



Newbury Estuarine Management Plan

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Cover images left to right: The fish ladder at Central Street Dam, Parker River from Route 1A, Bridge over Central Street Dam, Historic salt marsh hay harvest techniques off Route 1, Mouth of Parker River from Cottage Road.

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Executive Summary and Recommendations

The ACEC includes portions of the towns of Essex, Gloucester, Ipswich, Newbury, and Rowley. Almost 30% of this ACEC lies within the town of Newbury. While it would have been preferable to craft a management plan for the entire ACEC, however, interest and funding was not available for such an effort. The town of Newbury has boldly taken the planning lead in creating this document. This management plan will focus on the town's 6,500 acres of the ACEC. This area represents 30% of the entire ACEC and 45% of the town of Newbury. The Newbury portion of the ACEC is hereafter referred to as the "Newbury ACEC".

The Newbury ACEC is a place of incredible beauty and also contains many unique natural resources. The area has a biological productivity that is nearly double that of the most productive agricultural lands. The ACEC contains protected coastal lands such as the Parker River National Wildlife Refuge. As a result, it is an important site on the Atlantic Fly-way Migration route. It provides breeding habitat for more than 60 birds including the rare seaside sparrow and the least tern. The waters of the ACEC contain huge amounts of shellfish and are home to some of the largest anadromous fish runs of alewives and smelt on the North Shore (Massachusetts Coastal Zone Management, 2000).

In addition to its biological resources the Newbury ACEC provides recreational and economic opportunities to the region's inhabitants and contains many scenic, historical and archaeological resources as well. These many resources act as a magnet to population. Between 1980 and 2000, the population of Newbury increased almost 50%, from 4,500 to 6,700. In contrast, the larger town of Newburyport increased its population by only 8%, adding only 1,300 people. As more people move into Newbury and the surrounding region, the pressure on the Newbury ACEC is increasing.

The Estuarine Management Plan for the Town of Newbury evaluates the physical, biological, and human uses of the Newbury ACEC. It then identifies the major resource issues facing the town of Newbury. The final sections of the document describe recommendations and actions that can be taken to improve or at least maintain the health of the estuarine resources of Newbury.

Overview of Environmental Significance

The ACEC Program was established in 1975 when the Massachusetts Legislature authorized and directed the Secretary of Environmental Affairs to identify and designate areas of critical environmental concern to the Commonwealth and to develop policies for their acquisition, protection, and use. The Department of Conservation and Recreation (DCR) administers the ACEC Program on behalf of the Secretary and coordinates closely with the Office of Coastal Zone Management (CZM) regarding all aspects of coastal ACECs. CZM managed the coastal ACEC program until 1993 and administered the review and designation of 13 coastal ACECs.

Designation of an ACEC encourages the coordination of local, regional, state, and federal agencies and organizations to preserve, restore, and enhance the valuable resources found in the area. In addition, projects taking place in the ACEC require higher environmental standards and review under various state environmental regulations including the Massachusetts Environmental Policy Act (MEPA); the Department of Environmental Protection's (DEP) Waterways Regulations (Chapter 91), Wetlands Protection Act Regulations, and Solid Waste Facilities Site Assignment Regulations; and Coastal Zone Management (CZM) policies.

The Parker River/Essex Bay Area of Critical Environmental Concern (ACEC) was designated in 1979 by the Massachusetts Secretary of Environmental Affairs. It contains 25,500 acres of estuarine, riverine, salt marsh, and barrier beach ecosystems in the towns of Essex, Gloucester, Ipswich, Newbury, and Rowley (EOEA, 1979). Designation of an ACEC encourages the coordination of local, regional, state, and federal agencies and organizations to preserve, restore, and enhance the valuable resources found in the area. In addition, projects taking place in the ACEC require higher environmental standards and review under various state environmental regulations including the Massachusetts Environmental Policy Act (MEPA); the Department of Environmental Protection's (DEP) Waterways Regulations (Chapter 91), Wetlands Protection Act Regulations, and Solid Waste Facilities Site Assignment Regulations; and Coastal Zone Management (CZM) policies.

Framework for the Plan

At the time of the Parker River/Essex Bay ACEC nomination in 1978, requirements for an ACEC included evidence of at least 5 of 17 significant resources mentioned in CZM regulations (section 6.44). The Parker River/Essex Bay ACEC designation document described 14 of the 17 resources. The Newbury ACEC contains 13 out of the 14 significant resources present in the ACEC as a whole (EOEA, 1979). These resources include: barrier beach systems, salt marsh, dunes, beach, shellfish, estuaries and embayments, anadromous fish runs, floodplain, erosion and accretion areas, coastal related recreation, historic sites or districts, significant wildlife habitat, and significant scenic sites (EOEA, 1979).

History and Structure of the Newbury ACEC Planning Process

The ACEC was initially proposed to include parts of the towns of Newbury, Rowley, Ipswich, Essex and the City of Gloucester by the Ipswich Conservation Commission on October 25, 1978. Following nominations from other boards in the relevant towns the Secretary decided to proceed with a full review of the ACEC. During the public hearing, all speakers were in favor of the designation with only one exception. The support voiced for the proposed area in combination with the undeniable value of its natural resources led to the official designation of the Parker River / Essex Bay ACEC on March 2, 1979 by then Secretary of the Environmental Affairs John A. Bewick (EOEA 1979).

The designation of the ACEC fell during a period of rapid growth for the town of Newbury. Since 1950 the annual rate of population growth has been 4.4 times the state average. As a result of this growth, various planning measures have occurred over the past decades.

The Newbury 1980 Comprehensive Plan was written in order to "preserve the integrity and quality of land" as well as "provide Newbury with tools for guiding growth". The document and process sought to preserve Newbury's rural quality as well as emphasize public participation. The action plan of the 1980 document recommended the following six priority projects: zoning bylaw refinements; industrial development feasibility study; planning board handbook; personnel needs study; Plum Island planning and development; and environmental impact monitoring (Town of Newbury, 1980).

In 2000, the town completed and received approval for an Open Space and Recreation Plan (OS&RP) that identified important resources and summarized opportunities to preserve them. Following the 2000 OS&RP Update, voters decided to purchase a piece of open space in Byfield.

In addition, Newbury was the first coastal community in the Commonwealth to pass the Open Space Residential Design (OSRD) bylaw in April of 2001 (CZM, 2002). The OSRD bylaw is a tool designed to preserve open space while at the same time allowing full subdivision development rights for the landowner. The same number of homes allowed by traditional large lot zoning is guaranteed. However, they are placed on the land at higher densities, avoiding areas of sensitive resources, allowing for the preservation of larger contiguous tracts of open space.

Other recent additions to Newbury's zoning bylaws are the Plum Island Overlay District (PIOD) and the Wireless Communication Services bylaw. The Plum Island Overlay District (PIOD) will reduce damage to public and private property resulting from flood waters, ensure public safety by reducing threats to life and personal injury, eliminate costs associated with flooding conditions, preserve open space, and limit the expansion of nonconforming single and two family structures. The wireless communication services bylaw was enacted in 2001 to protect the visual, scenic, historic, and natural resources of Newbury as well as local property values (Town of Newbury web page, 2005).

Since the above planning measures were taken, Newbury has been developing a Community Development Plan (CDP) funded under Executive Order 418. Newbury is currently in the final stages of the CDP. As part of the CDP process, the town engaged in a major public outreach effort that included public workshops and the mailing of an opinion survey to all town residents. The survey and workshops resulted in a clear message from residents that the coastal location and the natural resources of the community are extremely important to them. There is some support in Newbury for either increased residential development or for increased commercial/

industrial development, presumably to help lower the residential tax burden. If development must occur, residents would prefer to see redevelopment and infill within existing developed areas rather than further loss of open space.

The CDP process has led to an effort to revise the town's Master Plan. The Master Plan will be brought to town meeting in the spring of 2005 for approval. This Estuarine Management Plan is intended to be incorporated into the Newbury Master Plan.

In addition to the many town regulations relevant to this management plan, many scientific studies have been performed since the ACEC was designated (CZM, 2000, 2001; HGSD, 1999; MAS, 1999; PRCWA, 1996). While many potential strategies for resource protection and regional resource management were identified by this body of research, only a few of the recommended strategies have been implemented. Lack of implementation is due to the fact that most of these plans are prepared by state agencies, academic institutions, and non-profit organizations and are not usually consulted by municipal officials who make the day-to-day decisions and who draft the ordinances, bylaws, and regulations that impact the Great Marsh.

