flowing into the system on a high tide.
- Both seaward and upstream channels are armored.
- The Fresh River supports a herring run into Siders Pond.
- Historically there was a clapper valve at this site to keep all tidal flow out of the system.

FA-d

- Spring Bars Road crossing of stream at north end of Little Pond.
- Site FA-d lies upstream of site FA-2 (restricted).
- Water was observed flowing seaward (into Little Pond) during an incoming tide cycle.
- The Wetlands Conservancy Program delineated Wooded Swamp (WS1) contiguous to the seaward of this site, therefore, no salt marsh is directly affected.

FA-e

- Route 28 crossing of the Dexter River (north end of Great Pond) just south of where it becomes the Coonamessett River.
- This site is upstream of restricted site FA-3.
- There is no shellfishing available in Dexter River portion of Great Pond, as the tide does not reach the head of the pond this far north. There is, however, a significant herring run that does utilize the Dexter River/Coonamessett River system.

FA-f

- Route 28 crossing at head of Green Pond. Route 28 acts as a dam, forming a Mill Pond just north of the roadway.
- This system historically supported a herring run that is no longer active. The Town of Falmouth and the Massachusetts Highway Department are currently working together to restore fish passage under Route 28, through the Mill Pond and north into Bachus Brook.
- Green Pond is tidally restricted by site FA-6.

FA-g

- Route 28 crossing at the head of Bournes Pond.
- The mouth of Bournes Pond is tidally restricted by site FA-7. Although the Wetlands Conservancy Program GIS mapping layer delineated salt marsh to the seaward side of Route 28, none was observed there.
- Wetland area delineated upstream of FA-g consists of 22.77 acres of cranberry bog.

FA-h

- Route 28 crossing at the head of the western most arm of Eel Pond, near Muriel Lane. Eel pond is an important shellfish resource in Falmouth.
- Salt marsh is not found this far upstream.

FA-i

- Route 28 crossing of Childs River, the eastern arm of the head of Eel Pond.
- The Childs River supports an anadromous fish run and is located within the Waquoit Bay Area of Critical Environmental Concern (ACEC).
- Shellfish resources are found upstream of Route 28, south of Cross Road, that are open to seasonal shellfishing.
- Salt marsh is not found this far upstream.

FA-j

- Route 28 crossing of Moonakiss River, upstream of the tidally restricted site FA-8.
- The Moonakiss River is of high concern in Falmouth because of its poor water quality.
- This site is located in the Waquoit Bay ACEC.
- Salt marsh is not found this far upstream.

FA-k / MA-a

- Meadow Neck Road (at the Falmouth-Mashpee town line) crossing of channel into Hamblin Pond.
- This channel is man-made and was installed to improve the tidal flow between Waquoit Bay and Hamblin Pond. The ponds' natural tidal entrance, the Little River, was not providing sufficient flushing for the pond when it was the only tidal connection with Waquoit Bay.
- The armored channel is 22 feet wide and the pipe is a large, corrugated metal 13-foot by 10-foot pipe.
- There was very minor scour observed near the upstream opening of the pipe.
- Hamblin Pond is a productive shellfish resource area, much of which is open year-round for harvesting.

- Two tidally restricted sites are found at the upper reaches of Hamblin Pond, MA-1 and MA-2.

FA-l / MA-b
- Cranberry bog berm crossing at the mouth of Red Brook (east of Ostrom Road, Falmouth and west of Bayshore Drive, Mashpee).
- Red Brook forms the town line between Falmouth and Mashpee.
- Cranberry bogs were created in the Red Brook just north of its confluence with Hamblin Pond.
- These bogs are no longer in production, however the berms created are still in place.
- Although salt marsh is delineated to the seaward side of this site, it is not considered a restriction in this Atlas because the berm was naturally breached allowing tidal flow to return to the bog. However, the breach may not be large enough to resemble natural free-flowing conditions for Red Brook. 2.06 acres of shallow marsh is delineated upstream of this site.

TOWN OF HARWICH

HA-a
- Channel off the Herring River terminating at the North Road roadway berm, just north of the intersection of North Road and Smith Lane (south of HA-b).
- According to local officials, there has never been a culvert under North Road at this location.
- There is a 10-foot wide channel terminating at the western side of North Road that is dominated by *Phragmites*. Because there is no flow under North Road, this marsh area is actually fed by a channel off the Herring River located upstream of non-restricted site HA-b.

HA-b
- North Road, a stone and dirt walking trail, crosses the Herring River (north of HA-a) via a 45-foot wooden board bridge supported on pylons in the riverbed.
- The Wetlands Conservancy Program delineated salt marsh both seaward and upstream of this crossing.
- The rivers' width is approximately 40 to 50 feet seaward and 50-60 feet upstream of this crossing.
- There are no visual signs of a restriction at this location, except for minor bank erosion seaward of the bridge.

HA-c
- Bells Neck Road, a public, dirt road, crosses the Herring River via a 55-foot long wooden board bridge suspended on pylons in the riverbed.
- The Wetland Conservancy Program delineated shallow marsh both seaward and upstream of this crossing.
- Cattails appear to be the dominant type of vegetation visible in both the seaward and upstream marsh areas. *Phragmites* is also dominant near the seaward side of the bridge.

