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.

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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

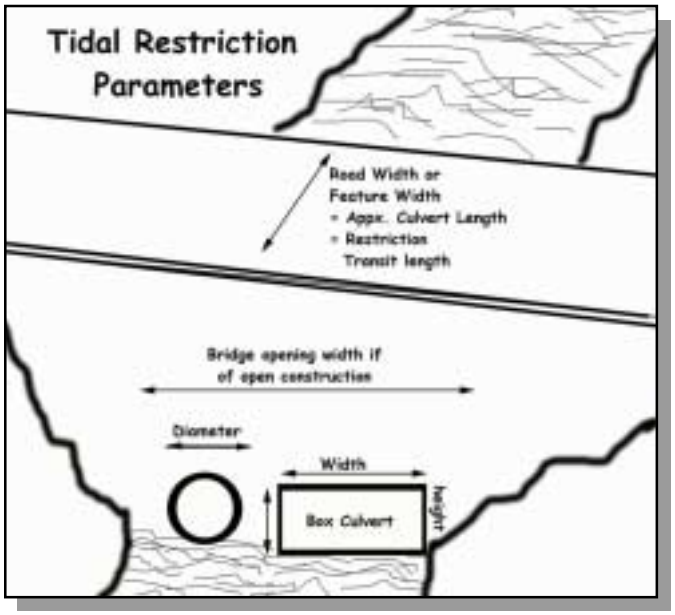
Project staff field-checked all identified potential salt marsh restriction sites to visually qualify the existence of restrictions and to collect information about crossing structures and affected salt marsh and wetland areas. Field reconnaissance generally was limited to tidal restriction sites with 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