This management plan was initiated as part of the Master Plan update. The Town Planning Board was successful in its application to CZM for funds from the Coastal ACEC Stewardship Grant Program to assist in the completion of the estuarine plan. The DCR ACEC Program has also offered technical assistance. The plan seeks to summarize the results of recent research, present the issues that are revealed by this research, and then make recommendations based on this information, public input, and review by town officials and staff, the regional planning agency, and the ACEC Program, in order to improve management of the estuarine resources of the ACEC. The Newbury Estuarine Plan Committee will then implement recommendations as appropriate.

Goals and Objectives

The primary goal of this plan is to maintain and, where necessary, restore or improve the health of estuarine resources in the Newbury portion of the Parker River/Essex Bay Area of Critical Environmental Concern. Portions of this plan will be incorporated into the Natural Resources section of the Master Plan and this document will also serve as an appendix to the Master Plan. Upon completion, Newbury hopes to share the plan with the other communities in the Parker River/Essex Bay ACEC with the hope that it will serve as a catalyst for the creation of a full ACEC Resource Management Plan.

The specific objectives of the management plan are to:

- Evaluate the physical conditions and trends in the estuary
- Evaluate biological resource conditions and trends in the estuary
- Evaluate human uses and trends in the estuary
- Identify the major resource management issues in the estuary
- Create a set of recommendations to address the major resource management issues
- Create a plan for the organizational structure and actions needed to implement the recommendations

Physical and Biological Conditions and Trends

Geographical Overview

The Newbury ACEC is almost completely contained in the Parker River Watershed. A small portion of the Newbury ACEC lies in the Merrimack River watershed. The 60,000 acre Parker River watershed is comprised of the Parker, Little, Mill and Rowley Rivers. The Newbury ACEC occupies lowland areas of the watershed. Salt marshes act as filters to the waters coming from upstream but they can also be negatively impacted by the input of pollution, nutrients, and sedimentation. Areas of contamination can range from specific sites of stormwater drainage to an entire river with impaired water quality. The portion of the Little River between Hanover Street and Hale Street has historically had lower water quality and deposits these waters drain into the Parker River (PRCWA, 1999, 2000, 2003).

Parker River/Essex Bay ACEC Boundary in Newbury

The ACEC in Newbury is generally bounded by the 10 ft contour line, the town boundary with Newburyport, roads towards the west and north, the mean low water line towards the sea, and includes principal open space uplands such as the US Fish and Wildlife Service Parker River National Wildlife Refuge and the state Division of Fisheries and Wildlife (DFW) Wildlife Management Areas. See the ACEC designation document for a detailed boundary description (EOEA, 1979). It includes estuarine habitats of saltmarsh, open water, tidal river segments, tideflats, barrier beach, dunes, and some adjacent upland.

Physical Characteristics

As a result of seasonal variations in freshwater inputs from rain, stormwater drainage, and river discharge, there are strong salinity gradients within the estuary that vary over time. During high flow, salinity drops to 0 parts per thousand (ppt) in the upper 10 km while during low flow salinity can exceed 15 ppt at the very head of the estuary. Likewise there are strong gradients in water residence times along the length of the estuary that also vary in response to river discharge (PIE-LTER, 2004).

Additional factors controlling estuarine hydrology and hydrodynamics are local precipitation (especially during summer when evapotranspiration is high and river discharge is low) and sea level variation. Mean sea level exhibits strong lunar, seasonal and annual cycles and variability. The effect of sea level variation is to alter tidal excursion lengths and marsh flooding depth and frequency. Direct precipitation becomes an increasingly important factor controlling salinity distribution, especially on the intertidal marsh in periods of low river discharge and low mean sea level when marsh flooding is limited or absent (PIE-LTER, 2004).

The mean depth of the entire Parker River-Plum Island Sound Estuary is 9.8 feet at mean high water and 5.2 feet at mean low water (Buchsbaum et al., 2000). The total surface area of the estuary varies from 4,470 acres at mean high water (MHW) to 2,690 acres at mean low water (MLW). The length of shoreline varies between 160 miles at MHW to 136 miles at MLW. Finally, the volume of water at MHW is 71,650,000 cubic yards and 22,469,000 cubic yards at MLW. The mean tidal amplitude of the marsh is 8.5 feet at the Ipswich River entrance to the sound (Buchsbaum et al., 2000).

Temperature and Salinity

Water temperature affects the rate of many of the river's biological and chemical processes. It affects the oxygen content of the water (cold water holds more oxygen), the rate of plant growth, and the metabolic rate of aquatic organisms (PRCWA, 2003). Water temperature changes naturally over daily and seasonal cycles, with variations in air temperature, currents, and local conditions. Long-term monitoring of water temperature makes it possible to detect temperature anomalies caused by human activities. Discharge of water from power plants or municipal and industrial effluent will often have a cooling effect on waters and can be considered thermal pollution (OzEstuaries.org, Temperature, 2005). Changes in the amount of freshwater flow entering the estuarine system will also impact water temperature. As impervious surface increases more water will be flushed into the rivers, which will further impact temperature fluctuations. While temperature varies naturally, sudden and drastic changes in temperature can cause problem for estuarine biota. Changes in water temperature impact biota by changing the solubility of oxygen and calcium carbonate in water, and also influences the extent to which metal contaminants and other toxicants are assimilated by physiological processes (OzEstuaries.org, Temperature, 2005).

Parker River Subwatershed

The Parker River flows from its headwaters in the towns of West Newbury, Groveland, Boxford, and Georgetown, through Georgetown and finally into Newbury. The Newbury ACEC extends up the Parker River almost 3 miles. The ACEC portion of the river is brackish as freshwater flowing from above the Central Street dam flows into the tidal portion of the Parker River (MAS, 1999). The river continues through Newbury, where it crosses Route 1, then flows through Kent Island Wildlife Management Area, past the Newbury town landing and finally out into Plum Island Sound.

The tidal portion of the Parker River runs roughly nine miles. The dominant land uses in this area are forest and salt marsh. Over the entire subwatershed, it is estimated that only 4% is covered by impervious surfaces, which would suggest that water quality is quite good (MAS, 1999).

Multiple organizations are involved in monitoring efforts in this subwatershed including the Department of Environmental Protection Division of Watershed Management; Massachusetts Division of Marine Fisheries Shellfish Program, Parker River Clean Water Association; Massachusetts Audubon Society; and the Marine Biological Laboratories.

Overall, water quality declines during rainfall events, because of particulate and chemical pollutants being flushed into waterbodies, streams and flowing out through the estuary. Such rainfall events frequently lead to temporary closure of shellfishing beds. Cart Creek in particular has been shown to have high nitrate-nitrogen and phosphorous levels. Dissolved oxygen is also depressed at multiple locations in the estuary. Water quality in the Parker River degrades significantly downstream of the Little River mouth for at least one mile (MAS, 1999). Pollution sources are varied and can include failed septic systems, stormwater runoff, improper waste disposal from marinas and boats, and input from pollution upstream.

Little River Subwatershed

The Little River is roughly 7 miles long and flows south through Newburyport into Newbury. About 4 miles of the Little River is tidal. The ACEC boundary extends north along this river almost 3 miles. The primary sensitive resource is a recreational oyster fishery in the tidal portion of the river, as well as other wildlife. Shellfishing is the designated use of this subwatershed and is not possible due to poor water quality (MAS, 1999).

The Little River subwatershed contains the Newburyport Industrial Park; commercial retail properties; an inactive, unlined landfill in Newburyport; an active landfill in Newbury; agricultural land; and protected open space. While the amount of undeveloped land has remained roughly constant during the 1990s, the amount of residential land has increased from 996 acres in 1991 to 1,592 acres in 1999 – a 60% increase. Impervious cover was about 10.5% in 1999 based on land-use information. This level of impervious cover indicates that the subwatershed is affected by urbanization (MAS, 1999).

A recent study completed by the Merrimack Valley Planning Commission (MVPC) indicates that non-point source pollution is a major contributor to pollution. The Newburyport industrial park and some agricultural land use are likely the main contributors to non-point source pollution (MVPC, 2001).

Data collected at Hanover St and Parker St suggest that water quality worsened during 2004 (see Table 1). Fecal coliform, nitrate and phosphate levels were higher or the same at both of these locations.