HA-d
- The dam of the Great Western Reservoir at the Herring River.
- The Wetland Conservancy Program delineated shrub swamp and upland reaching to the seaward side of this crossing.
- Set in the wall of the dam there is a 3-foot spill over pipe and a fish ladder.

HA-e

- Lothrop Road crossing of Coys Brook, a tributary to the Herring River, north of the Lothrop Road crossing at restricted site HA-4.
- The Wetland Conservancy Program delineated shallow marsh to the seaward side of this crossing as well as 23.61 acres of shallow marsh and 4.47 acres of shrub swamp upstream.
- Cattails are the dominant type of vegetation visible in the seaward marsh area.

HA-f

- Lower County Road crossing of Doanes Creek at the north end of Allens Harbor, near the Allens Harbor Yacht Club marina in Harwich Port.
- Restricted site HA-5 lies upstream of this crossing.
- A 50-foot bridge span supported by wooden pylons passes tidal flow under Lower County Road into upstream salt marsh and tidal flats. The upstream channel is approximately 50 feet wide. Therefore, the channel to opening ratio is reflective of natural stream conditions.
- Visual indicators of a restriction do not occur here, except for minor bank erosion in the channel upstream of the bridge and a small amount of *Phragmites* growing on the edges of the upstream salt marsh area.
- This bridge was not considered to be a restriction by the Army Corps of Engineers (ACOE, *Cape Cod Wetlands Investigation*, June 1996, p. 85).

HA-g

- Route 28 crossing of channel north of Allens Harbor, Harwich Port.
- This crossing is upstream of restricted site HA-5 at Kildee Road.
- No salt marsh was delineated by the Wetlands Conservancy Program to the seaward side of this site.
- This site was studied by the Army Corps of Engineers (ACOE, *Cape Cod Wetlands Investigation*, June 1996). The estimated length of this crossing from the seaward side of Kildee Road to the upstream side of this site is 210 feet. Findings indicated that very little restriction was caused by either Kildee Road or this site at high tide. No further study was recommended at that time.

HA-h

- Carding Machine Brook flows under Route 28 into Saquattucket Harbor via a 4-foot concrete box culvert set below a large rock retaining wall.
- No wetland was delineated by the Wetlands Conservancy Program abutting Route 28. Salt marsh fringes the Harbor but does not extend to the seaward side of Route 28. Cranberry Bogs are delineated upstream of Route 28.

HA-i

- Route 28 crossing of unnamed stream flowing into the northeastern corner of Saquattucket Harbor.
- The Wetlands Conservancy Program delineated salt marsh along this channel south of Route 28, but it does not extend to the crossing. Shallow marsh and shrub swamp were delineated upstream.
- The seaward side of the pipe is not accessible. Upstream of Route 28 a 3-foot opening is visible within a concrete headwall that does not appear to be broken or clogged.

TOWN OF MASHPEE

MA-a/FA-k

- Meadow Neck Road (at the Falmouth-Mashpee town line) crossing of channel into Hamblin Pond.
- This channel is man-made and was installed to improve the tidal flow between Waquoit Bay and Hamblin Pond. The ponds' natural tidal entrance, the Little River, was not providing sufficient flushing for the pond when it was the only tidal connection with Waquoit Bay.
- The armored channel is 22 feet wide and the pipe is a large, corrugated metal 13-foot by 10-foot pipe.
- There was very minor scour observed near the upstream opening of the pipe.
- Hamblin Pond is a productive shellfish resource area, much of which is open year-round for harvesting.
- Two tidally restricted sites are found at the upper reaches of Hamblin Pond, MA-1 and MA-2.

MA-b/FA-l

- Cranberry bog berm crossing at the mouth of Red Brook (east of Ostrom Road, Falmouth and west of Bayshore Drive, Mashpee).
- Red Brook forms the town line between Falmouth and Mashpee.
- Cranberry bogs were created in the Red Brook just north of its confluence with Hamblin Pond.
- These bogs are no longer in production, however the berms created are still in place.
- Although salt marsh is delineated to the seaward side of this site, it is not considered a restriction in this Atlas because the berm was naturally breached allowing tidal flow to return to the bog. However, the breach may not be large enough to resemble natural free-flowing conditions for Red Brook. 2.06 acres of shallow marsh is delineated upstream of this site.

MA-c

- Crossing of channel off of Jehu Pond.
- Private resident access only – fieldwork could not be done at this site.
- According to the Mashpee Harbormaster, tidal access may have been restricted to salt marsh during construction of the town homes that now exist.
- The WCP delineates affected area as 3.43 acres of shallow marsh (M) and 2.99 acres of shrub swamp (SS).

MA-d

- Access road (Great Oak Road) to parking area for the South Cape Beach State Park crossing of unnamed tidal channel.
- The road and Park are owned and managed by the Massachusetts Department of Environmental Management.
- A 20-inch clay pipe passes under the access road enabling flow to move between Sage Lot Pond and Flat Pond.
- This site lies upstream of restricted sites MA-4 and MA-5.
- The WCP delineated upland on both side of this access road.
- No salt marsh exists upstream of MA-d, but the wetland system does continue and is delineated by the WCP as 27.24 acres of shallow marsh.
- This site is not restrictive of salt marsh, though flow is certainly restricted by the undersized culvert.