A dye tracer study conducted by the Division of Marine Fisheries and the U.S. Food and Drug Administration found that the Little River affects an area of the Parker River one mile downstream of the mouth of the Little River (MAS, 1999. The Mass Audubon Society Minibay Study found that almost 50% of the fecal coliform bacteria found in the lower Parker River comes from the Little River subwatershed. However, this water quickly dilutes in the larger Plum Island Sound due to contributions from other rivers flowing into the Sound.

While Little River water quality needs to improve, it is important to recognize some long-term trends recorded at the mouth of the Little River by the Division of Marine Fisheries. Figure 2 shows that fecal coliform levels have been decreasing in the Little River between 1992 and 2003. The dye tracer

studies also showed that water entering the Parker River from the Little River has very low residence times in the Parker River and even Plum Island Sound before being flushed to the ocean (Personal Communication, Chuck Hopkinson, 2005).

Mill River Subwatershed

The Mill River is a Parker River tributary which begins in the Georgetown-Rowley State Forest and runs north-northeasterly through Rowley until it joins the Parker River at Oyster Point about a mile east of Governor Dummer Academy (MAS, 1999). The lower section of the Mill River forms the boundary between Newbury and Rowley. The Mill River Watershed is the largest Parker River Subwatershed (at least 8,200 acres in size). Mill River tributaries include Muddy Brook, Great Swamp Brook, Bachelder Brook, and Ox Pasture Brook. The Mill River provides important spawning habitat for blueback herring and rainbow smelt. The Mill River, also once known as Mill Creek, derives its name from the several mills it once powered (MAS, 1999). There are currently 3 dams on the Mill River (PRCWA web-site, 2005).

The Mill River had the highest nutrient (nitrogen and phosphorous) concentrations of the entire Parker River watershed in the 2003 monitoring season. The 2004 nutrient concentrations were also extremely high. The source of these high nutrient loads is unknown at this time but it is probably not naturally occurring (PRCWA, 2004).

Sea Level Rise

Documented changes in the average sea level have been established from measurements of the Boston tidal gauge. Figure 1 is taken from a NOAA website and shows the increasing trend that confirms sea-level rise in Massachusetts. The mean sea level trend is 2.65 millimeters/year. The graph also shows why it is difficult to capture such trends without long-term data. The trend would show wide inter-annual variability if only a small portion of the graph were present. However,

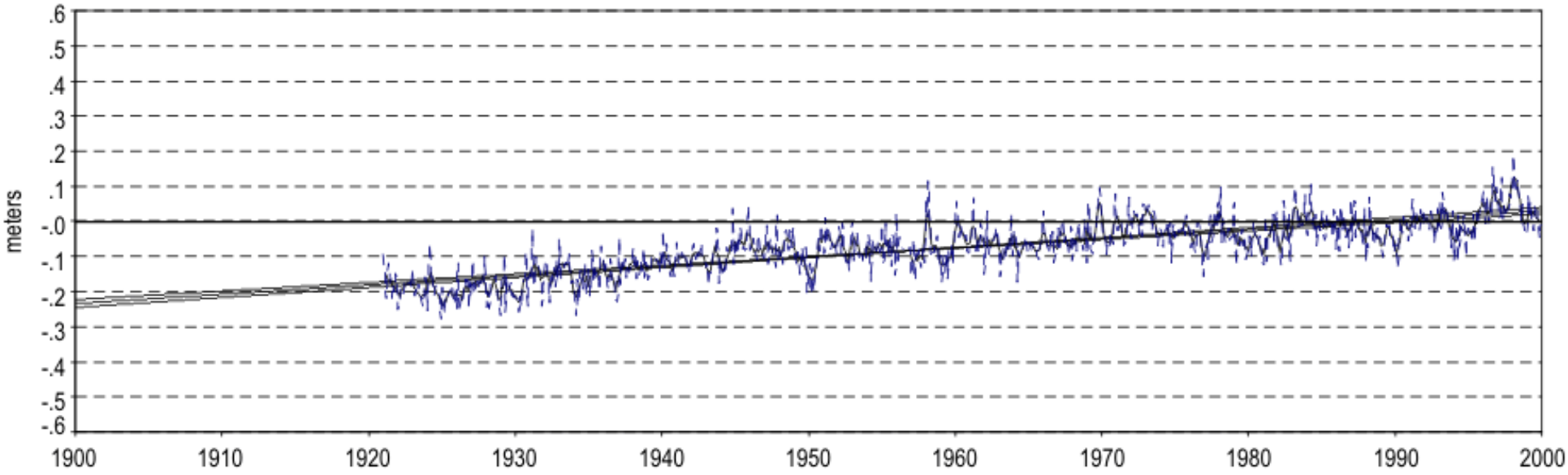


Figure 1. Rising sea-levels as measured at the Boston tidal gauge

from: http://www.co-ops.nos.noaa.gov/sltrends/sltrends_station.shtml?name=Boston&state=Massachusetts&stnid=8443970&start_yr=1921&end_yr=1999&start_yr=1921&end_yr=1999&slt=2.65&sterr=0.1

investigation of data over an entire century reveals a strong trend.

Historically, the salt marsh system has been able to keep up with sea level increases through the deposition of dead plant material and other sediments in the beds at a rate that balances increasing water levels. However, the future rates of sea level change are uncertain due to global warming. If changes in sea level were to take place too rapidly, it may be too vast a change for the estuarine system to absorb (Personal communication, Chuck Hopkinson).

An EPA-commissioned study was recently released entitled the "Climate's Long-term Impacts on Metro Boston" (CLIMB). The study culminates a four-year, million dollar research effort – funded by the United States Environmental Protection Agency (EPA) and conducted by experts at Tufts University, the University of Maryland and Boston University in consultation with officials from the EPA, the State of Massachusetts, the Metropolitan Area Planning Council and local government officials (Kirshen et al., 2005). The most alarming finding is that by 2100 sea levels may be between 24 and 39 inches higher than current levels. Sea levels have been increasing over the past century at the rate of roughly a foot per century. The rate for this century is projected to double, possibly triple, the historic rate. This one projection has many implications for the marsh system of Newbury. If the system may not be able to accrete enough sediment to keep up with these rises in sea level, marsh degradation will begin to occur. Additional predictions include increased frequency of larger storms and flooding as well as an overall increase in temperature between 6 and 10 degrees Fahrenheit (Kirshen et al., 2005).

Water Quality

Rivers are wonderfully complex, and represent a unique intersection of the physical, biological, and chemical realms. Many different water quality measures can be used to indicate river health. In Newbury, there are multiple organizations that provide water quality information.

The Parker River Clean Water Association (PRCWA) is a non-profit organization that monitors the Parker River subwatersheds as well as educating citizens about the importance of the a watershed perspective. As mentioned earlier the Parker, Little, and Mill rivers contribute to the Newbury ACEC. There are many monitoring sites that have been regularly sampled inside the Newbury ACEC. The PRCWA monitors the following river indicators: dissolved oxygen, velocity, depth, water temperature, fecal coliform, turbidity, and phosphate and nitrate levels. Each water quality indicator helps piece together a diagnosis for the health of a river (PRCWA, 2003).

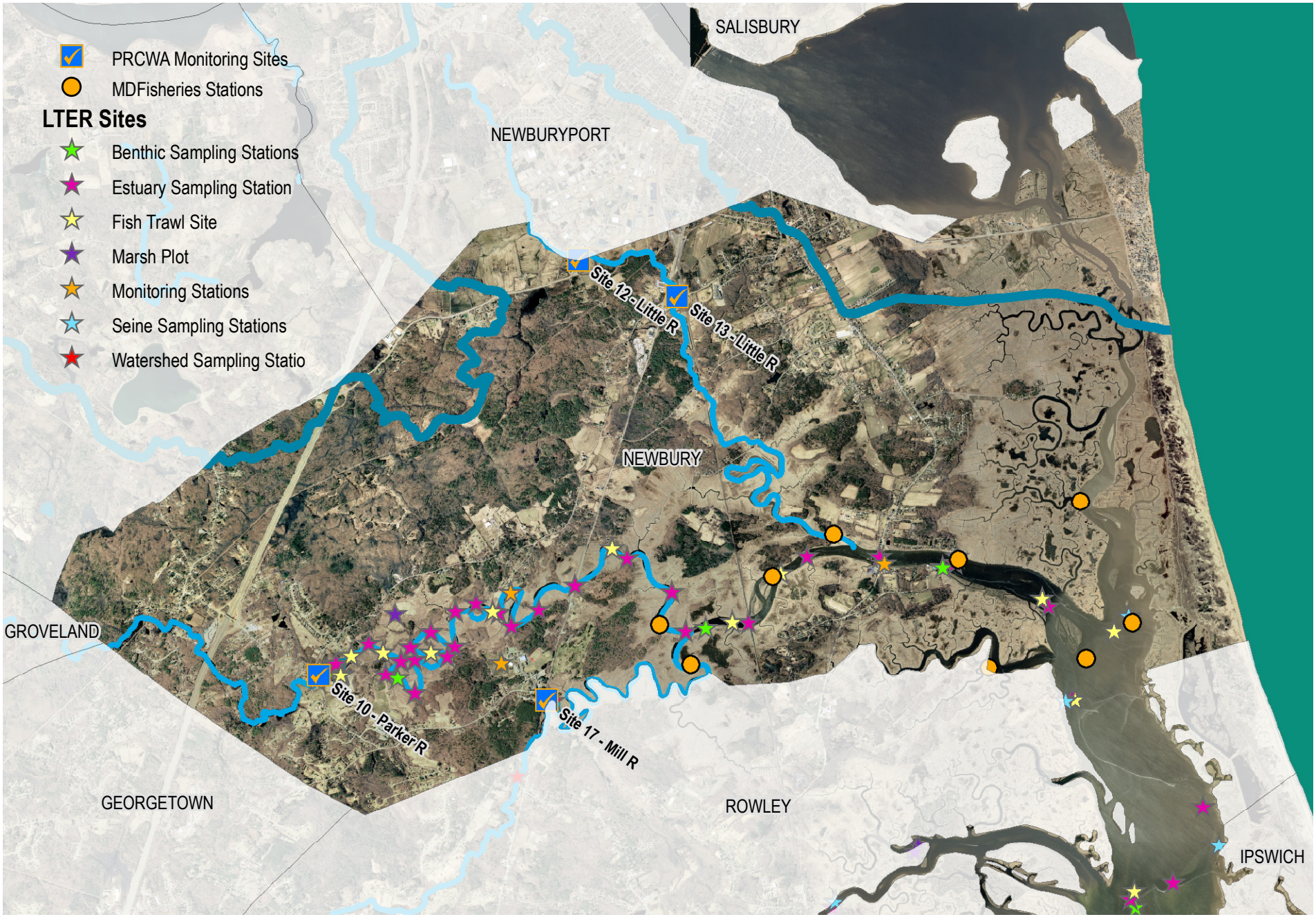
The Massachusetts Division of Marine Fisheries (MDMF) Shellfish Program regularly tests the water in the tidal portion of the Parker River as well. Information on fecal coliform levels is shown in Figure 2 from 1992-2003 data collected by the MDMF.

The Plum Island ecosystem was designated as a "Long-term Ecological Research" (PIE-LTER) site by the National Science Foundation in 1998. However, research and data have been collected on this area since the late 1980s. The Marine Biological Laboratory is one of the major institutions involved in research and recently established a new research center in Newbury.

Many different data sets are available online from the Plum Island Long-term Ecological Research Site. The program areas include information on: watersheds, marshes, water column, benthos, higher trophic levels, models, long-term experiments and short-term experiments. Map 1 shows the location of the PIE-LTER monitoring stations. These include a transect (estuary sampling stations) along the Parker River from the Central Street dam to the mouth of the River where dissolved oxygen; conductivity; temperature; percent saturation; pH; DIC and pCO2; water-column nutrient and particulate information has been collected since the mid-1990s. There are two marsh plots along the Parker River where experiments contrasting Cattail (Typha) and Spartina marsh ecology have been conducted. The water column depth has been measured every 15 minutes at the Parker River monitoring stations located just below the Route 1 bridge and at Middle Road. Other stations include benthic sampling, fish trawl sites, seine sampling stations, and watershed sampling stations.

Bacterial Contamination

Fecal coliform is a bacterium that is found in the intestinal tract of all warm-blooded animals,



Map 1: Water quality monitoring sites relevant to the Newbury ACEC

including humans. Massachusetts State regulations are based on the concentration of fecal coliform colonies per 100 ml of river water as follows:

- 1,000 colonies per 100 ml : boating allowed
- 200 colonies per 100 ml : swimming allowed
- 14 colonies per 100 ml : shellfishing allowed.

When fecal coliform colonies are detected, their presence is often an indicator of sewage contamination and may signify more dangerous disease causing bacteria and viruses. Untreated or poorly treated wastewater treatment plant discharges, leaking and or failing septic systems, domestic and wild animal manure and manure-based agricultural fertilizers are all sources of fecal coliform (PRCWA, 2000).

Dissolved Oxygen

Most aquatic plants and animals need dissolved oxygen in the water to survive. Some fish species, such as trout, require relatively high levels. Others, such as suckers, can live in lower levels. Decomposing organic material in the water lowers the amount of oxygen available to aquatic organisms. Too little oxygen in the water can suffocate fish and severely reduce river biodiversity.

Nutrient levels that are too high can lead to excessive bacterial activity, which removes oxygen from water bodies, and potentially making them unlivable for local fish and plant species.

In general, dissolved oxygen levels that lie below 6 parts per million (ppm) will not be able to sustain healthy aquatic flora and fauna (EOEA, 1979). This threshold continues to be used by watershed associations in their water quality monitoring protocols. Dissolved oxygen concentrations below 5 mg/l and 6 mg/l are used as indicators of poor dissolved oxygen quality for warm water and cold water fisheries respectively (Blackstone River Coalition, 2004).

pH

In an estuary the concentration of hydrogen ions (pH) will be affected by both marine and freshwater influences as well as by any effluents entering the water (pollution). The pH of seawater tends to be above 8. Freshwater pH, while often around 7, can be more acidic depending on the local geology (PRCWA, 2000).

If pH is not in a specified range, normal function of most aquatic organisms and some bacterial processes can be adversely impacted. For fish species, if pH drops below 7 or rises above 9, physical damage to the gills, skin and eyes can result. Eutrophic conditions will often lead to extreme variability in pH, and can give an advantage to algal species that can tolerate extreme pH levels (Ozestuaries.org, pH, 2005).

More complex impacts can also result from changes in pH such as the biological availability of metals, the release of viruses into the water column, and the normal formation of shells (Ozestuaries.org, pH, 2005).

Nitrogen and Phosphorus

The two most important nutrients to river systems are nitrogen and phosphorus. Both occur naturally, but human influence can cause nutrient loading – too many nutrients. In a natural system, algae float throughout the water column, competing with other autotrophic organisms for sunlight and nutrients. When there is an excess of nutrients, algae grow and multiply rapidly.

Sources of nutrients include failing septic systems or treatment plants, and run-off from fertilized lawns or agricultural fields. In instances where phosphorus is a growth limiting nutrient, the discharge of raw or treated wastewater, agricultural drainage or certain industrial wastes will stimulate the growth of photosynthetic aquatic organisms (like algae) in nuisance quantities (PRCWA, 2000).

Nutrient loading is one of the most important issues to be addressed in future management of the Newbury ACEC and the surrounding areas that input water into the ACEC. In some cases, moderate levels of nutrient inputs actually serve to fertilize the existing marsh species, thus stabilizing the marsh. However, excessive amounts of nutrients can also have the opposite impact, actually accelerating the bacterial breakdown of organic material in the marsh, leading to its erosion. Monitoring of nutrient levels is necessary to obtain data, establish a baseline, and assess trends. The Parker River Clean Water Association annual reports do not establish any thresholds that indicate poor water quality with respect to nitrogen and phosphorus. However, concentrations higher

than 0.03 mg/L indicate excessive amounts of nitrogen in the estuarine system (Blackstone River Coalition, 2004). In other areas, total phosphorus concentrations higher than 0.31–0.75 mg/L begin to indicate impairment (Blackstone River Coalition, 2004).

Existing infrastructure and development is contributing to excessive inputs of nutrients in the Little River tributary of the Parker River. Future residential development will also lead to increases in nutrients into the system.

Turbidity

Turbidity is the measure of water clarity. Water turbidity depends on the amount, size and type of particles suspended in the water column. Suspended particles can be anything from clay and silt to algae and microbes. Sources of suspended material include soil erosion, agricultural runoff, road runoff, and waste discharge (PRCWA, 2000).