MA-e

- Popponesset Island Road crossing Popponesset Creek and connecting with the northern end of Popponesset Island.
- Tidal flow is heavy into Popponesset Creek around the southern tip of the island.
- Local officials believe that the bridge itself is not restricting tidal flow.
- The area near the bridge is very shallow; with low tide water depth at approximately six inches.
- The land on the western shore of the island and western shore of Popponesset Creek now supports 6.97 acres of salt marsh scattered in seven small patches. According to local officials this is a fraction of what existed historically; much of the area was filled to enable housing development.

TOWN OF ORLEANS

OR-a

- Private driveway crossing of channel off Rachel's Cove.
- The WCP delineated 0.54 acres of SM upstream of this unpaved driveway.
- A 3-foot corrugated metal pipe set in a concrete headwall passes tidal flow. It appears to be in good condition.
- There were no visual indicators of a restriction at this site other than minor scouring on the seaward side. Flow closely resembled natural free-flowing conditions.

OR-b

- Weston Taylors Lane crossing of a channel off The River.
- Site is located on private property on Barley's Neck, within the Pleasant Bay Area of Critical Environmental Concern.
- The WCP delineated 3.59 acres of SM upstream of the crossing.
- A 3-foot pipe was in stalled in 1997 by the homeowner, which replaced a previously restrictive pipe that measured 15-inches in diameter.
- Visual indicators of a restriction were observed by the project staff, however according to the homeowner the damage observed is a result of the previously undersized pipe that has yet to heal.

OR-c

- Route 28 crossing of channel off Little Pleasant Bay.
- Site is located north of the Route 28 intersection with Tar Kiln Road and the Brewster/ Orleans town line and is within the boundary of the Pleasant Bay Area of Critical Environmental Concern.
- A 46-foot open bridge span is supported on wooden pylons.
- There are only minor visual indicators of a restriction observed, including minor upstream bank erosion and *Phragmites* on the fringes of the upstream affected area.
- The WCP delineated 8.89 acres of SM upstream of the crossing.

OR-d

- Dirt berm crossing of channel off Pleasant Bay. The channel's inlet is located east of the entrance to Quanset Pond and west of The Narrows (Latitude 41-44-20/ Longitude 69-58-47).
- This crossing is located within the boundary of the Pleasant Bay Area of Critical Environmental Concern.

- Flow passes under the berm via an 8 inch (estimated) clay pipe with a concrete sluiceway on the upstream side that allows for the placement of water-tight stoplogs.
- The pipe appears to be partially blocked by debris.
- Vegetation on either side of the berm appears to be the same. A small area of salt tolerant grasses was observed upstream of the dirt berm. Deciduous trees upstream of the berm are dying off – possibly a result of salt water flow.
- Visual indicators of a restriction were minor.
- Before reaching the berm, tidal flow travels through a 3 to 5-foot wide channel off of the Bay that remains at approximately the same width upstream of the crossing.
- The WCP delineated 0.63 acres of SS extending inland from the Bay with WS upstream of that. There is no SM lying seaward of the berm.
- Field staff were lead to the site by Vince Ollivier, a member of the Orleans Conservation Trust who is very knowledgeable about this location.

OR-e
- Continuing east past the end of the paved section of Quanset Road, the roadway berm crosses a small tidal channel with its mouth on The Narrows, Little Pleasant Bay. Another branch of this channel flows to restricted site OR-7.
- This crossing is located within the boundary of the Pleasant Bay Area of Critical Environmental Concern.
- The crossing is a 2-foot corrugated metal pipe that appears to be in good condition.
- The WCP delineated 1.83 acres of SM upstream.
- Visual indicators of a restriction were minor, including only minor scour and upstream erosion.

TOWN OF PROVINCETOWN

There are no NTR's identified in Provincetown.

TOWN OF SANDWICH

SA – a
- Town Neck Road crossing of the north branch of Mill Creek.
- Two 16-inch pipes convey flow under Town Neck Road.
- The WCP delineated SS to the seaward side of this crossing.

SA - b
- River Street crossing of Mill Creek.
- The WCP delineated SM that ends before reaching this crossing. Upland is delineated around the crossing itself and WS is delineated upstream of River Street.
- Mill Creek flows under River Street via two 5-foot diameter semi-circular culverts. Flow continues into Shawme and Upper Shawme Pond.
- Mill Creek does support an anadromous fish run into these ponds.

SA-c
- Route 6A crossing of Dock Creek.
- This site lies upstream of tidally restricted sites SA-4 and SA-5.
- Tidal flow and SM are restricted at site SA-5 by a tide gate allowing flow to pass upstream

through only a 6-inch opening.
- The WCP delineated M seaward of this site.

SA -d
- Penn Central Railroad bed crossing of Spring Hill Creek. This crossing is approximately 30 yards west of the railroads' intersection with Spring Hill Road.
- The WCP delineated SM to the seaward opening and 1.97 acres of SS upstream.
- Flow passes under the railroad via a 30-inch stone box culvert.
- *Phragmite*s dominates the vegetation to the seaward side of the crossing indicating that flow is restricted before reaching this site. Upstream vegetation consists of SS. *Phragmites* was not observed in the upstream affected area.