The most obvious effect of increased turbidity is a reduction in the amount of light available for photoshynthesis. Consistently turbid environments will allow free-floating microscopic plants to out-compete larger bottom-dwelling plants. Turbid conditions caused by suspended sediment can suffocate fish and other estuarine species. Sediments also transport contaminants, promote the growth of pathogens, and can lead to low levels of dissolved oxygen. Overall, high turbidity usually leads to reduced production and diversity of species (Ozestuaries.org, Turbidity, 2005).

Site / Measured Feature	2000	2003	2004
Site 10 - Parker River - Central St			
Fecal Coliform (Colonies / 100 ml)	56	43	57
Phosphorus (mg/L)	0	0	0.02
Nitrogen (mg/L)	0.07	0.1	0.11
Dissolved Oxygen (ppm)	7.22	5.3	7.09
Water Temp (Degrees F)	61.1	44.7	56.7
Site 12 - Little River - Parker St			
Fecal Coliform (Colonies / 100 ml)	135	304	725
Phosphorus (mg/L)	0.03	0.2	0.57
Nitrogen (mg/L)	0.46	0	0.47
Dissolved Oxygen (ppm)	3.28	7.6	5.74
Water Temp (Degrees F)	62.6	45.8	52.3
Site 13 - Little River - Hanover St			
Fecal Coliform (Colonies / 100 ml)	550	314	729
Phosphorus (mg/L)	0.31	0.2	0.43
Nitrogen (mg/L)	0.02	0.2	0.28
Dissolved Oxygen (ppm)	NA	7.4	5.28
Water Temp (Degrees F)	58.4	41.2	53.1
Site 17 - Mill River - Rt 1 and Elm St			
Fecal Coliform (Colonies / 100 ml)	244	221	376
Phosphorus (mg/L)	0.54	0.1	1.73
Nitrogen (mg/L)	2.54	0.3	1.71
Dissolved Oxygen (ppm)	7.97	5.6	8.04
Water Temp (Degrees F)	56.2	46.7	57.9

Table 1: PRCWA Water quality data (2000 – 2004)

Recent Water Quality Results

Information on water quality in Newbury and the Newbury ACEC is generated by multiple organizations including state, non-profit, and reserach institutions. Recent data from multiple sources is summarized below.

Parker River Clean Water Association

PRCWA has had as many as 20 monitoring sites in the Parker River watershed in the past. At this time, of the 10 sites there are 4 relevant to Newbury. All sites are freshwater and provide information on the water feeding into Newbury estuarine systems.

Fecal coliform levels at site 10 remained consistently low in 2004. They are well below the threshold that allows swimming, although not low enough to allow shellfishing. However, coliform levels at the remaining three sites have jumped to much higher levels in 2004. Swimming is certainly not permissible in both the Little and Mill Rivers and the levels in the Little River are only 300 colonies short of the thresholds at which boating should not be permitted. Phosphorous and nitrogen levels increased in 2004 at all monitoring sites. The levels at Central Street on the Parker River are normal, although the 2004 phosphorus concentration deserves attention this coming year. At all other sites, the phosphorus levels are unnaturally high. Dissolved oxygen levels and the water temperature are at better levels. The dissolved oxygen in the Mill River is good as well as at Central Street. Dissolved oxygen is low in the Little River. Several water quality monitoring programs in Massachusetts (Blackstone River Coalition, Charles River Watershed Association) have set thresholds for water quality in their river systems and can publish a "report card" of water quality. Such thresholds have not been set by the Parker River Clean Water Association.

Massachusetts Division of Marine Fisheries

Another source of water quality data is the Massachusetts Division of Marine Fisheries (DMF). They have a variety of monitoring stations in Newbury. Monthly fecal coliform information is gathered at 9 of these stations and is summarized yearly as a geometric mean. The number of fecal coliform colonies is uniformly decreasing at all stations throughout the 1990s and early 2000s. This is possibly an indication that Title V has had a positive effect on fecal coliform levels. The fecal coliform levels measured in the Little River by the PRCWA are much higher than those obtained by the DMF. The discrepancies between the PRCWA and DMF measurements should be investigated. The differences may result from the PRCWA sites being closer to point sources of pollution in the Little River. Map 1 shows the locations of the stations in Table 1. At this time, it is unclear what is responsible for the high counts collected by the PRCWA.

PIE-LTER

An immense amount of information is available from the Plum Island Ecosystem Long-Term Ecological Research (PIE-LTER) website. Map 2 shows just one application of the data.

Dissolved oxygen is measured at multiple points along the Parker River throughout the sampling year (April–November). Map 2 shows the monthly averages of the dissolved oxygen measurements taken at dawn at each point along the transect. Two patterns are readily apparent: 1) Dissolved oxygen levels vary significantly throughout the year, peaking in the colder months and 2) Dissolved oxygen levels vary along the length of the Parker River.

It is also possible to view this information over time, showing the dissolved concentrations for particular months. Map 3 shows the June dissolved concentrations for various years. It is possible to identify the stations at which dissolved oxygen was decreasing over time. These maps illustrate that the estuary is a naturally dynamic system. Relationships with the state and research institutions will boost the credibility of the interpretations made about the health of the system.