SA –e
- Abandoned road crossing of Mill Creek, a tributary to the Scorton River.
- The abandoned road is located on the Massachusetts State Game Farm and is a continuation of Pine Terrace. It is gated to prevent vehicle access.
- A concrete box structure acts to dam water upstream of this road and a 2-foot pipe passes flow under it.
- The WCP delineated SM to the seaward opening but only deep marsh is delineated upstream.
- Sandwich Conservation Officer stated that the town is interested in allowing the upstream deep marsh to become a freshwater pond in order to enhance the anadromous fish run in this system.

SA-f
- Torrey Road crossing of easterly channel of Scorton Creek (Sandwich).
- Torrey Road is a private, paved road through Scorton Neck that terminates at a small beach parking lot on the south side of the Scorton Neck barrier beach.
- Scorton Creek's mouth is at Scorton Harbor, a man-made tidal entrance. Historically, Scorton Creek flowed in from Cape Cod Bay near what is today the Torrey Road beach parking lot.
- The WCP delineated 0.3 acres of SM upstream of Torrey Road and SM extending to the seaward side of the road.
- Field conditions observed were as follows: a one-foot diameter, metal pipe set in a stone embankment was in place to convey flow under the road; no channels or water was visible either reaching the seaward side of Torrey Road or continuing upstream of the crossing; no scour or erosion was visible near the culvert; and, only a minor amount of *Phragmite*s was visible in the upstream affected area.

TOWN OF TRURO

TR-a
- Earthen dike (inaccessible) and Fisher Road crossings of unnamed tidal channel flowing south from Pamet Harbor.
- According to local officials the dike (lying approximate 1/2 mile seaward of the Fisher Road crossing) was built to protect Fisher Road from flooding.
- The WCP delineated 4.09 acres of SM between Fisher Road and the earthen dike and 0.53 acres of SS upstream. Fieldwork did not identify any flow reaching Fisher Road.

TR-b
- Abandoned railroad bed crossing of Eagle Neck Creek in the marsh area south of Pamet Harbor.
- The railroad bed was breached in 1991 by Hurricane Bob and has intentionally not been reconstructed.
- Fieldwork determined that the breach was wide enough so as not to restrict tidal flow.

TR-c
- Abandoned railroad bed crossing of channel to Mill Pond in the marsh area south of Pamet Harbor.
- The railroad bed was breached in 1991 by Hurricane Bob and has intentionally not been reconstructed.
- Fieldwork determined that the breach was wide enough so as not to restrict tidal flow.

TR-d
- High Head Road (extension) crossing of the channel from Pilgrim Lake into Salt Meadow/ Head of the Meadow.
- This site lies upstream of restricted sites TR-6 and TR-7, and is seaward of TR-e.
- The WCP delineated 1.81 acres of M and 2.62 acres of SS between this site and TR-e.
- According to John Portnoy of the Cape Cod National Seashore, Salt Meadow was historically a vast salt marsh ecosystem.

TR-e
- Earthen dike crossing of the channel from Pilgrim Lake into Salt Meadow/Head of the Meadow. This crossing lies just upstream of site TR-d.
- The WCP delineated 49.13 acres of M and 91.90 acres of SS upstream of this site.
- According to John Portnoy of the Cape Cod National Seashore, Salt Meadow was historically a vast salt marsh ecosystem.

TOWN OF WELLFLEET

WE-a
- Blue Heron Road crossing of channel off Fresh Brook, which flows north and crosses under the road to the west of Route 6.
- A 3-foot diameter concrete culvert passes flow, however the channels were dry at the time of the site visit.
- The WCP delineated 0.57 acres of SM upstream of the crossing.
- *Phragmites* growth was significant on the seaward side of Blue Heron Road, however there was none observed in the patch of upstream affected salt marsh.

WE-b
- Earthen dike crossing of an unnamed creek flowing to the north of Fresh Brook, and bounded on the west by Route 6 and on the north by Lieutenant Island Road.
- This site was identified by the Commission project staff as a potential salt marsh restriction site. It seems likely that this is a site that should be considered tidally restrictive of salt marsh. However, after many attempts project staff was unable to locate this site in the field.
- The WCP delineated SM to the seaward side of the berm. The vegetation appears to change just upstream of the dike and was delineated as 21.02 acres of SS and 2.87 acres of M.

- This area was originally diked to support cranberry farming, however no bogs are actively farmed today.
- The Wellfleet Shellfish Department believes that there is a clapper gate restricting flow under this dike and that there is a healthy fresh water wetland upstream of this crossing.

WE-c
- Lieutenant Island Road crosses, via an 80-foot wood pylon bridge, a channel connecting Loagy Bay to the Wellfleet Harbor area on the south side of Lieutenant Island.
- The bridge is in good condition. It was constructed low, at marsh level, to enable extreme high and storm tides to simply flood the roadway.
- There were no visual indicators of a restriction observed.

WE-d
- Two, 4-foot diameter concrete culverts pass the flow of Blackfish Creek under the Cape Cod Rail Trail.
- This crossing is upstream of restricted site WE-3.
- Under the present conditions at site WE-3, WE-d is not considered tidally restrictive of salt marsh because it is adequately sized to pass the quantity of tidal flow that reaches it. Should work to improve tidal flow at site WE-3 ever be undertaken, then the size of site WE-d should be re-evaluated.
- The WCP delineated 2.20 acres of SM upstream of this crossing.

WE-e
- Railroad embankment crossing of Duck Creek to the north of the Shirttail Point parking lot.
- The embankment is breached and no visual indicators of a restriction were observed.
- According to a study intended to elucidate the processes of circulation and sedimentation in Duck Creek, “it may well be that [this] railroad embankment across Duck Creek has hindered the development of salt marsh in the upper part of the system and that is removal would stimulate increased marsh development there” (Giese, 1994).

TOWN OF YARMOUTH

YA – a
- Walking path at end of Ancient Way, over unnamed stream
- Upland vegetation on both sides of culvert

YA - b
- Route 6A (near Weir Rd.) crossing of Whites Brook
- Salt marsh does not extend to seaward side of road

YA - c
- Cranberry bog berm north of Highland St. crossing of unnamed stream, between restricted site YA-5 and abandoned cranberry bogs upstream
- Stream not accessible or visible from road; upland vegetation

YA - d
- Route 28 crossing of west arm of Mill Creek flowing into Mill Pond (West Yarmouth)
- Baxter Grist Mill on upstream end; flow controlled for bogs and historic consistency
- Although salt marsh extends to seaward culvert opening, upstream is all open water

YA - e

- Route 28 crossing of Thornton Brook — east arm of Mill Creek in West Yarmouth
- Wooded-swamp (WS1) on upstream end

YA – f

- Along western edge of Colonial Acres beach, berm between Mill Creek (connected to Lewis Bay) and unnamed tributary to the creek.
- Relatively new corrugated metal pipe, 6-foot diameter.
- 7.41 acres of salt marsh were delineated upstream by the Wetlands Conservancy Program but no visual indicators of a restriction occur near the site.

YA-g / DE-c

- Route 28 crossing of the Bass River on the Yarmouth/Dennis town line.
- Route 28 crosses the river via a 300-foot bridge span supported on pylons in the riverbed.
- There is a significant amount of salt marsh and other wetland type that occurs along the upstream banks of Bass River.
- Non restricted site YA-h/DE-d and restricted site YA-11/DE-13 lie upstream.
- There are no visual indicators of restricted tidal flow at this location. The channel width-to-opening ratio resembles natural, free-flowing conditions.
- A review of aerial photography showed no pooling on either side of the bridge; fieldwork confirmed this analysis.
- The Bass River supports an anadromous fish run and productive shellfish resources.

YA-h / DE-d

- Highbank Road crossing of the Bass River on the Yarmouth/Dennis town line.
- This site lies upstream of YA-g/DE-c and seaward of YA-11/ DE-13.
- The road crosses the river via a 160-foot bridge span supported on pylons in the riverbed.
- The upstream area affected by this crossing includes Priority Habitat of Rare Species and Estimated Habitat of Rare Wildlife.
- The Bass River supports an anadromous fish run and productive shellfish resources.
- Visual indicators of a tidal restriction are limited to minor scouring of the riverbanks.

YA – i

- North Dennis Road crossing of Weir Creek, which connects Follins Pond with Mill Pond at northern end of Bass River system.
- The Wetlands Conservancy Program delineated upland seaward of, and wooded swamp up-stream of, this crossing.

Appendix C

Latitude and Longitude of Identified Salt Marsh Restriction Sites

At each site, a hand-held Global Positioning System (GPS) receiver was used to determine the latitude and longitude. The receiver used was the "GPS-12 Personal Navigator" made by Garmin International, Inc., based in Olathe, Kansas.

Where practical, readings were taken approximately half way between the seaward and upstream opening of a pipe or culvert. Most often, the GPS position was recording while standing on top of the seaward opening of the site. If a site was particularly long, two GPS positions were recorded. The first at the seaward opening, and the second at the upstream opening. Both readings are recorded below and the location of the reading is indicated. The horizontal accuracy of the position recorded is 7 to15 meters (21 to 45 feet). The position is given in the standard Latitude/Longitude units of degrees (˚), minutes ('), seconds ("). The receiver gave the seconds reading to three decimal places, which was rounded in the field to two digits.

Site No.	Latitude (N)	Longitude (W)
BARNSTABLE		
BA-1/ SA-13	41° 43' 58"	70° 23' 80"
BA-2	41° 42' 19"	70° 21' 74"
BA-3	41° 42' 16"	70° 21' 78"
BA-4	41° 42' 07"	70° 21' 14"
BA-5	41° 42' 38"	70° 17' 91"
BA-6	41° 42' 20"	70° 17' 29"
BA-7	41° 43' 86"	70° 19' 70"
BA-8/ YA-1	41° 42' 45"	70° 15' 73"
BA-9/ MA-6	41° 37' 00"	70° 27' 02"
BA-10	41° 35' 96"	70° 26' 54"
BA-11	41° 38' 16"	70° 21' 50"
BA-12	41° 38' 35"	70° 21' 66"
BA-13	41° 38' 36"	70° 20' 67"
BA-14	41° 38' 33"	70° 20' 20"
BA-15	41° 38' 00"	70° 18' 62"
BA-16	41° 38' 12"	70° 18' 55"
BA-17	41° 38' 13"	70° 17' 58"
BA-18	41° 38' 15"	70° 16' 89"
BA-19	41° 38' 57"	70° 16' 77"