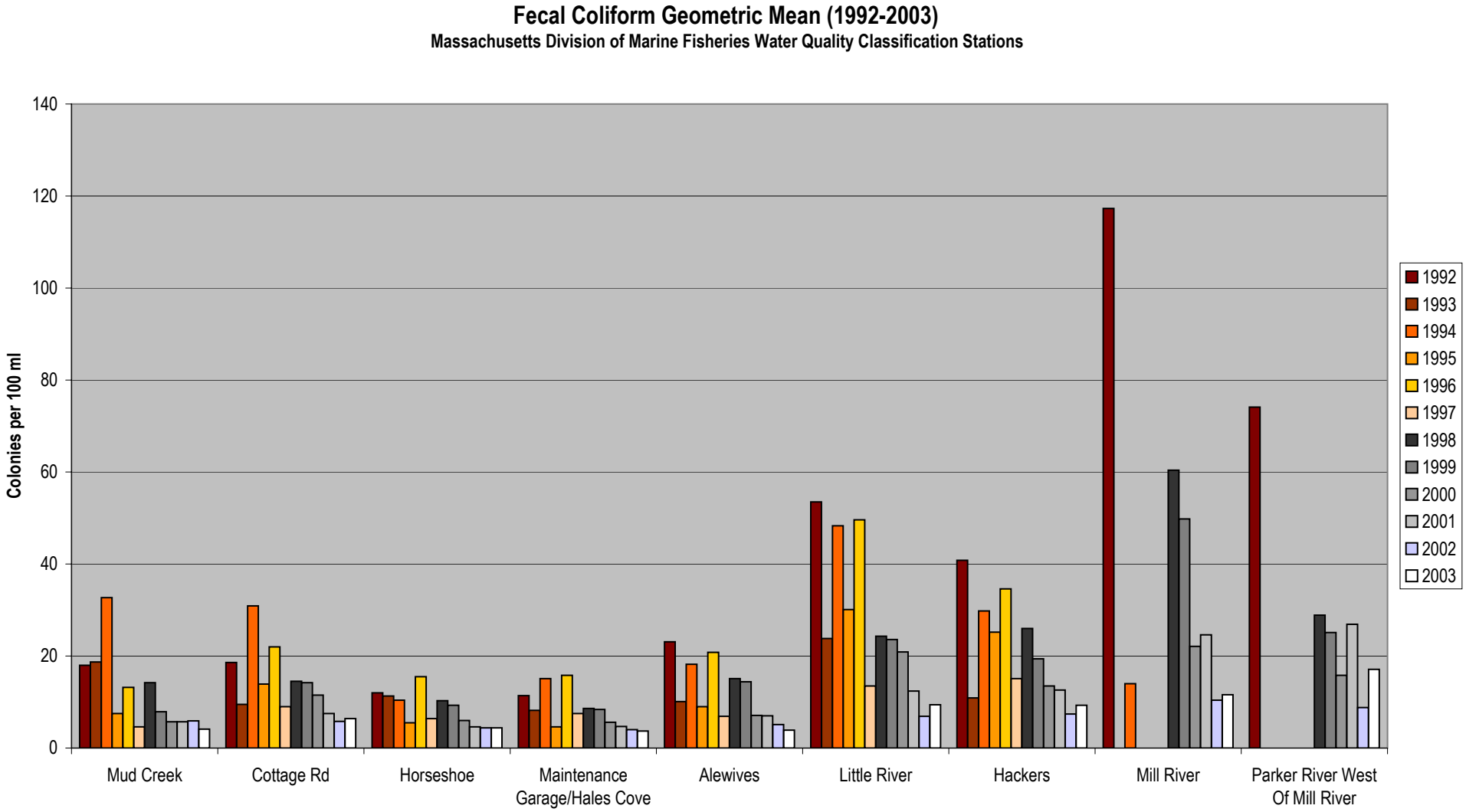
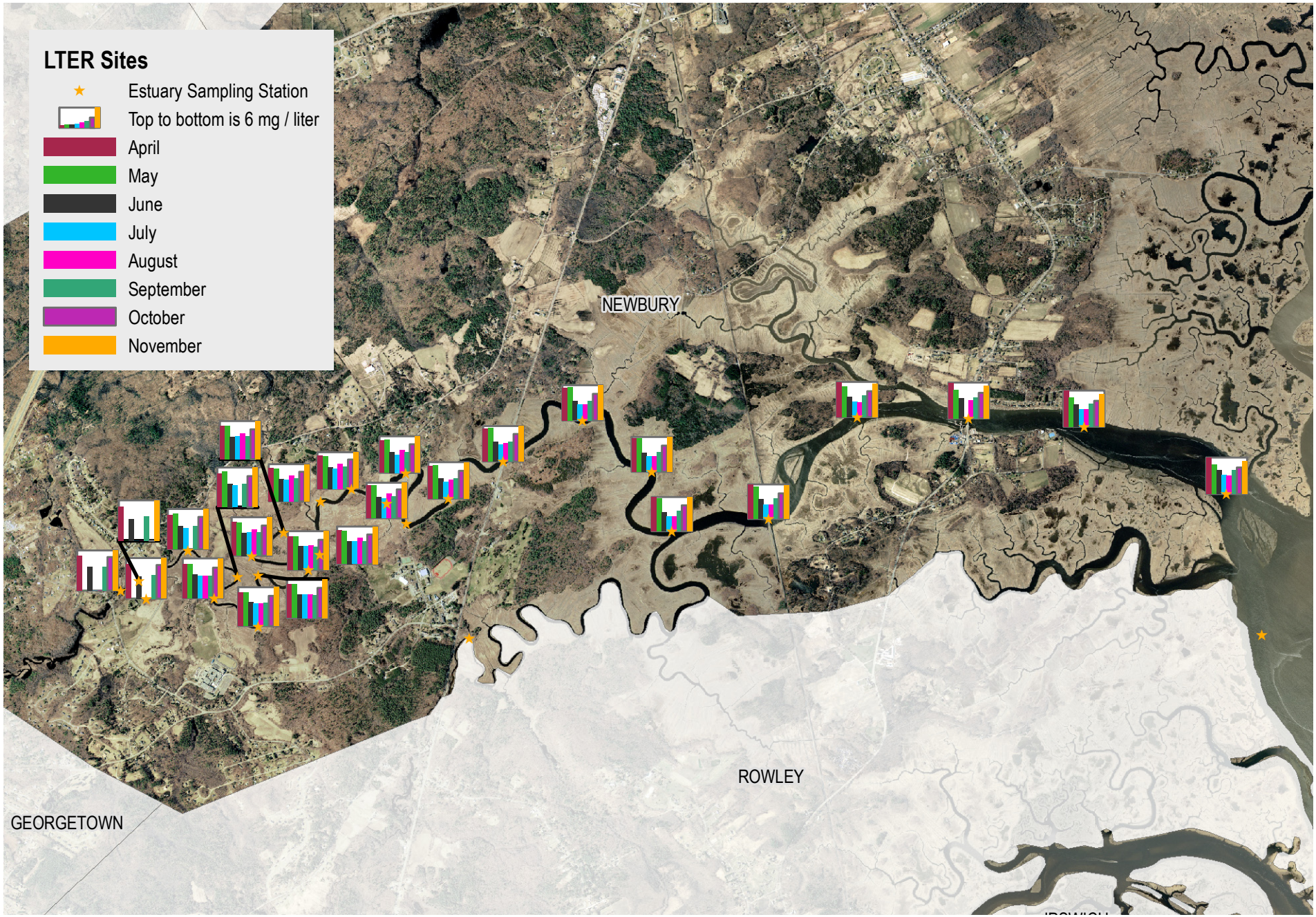
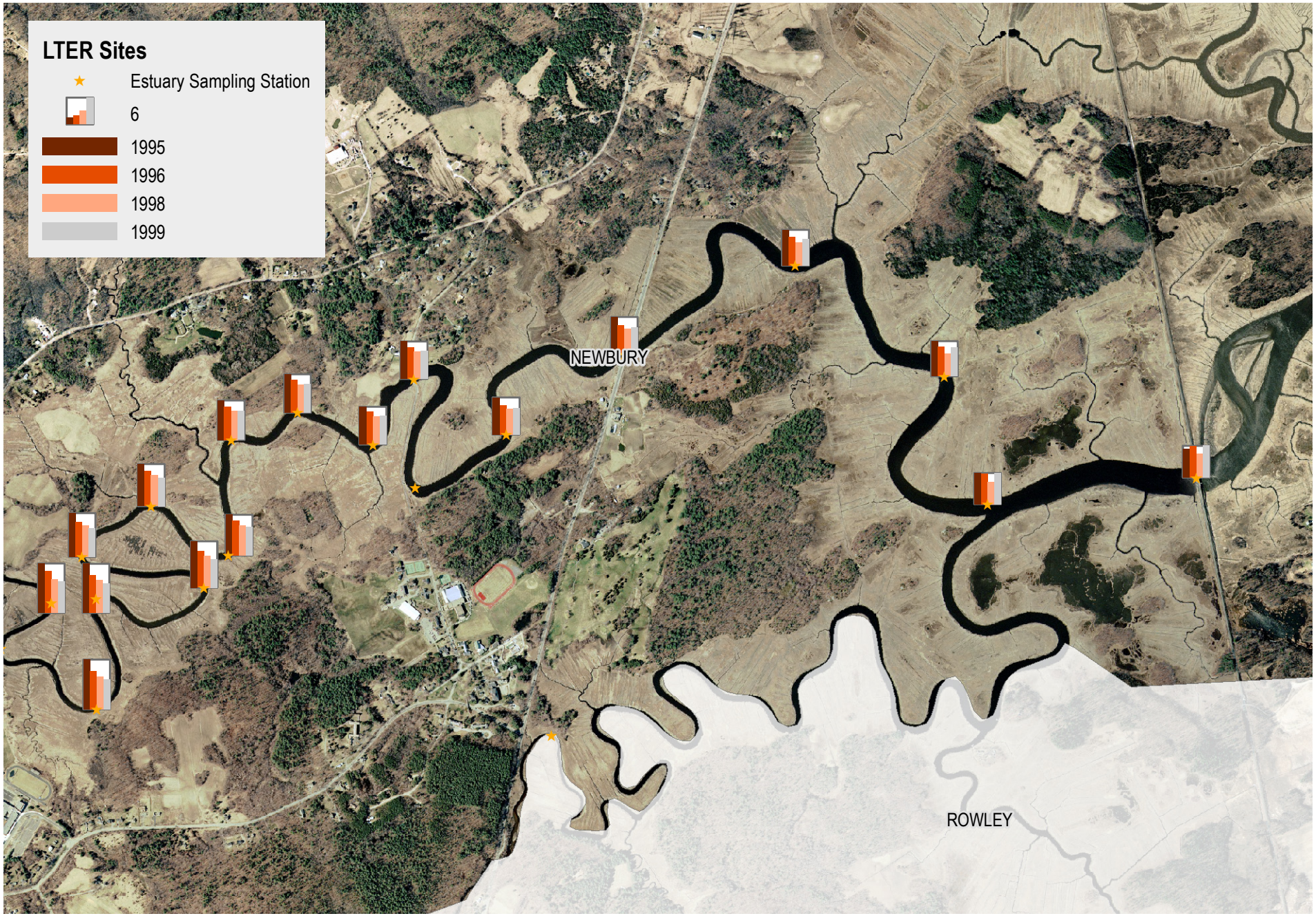


Figure 2: Fecal Coliform Geometric Mean



Map 2: Seasonal dissolved oxygen levels in the Parker River



Map 3: June dissolved oxygen concentrations over several years

Wetland Resources and Aquatic Vegetation

There are 5,650 acres of wetland resources in Newbury, representing 36% of the town. There are 15 wetlands types present. Table 2 shows the types and acreages. Newbury's wetlands serve many different functions: provision of habitat for multiple marine species, filter of pollutants from upland areas on their way to the ocean, and mitigation of shore erosion by marsh vegetation.