Site No.	Latitude (N)	Longitude (W)
BREWSTER		
DE-2/ BR-1	41° 44' 82"	70° 08' 61"
BR-2	41° 45' 29"	70° 07' 44"
BR-3	41° 45' 25"	70° 07' 46"
BR-4	41° 45' 66"	70° 06' 83"
BR-5	41° 45' 24"	70° 06' 86"
BR-6	41° 45' 28"	70° 06' 77"
BR-7/ OR-1	41° 46' 86"	70° 00' 68"
Site No.	**Latitude (N)**	**Longitude (W)**
CHATHAM		
HA-8/ CH-1	41° 40' 33"	70° 02' 23"
CH-2	41° 40' 39"	70° 00' 95"
CH-3	41° 40' 55"	70° 00' 38"
CH-4	41° 40' 56"	70° 00' 32"
CH-5	41° 40' 03"	69° 57' 98"
CH-6	41° 42' 13"	69° 58' 16"
HA-9/ CH-7	41° 42' 72"	69° 59' 66"

Site No.	Latitude (N)	Longitude (W)
DENNIS		
DE-1	41° 44’ 70”	70° 09’ 75”
DE-2/ BR-1	41° 44’ 82”	70° 08’ 61”
DE-3	41° 40’ 28”	70° 10’ 11”
DE-4	41° 39’ 40”	70° 10’ 40”
DE-5	41° 39’ 38”	70° 10’ 10”
DE-6	41° 39’ 35”	70° 09’ 97”
DE-7	41° 39’ 18”	70° 09’ 48”
DE-8	41° 39’ 17”	70° 09’ 52”
DE-9	41° 39’ 17”	70° 09’ 57”
DE-10 seaward	41° 39’ 17”	70° 09’ 61”
DE-10 upstream	41° 39’ 18”	70° 09’ 68”
DE-11	41° 39’ 33”	70° 09’ 27”
DE-12	41° 40’ 03”	70° 08’ 79”
DE-13/ YA-11	41° 41’ 60”	70° 10’ 17”
Site No.	**Latitude (N)**	**Longitude (W)**
EASTHAM		
EA-1	41° 48’ 13”	70° 00’ 15”
EA-2	41° 48’ 07”	69° 59’ 94”
OR-4/ EA-3	41° 48’ 10”	69° 59’ 20”
EA-4	41° 48’ 04”	69° 59’ 01”
EA-5	41° 48’ 34”	69° 59’ 14”
EA-6	inaccessible	inaccessible
EA-7	41° 49’ 04”	69° 58’ 03”
EA-8	41° 49’ 03”	69° 58’ 10”
EA-9	41° 52’ 58”	70° 00’ 02”

Site No.	Latitude (N)	Longitude (W)
FALMOUTH		
FA-1	41° 32’ 39”	70° 37’ 82”
FA-2	41° 32’ 75”	70° 35’ 34”
FA-3	41° 32’ 72”	70° 34’ 80”
FA-4	41° 33’ 03”	70° 34’ 63”
FA-5	41° 33’ 92”	70° 34’ 97”
FA-6	41° 33’ 18”	70° 34’ 22”
FA-7	41° 32’ 98”	70° 33’ 34”
FA-8	41° 34’ 71”	70° 30’ 88”
Site No.	**Latitude (N)**	**Longitude (W)**
HARWICH		
HA-1	41° 39’ 65”	70° 06’ 78”
HA-2	41° 40’ 16”	70° 06’ 53”
HA-3	41° 40’ 24”	70° 06’ 46”
HA-4	41° 40’ 66”	70° 05’ 90”
HA-5	41° 40’ 12”	70° 05’ 16”
HA-6	41° 40’ 07”	70° 02’ 59”
HA-7	41° 40’ 07”	70° 02’ 68”
HA-8/ CH-1	41° 40’ 33”	70° 02’ 23”
HA-9/ CH-7	41° 42’ 72”	69° 59’ 66”
Site No.	**Latitude (N)**	**Longitude (W)**
MASHPEE		
MA-1	41° 34’ 68”	70° 30’ 02”
MA-2	41° 34’ 54”	70° 30’ 02”
MA-3	41° 34’ 49”	70° 29’ 47”
MA-4	41° 33’ 15”	70° 30’ 39”
MA-5	41° 33’ 15”	70° 30’ 30”
MA-6/ BA-9	41° 37’ 00”	70° 27’ 02”

Site No.	Latitude (N)	Longitude (W)
ORLEANS		
BR-7/ OR-1	41° 46’ 86”	70° 00’ 68”
OR-2	41° 46’ 89”	70° 00’ 57”
OR-3	41° 47’ 44”	70° 00’ 61”
OR-4/ EA-3	41° 48’ 10”	69° 59’ 20”
OR-5	41° 45’ 38”	69° 58’ 18”
OR-6	41° 45’ 42”	69° 58’ 18”
OR-7	41° 44’ 32”	69° 58’ 30”
Site No.	**Latitude (N)**	**Longitude (W)**
PROVINCETOWN		
PR-1	42° 02’ 41”	70° 12’ 21”
Site No.	**Latitude (N)**	**Longitude (W)**
SANDWICH		
SA-1	41° 45’ 75”	70° 29’ 72”
SA-2	41° 45’ 66”	70° 29’ 73”
SA-3	41° 45’ 74”	70° 29’ 39”
SA-4	41° 45’ 48”	70° 29’ 36”
SA-5	41° 45’ 47”	70° 29’ 43”
SA-6	41° 45’ 19”	70° 28’ 91”
SA-7	41° 45’ 09”	70° 28’ 60”
SA-8	41° 45’ 33”	70° 27’ 35”
SA-9	41° 44’ 95”	70° 26’ 41”
SA-10	41° 44’ 19”	70° 25’ 53”
SA-11	41° 44’ 15”	70° 25’ 69”
SA-12	41° 43’ 82”	70° 24’ 37”
SA-13/ BA-1	41° 43’ 58”	70° 23’ 80”
Site No.	**Latitude (N)**	**Longitude (W)**
TRURO		
TR-1	41° 59’ 06”	70° 04’ 03”
TR-2	41° 59’ 39”	70° 04’ 03”
TR-3	41° 59’ 62”	70° 03’ 02”

Site No.	Latitude (N)	Longitude (W)
TRURO		
TR-4 seaward	41° 59’ 61”	70° 02’ 93”
TR-4 upstream	41° 59’ 61”	70° 02’ 85”
TR-5	41° 59’ 92”	70° 03’ 96”
TR-6 seaward	inaccessible	inaccessible
TR-6 upstream	42° 02’ 04”	70° 07’ 02”
TR-7	42° 03’ 17”	70° 07’ 10”
Site No.	**Latitude (N)**	**Longitude (W)**
WELLFLEET		
WE-1	41° 53’ 43”	69° 59’ 28”
WE-2	41° 54’ 64”	69° 59’ 20”
WE-3	41° 54’ 88”	69° 59’ 25”
WE-4	41° 55’ 01”	70° 01’ 22”
WE-5	41° 55’ 84”	70° 01’ 78”
WE-6	41° 55’ 87”	70° 03’ 87”
Site No.	**Latitude (N)**	**Longitude (W)**
YARMOUTH		
YA-1/ BA-8	41° 42’ 45”	70° 15’ 73”
YA-2	41° 42’ 28”	70° 15’ 50”
YA-3	41° 42’ 44”	70° 14’ 98”
YA-4	41° 42’ 97”	70° 14’ 23”
YA-5	41° 38’ 85”	70° 16’ 40”
YA-6	41° 38’ 54”	70° 16’ 21”
YA-7	41° 38’ 40”	70° 14’ 95”
YA-8	41° 38’ 47”	70° 14’ 32”
YA-9	41° 38’ 95”	70° 13’ 41”
YA-10 seaward	41° 38’ 72”	70° 11’ 84”
YA-10 upstream	41° 38’ 75”	70° 12’ 04”
DE-13/ YA-11	41° 41’ 60”	70° 10’ 17”

Appendix D

GROWetlands Restoration Project Nomination Form

Wetlands Restoration & Banking Program
GROWetlands

Wetlands Restoration Project Nomination Form

Thank you for your interest in restoring Massachusetts' wetlands. If you wish to sponsor a wetland restoration project and would like to propose that it be considered part of the statewide wetlands restoration initiative called **GROWetlands** (Groups Restoring Our Wetlands) under the Massachusetts Wetlands Restoration & Banking Program, please fill out this form and return to the address below.

Project Name: _____

Project Location: City/Town _____ Watershed _____

Please attach a USGS quad sheet or other map on which the site location has been marked.

If available, please attach current and historic photos and aerial photos of the project site.

Project Sponsor: _____

Designated Representative: _____

Telephone: _____ FAX _____ EMail _____

Address: _____

Project Co-Sponsors: _____

Landowner: _____

Has landowner expressed support for wetland restoration at the site? Yes ___ No ___
Explain:

Is all or part of the wetland totally destroyed or does it exist in a degraded condition? Explain:

Briefly describe the current condition of the wetland to be restored.

Wetlands Restoration Project Nomination Form (page 2)

Is the wetland part of an agricultural facility or was it farmland in the past?
___ Is in agricultural use now. ___ Was never farmed.___ Was formerly agricultural land.
Explain:

What caused the impact to the wetland?

Is the wetland area under an outstanding enforcement order? Yes ___ No ___
If yes, explain:

What is the approximate size of the area proposed to be restored?

What is the approximate size of adjacent wetland areas, if any?

Please attach a sketch of the area showing the wetland to be restored, adjacent wetlands and waterbodies, roads and buildings in the immediate vicinity, and other pertinent information to describe the site. If possible, indicate different wetland types that are present (Phragmites swamp, wet meadow, forested wetland, etc.).

If known, what was the wetland type(s) prior to impact?