Barrier Beach

A barrier beach is a narrow strip of beach and dune separated from the mainland by a wetland or water body. Beaches are formed by the constant wave action and deposition of sand on the shore by waves. Dunes are raised areas of sand or coarser material deposited by wind and wave action. Barrier Beach dunes are often covered and stabilized by beachgrass. The barrier beach system is comprised of the beach, dunes, tidal flats, and any associated water bodies (CZM, 2000). Figure 3 shows a portion of Plum Island in Newbury. The beach, dunes, and wetland complex are visible. Newbury contains 607 acres of barrier beach, representing 3.8% of the town (Hankin et al. 1985).

Barrier beaches are dynamic systems, constantly being changed by storms, currents, waves, and wind. They protect human resources during storm events, acting as a protective shield against severe weather. In addition, their unique natural properties create habitat for a variety of plant and

Wetland Type	Acres in Newbury ACEC
Barrier Beach System	121.7
Barrier Beach - Coastal Beach	53.2
Barrier Beach - Coastal Dune	372.7
Barrier Beach - Marsh	0.6
Barrier Beach - Shrub Swamp	6.4
Barrier Beach - Wooded Swamp - Deciduous	14.8
Coastal Bank Bluff or Sea Cliff	10.3
Deep Marsh	8.5
Open Water	342.3
Salt Marsh	4220.8
Shallow Marsh Meadow or Fen	362.7
Shrub Swamp	61.4
Tidal Flat	7.6
Wooded Swamp - Deciduous	66.2
Wooded Swamp - Mixed Trees	2.9
Total Acres of Wetlands	**5652.3**

Table 2: Wetland Types in the Newbury ACEC

Figure 3: The Plum Island barrier beach in Newbury

animal species, including the endangered piping plover and least tern. Barrier beaches also provide wonderful recreation opportunities (CZM, 2000).

Longshore currents have gradually extended Plum Island southward while rising sea levels, combined with wind, wave, and storm action have pushed the island westward (CZM, 2000).

Tidal Wetlands

Poised between the land and sea, Newbury's expansive tidal wetlands are a transition zone containing diverse habitats, the most distinctive of which are salt marsh grasslands and tidal flats. There are over 4000 acres of salt marsh present in Newbury. There are 7.6 acres of tidal flat.

Salt Marshes

Roughly 4,220 acres is classified as "salt marsh" according to the Massachusetts Department of Environmental Protection. A large part of the salt water marsh lies between Plum Island (to the east) and the mainland part of Newbury (on the west). This area surrounds Pine Island and includes parts of the Parker River National Wildlife Refuge as well as State DFW Wildlife Management Areas. The other large salt marsh areas are found penetrating inland along the Parker, Little, and Mill Rivers.

Salt marshes are intertidal grasslands and are among the world's most productive ecosystems. In Newbury and surrounding Great Marsh region, salt marshes are the predominant visual and ecological feature of the estuarine landscape, and provide multiple environmental and social benefits. The marshes are divided into two general vegetation zones which contain a number of plant species that tolerate or live only in seawater or brackish water. The low marsh is flooded daily by the incoming tide and is dominated by Spartina alterniflora (salt marsh cordgrass), while the high marsh is flooded sporadically and is dominated by Spartina patens (salt marsh meadow grass or marsh hay) (CZM, 2000). Together, these two marsh zones are a major source of nutrients for the marine food web, provide flood control and protection of bordering upland areas from coastal storm damage, and serve as efficient filters for contaminants from stormwater runoff and septic system discharges. They also provide important nursery areas and habitat for diverse fish, plant, and wildlife species (Jerome et al., 1968; Chesmore et al., 1973; Myers, 1996; as referenced in CZM, 2000)

As noted by the Massachusetts Audubon Society (1999),

> "Many tidal creeks and salt pannes (shallow, temporary ponds on the marsh surface) are interspersed within the extensive open grassland of the marsh surface. These habitats are home to millions of small invertebrates that serve as food for salt marsh killifish and sticklebacks. These, in turn, are eaten by larger fish and birds. Small, upland islands within the marsh serve as resting and nesting areas for birds and animals that occasionally need some dry land."

Over the years, large tracts of salt marsh along portions of coastal Massachusetts, particularly in the Metro Boston area, have been destroyed or degraded by filling for urban development. Fortunately, the Newbury salt marshes have been spared this fate. With the exception of the mosquito "control" grid ditching of the 1930s, the broad expanse of the Newbury salt marshes has remained largely intact despite the town's population growth. (Land cover statistics compiled by the Massachusetts Geographic Information Systems Office show only a 1-acre loss from the town's total 4,644 salt marsh acres during the high growth period of 1971-1999.) The salt marshes are now protected against widespread filling by the Wetlands Protection Act, although small, incremental losses – both legal (e.g., public works projects) and illegal – are possible. The Massachusetts Department of Environmental Protection has increased its environmental enforcement activities in FY2004. One of the main thrusts of this effort was to stop illegal filling of wetlands. For more information visit the following website, http://www.mass.gov/dep/enf/files/04record.htm.

Tidal Flats

The Massachusetts Wetlands Protection Act defines tidal flats as "those nearly level portions of coastal beaches extending from mean low water landward to the more steeply sloping face of the beach." Composed of materials that range from coarse sands to fine silt and clay, tidal flats are covered by water during high tide and are exposed to the air at low tide (CZM, 2000). In Newbury, they are prevalent along the Plum Island seashore and in Plum Island Sound, the lower reaches of the Parker

and its tributaries, and the myriad tidal creeks that interlace the salt marsh.

The combination of salinity, substrate materials, and water movement determines the composition of plant and animal species in the tidal flats. Large plants are absent from the flats because of the harsh sand-mud environment and daily tidal fluctuations. Instead, the dominant plant species are algae that tolerate exposure and do not require a physically stable surface for growing. Although their significance to the marine environment is often overlooked, algae are vitally important because they provide essential food and cover for many other life forms such as snails, fish, and crustacea.

Most of the animal species found in the tidal flats have also adapted to daily environmental stress or burrow beneath the exposed surface during low tide. In addition to being habitat for many invertebrates, tidal flats are also a major feeding ground for large numbers of shorebirds. Birds search the tidal flats for clams, snails, sand shrimp, and worms that live just below the surface. At high tide, these same invertebrates are food for foraging fish, such as winter flounder and striped bass.

In the past, many tidal flats in Massachusetts have been subjected to the same urban development filling activities that have plagued salt marshes. Fortunately, this has not been the case in Newbury. With the exception of the alterations to some tidal creeks from past grid ditching, the areal extent of the Newbury tidal flats remains largely unchanged by development. A greater threat is the degradation of the tidal flats by pollution. Tidal flats are especially prone to high levels of pollutants from stormwater runoff and other sources since they are areas of sediment accumulation.

Aquatic Vegetation

Vegetation plays an important role in the aquatic ecosystem. It is a major source of primary production. Daily fluctuations in dissolved oxygen level are also due to photosynthetic activity of vegetation.

Eelgrass

Eelgrass (*Zostera marinara*) is a form of aquatic vegetation rooted in the bottom of estuarine waters. It can be fully or partially submerged depending on the tide. Although eelgrass is now widely recognized as an important indicator of the health of the marine ecosystem, it was not always so. Indeed, boaters and fishermen sometimes consider it more a nuisance, as they unwittingly damage or lose equipment in its sometimes dense growth.

The importance of eelgrass stems from the multiple beneficial roles it plays in the marine environment. With its long blades, ranging from six inches to three feet, it helps to stabilize bottom sediments and protect the shore by absorbing wave energy. It also filters suspended sediments and absorbs excess nutrients from the water that otherwise could promote algae blooms. Eelgrass is perhaps best known for its importance as a habitat for shellfish, finfish, and waterfowl. For example, it serves as a breeding ground for flounder, scallops, and crabs, and protects these species from predators. It also serves as a food source for several species of migratory waterfowl. Even when it decays, eelgrass provides an additional food source for invertebrates.