If known, what restoration activity would be required to restore the wetland?

If known, what is the approximate cost of the restoration?

Has any funding been identified for this project? Yes ___ No ___
If yes, describe:

Would you like WRBP to arrange a site visit and project evaluation? Yes ___ No ___

Signed: _____ Date: _____

Please send this form with attachments to:

Steve Block
Wetlands Restoration & Banking Program
One Winter Street – 5th Floor
Boston, MA 02108
Phone: (617) 292-5743 • FAX: (617) 292-5850
Email: steve.block@state.ma.us

A representative of WRBP will contact you as soon as possible. Please call us if you have any questions.

Appendix E

List of Officials and Others Consulted

Several local and regional officials were consulted during the creation of this Atlas and asked to provide general information about their local salt marsh resources and about specific sites that were identified as a potential salt marsh restriction sites, and to suggest additional sites for project staff to investigate. They were also given a draft of their local area and asked to edit and comment on that draft. All of the edits and suggestions provided to project staff were incorporated into this Atlas. The following individuals were consulted:

■ **BARNSTABLE**
Darcy Karle, Conservation Agent
Dale Saad, Coastal Health Resource Coordinator
Stephen Seymour, Supervisory Project Engineer

■ **BOURNE**
Matt Boulanger, Conservation Agent

■ **BREWSTER**
All members of the Conservation Commission

■ **CAPE COD NATIONAL SEASHORE**
John Portnoy, Ecologist, National Park Service

■ **CHATHAM**
Kristin Andres, Conservation Agent
Dr. Robert Duncanson, Director,
Water Quality Laboratory

■ **DENNIS**
Alan Marcy, Shellfish Constable
George MacDonald, Director of
Natural Resources

■ **EASTHAM**
Henry Lind, Director of Natural Resources

■ **FALMOUTH**
Peggy Emslie, Conservation Agent
Paul Montigue, Shellfish Warden
Mark Patton, Director of Natural Resources

■ **HARWICH**
John Chatham, Conservation Agent
Tom Leach, Harbormaster
Heinz Proft, Natural Resources Officer

■ **MASHPEE**
Perry Ellis, Harbormaster
Jim Hanks, Chairman, Waterways Committee
Robert Sherman, Conservation Agent
Rick York, Shellfish Officer

■ **ORLEANS**
Dawson Farber, Harbormaster
Jenny Wood, Conservation Agent
Vince Ollivier, Orleans Conservation Trust

■ **PROVINCETOWN**
John Bennett, Chair, Conservation Commission
Roger Dias, Building Inspector/Conservation Agent
Anthony Jacket, Shellfish Warden

■ **SANDWICH**
Mark Galkowski, Conservation Officer

■ **TRURO**
Robert Bednarek, Secretary, Conservation Commission
Howard Irwin, Chair Conservation Commission
Anthony Jacket, Shellfish Warden
Paul Morris, Director, Dept. of Public Works

■ **WELLFLEET**
Paul Lindberg, Assistant Harbormaster
James McGrath, Assistant Shellfish Constable
Bill Walton, Shellfish Constable

■ **YARMOUTH**
Bradford Hall, Conservation Administrator
Karl Von hone, Director of Natural Resources

Appendix F

Distribution List for the FINAL DRAFT ATLAS (dated 11/20/01)

The following individuals were given an opportunity to comment on a Final Draft Atlas. Their comments were incorporated into this Final Atlas as appropriate:

■ **Bruce Carlisle**
Massachusetts Coastal Zone Management
251 Causeway Street
Suite 500
Boston, MA 02114-2136

■ **Hunt Durey**
Watershed Wetlands Planner
Massachusetts Wetlands Restoration Program
1 Winter Street, 5th Floor
Boston, MA 02108

■ **Christy Foote-Smith**
Director
Massachusetts Wetlands Restoration Program
1 Winter Street, 5th Floor
Boston, MA 02108

■ **Truman Henson**
Cape & Islands Regional Coordinator
Massachusetts Coastal Zone Management
Barnstable Superior Court Building
Barnstable, MA 02630

■ **Eric Hutchins**
National Marine Fisheries Service
One Blackburn Drive
Gloucester, MA 01930

■ **Patti Kellogg**
Cape Cod Watershed Leader
Waquiot Bay NERR
P.O. Box 3092
Waquiot, MA 02536-3092

■ **Don Liptack**
District Conservationist
USDA/ Natural Resources Conservation Services
P.O. Box 709
Barnstable, MA 02630

■ **Katie Lund**
Massachusetts Coastal Zone Management
193 Oyster Pond Rd., MS #2
Woods Hole, MA 02543

■ **John Portnoy**
Cape Cod National Seashore
99 Marconi Site Road
Wellfleet, MA 02667

■ **Ed Reiner**
Senior Wetland Scientist
US Environmental Protection Agency, Region 1
One Congress Street
Boston, MA 02114-2023

■ **Jan Smith**
Director, Mass Bays NEP
c/o MCZM
251 Causeway Street, Suite 500
Boston, MA 02114-2136

■ **Elizabeth Sorenson**
Coastal Coordinator, ACEC Program
Department of Environmental Management
251 Causeway St., Suite 700
Boston, MA 02114-2104