Because eelgrass beds are largely subtidal (i.e., beneath the water surface), estimating their current distribution, abundance, and health is a challenging proposition. Nevertheless, various efforts have been undertaken to accomplish this. The Massachusetts DEP Wetlands Conservancy Program (WCP) developed and completed a project between 1994 and 1997 to map eelgrass distribution. The results are available from MassGIS and indicate that eelgrass is not present in Newbury. Historical distribution of eelgrass in Newbury was not researched due to time constraints. At the time of publication, Massachusetts CZM planned to study potential eelgrass habitat on the North Shore (personal communication, Elizabeth Sorenson, 2005).

Algae

Marine algae, or seaweed, range in size from microscopic to hundreds of feet long. They are chlorophyll-containing organisms that gain energy from the sun and nutrients from the water in which they occur. Under eutrophic conditions where an excess of nutrients are present, algal blooms can grow, depleting oxygen from the water column and blocking sunlight from penetrating to bottom-dwelling plants.

Shellfish, Finfish, and Wildlife

Several layers of spatial information have been created by the Massachusetts Division of Marine Fisheries that are useful when learning of the Newbury shellfishing resources. Map 4 shows the shellfish suitability areas for various species While the Division of Marine Fisheries does not have funds that are available to municipalities, they sometimes partner with local groups or agencies (e.g. Merrimack Valley Planning Commission) to aid in projects such as processing of water quality samples (Personal Communication, Jeff Kennedy). This possibility should be kept in mind for future potential collaboration

Shellfish

Historically, the lower Parker River and Plum Island Sound area has been a major shell producing area, supporting the harvesting of six shellfish species: soft-shell clam (Mya arenaria), surf clam (Spisula solidissima), blue mussel (Mytilus edulis), razor clam (Enis directus), oyster (Crassostrea virginica), and ocean quahog (Artica islandica) (CZM, 2000). Of these species, soft-shell clams have by far the greatest geographic distribution and abundance as well as economic and recreational value. Shellfish also provide an important function in the food web by transferring food from the water column to benthic habitats. Through filter-feeding, they convert water column productivity in the form of plankton into their tissues, which then becomes available as food to many higher animals in the food web, such as birds, crabs, and fish, that consume shellfish (Buchsbaum et al., 2000).

Soft-shell Clams

The soft-shell clam is the most important commercial fishery in the Parker River estuary/ Plum Island Sound area, and supports an active community of harvesters, distributors, processors, and restaurant owners in the ACEC region. Historically, it was a vital food source for Native Americans and has served as a prime bait for catching cod and other commercially-important finfish (Buchsbaum et al., 2000).

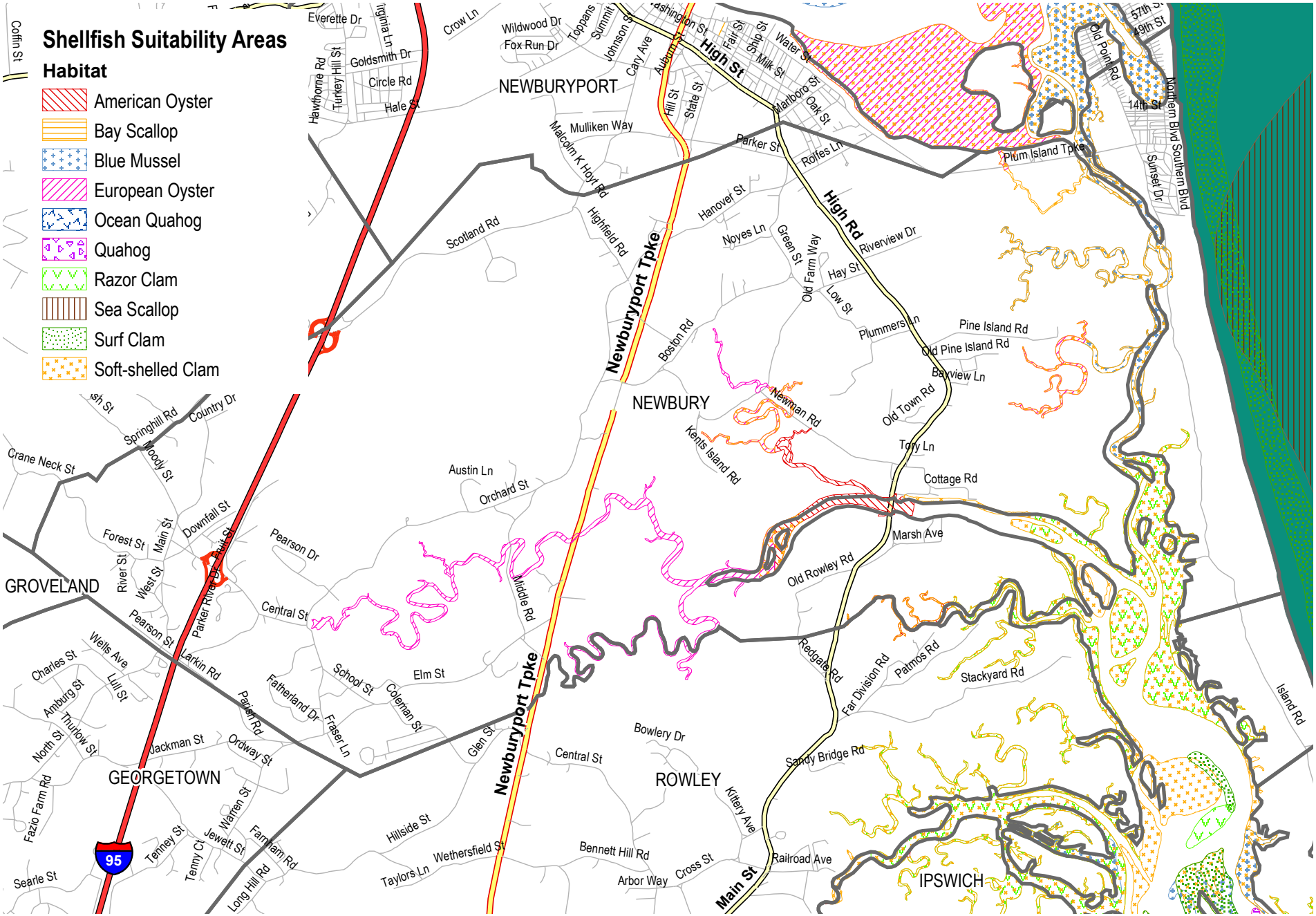
Soft-shell clams inhabit the intertidal flats of estuaries and, like many estuarine organisms, can tolerate a wide range of temperature and salinity. In the Plum Island Sound area, the clams inhabit soft sediments where salinities are typically around 30 parts per thousand (ppt). Those that inhabit the midpoint between high and low water tend to grow the fastest; thus this is the region where they are most often harvested. In general, the substrate composition of Plum Island Sound intertidal clam flats is primarily sand or sand-silt mixture. Sand occurs in areas exposed to tidal currents and wave action. Sandy silts and muds are typically found in the tidal rivers, creeks, and other less exposed areas where tidal currents are more restricted. The clams spawn primarily in the summer, and, like many marine animals with planktonic larvae, experience high larval mortality. Juvenile clams also are vulnerable to predation from crabs, gulls, and other animals, as well as mortality from temperature fluctuations and low dissolved oxygen. Those that survive reach reproductive maturity at about two years, at which time they are roughly at the legal size (51 mm) for harvesting (Buchsbaum et al., 2000).

Oysters

Oysters were reportedly quite abundant in the estuary when the early settlers arrived. Ewell's history of Byfield (1904) reports that "As lately as 1840, Coffin tells us that there was not a day in the year in which inmates of the Newbury almshouse … could not obtain oysters for their own use." Since that time, the oyster population has declined, and various attempts to stock oysters for commercial harvest have been largely unsuccessful. Today, according to Division of Marine Fisheries biologists, oysters are known to be present in Newbury in only a few locations (e.g, just below the Route 1A Bridge) and in limited numbers. These isolated locations correspond to rocky substrates where oysters cling. In recent decades, oyster harvests have been very small and almost entirely recreational, with harvest totals varying from year to year. From 1985-1996 the peak oyster harvest in Newbury was 300 bushels in 1989 (Buchsbaum et al., 2000).

Mussels

Blue mussels are also present in the estuary. They anchor themselves to any firm substrate or support, such as docks or the hull of a boat, and can compete with barnacles and seaweed to cover intertidal rocks. If given a foothold of scattered rocks, they can form shoals even on muddy flats. Blue mussels are edible, but are more popularly eaten in Europe than in America. Their harvests in Plum Island Sound have been sparse and generally only recreational. During the decade of 1990-1999, the mussel harvest in Newbury totaled less than 10 bushels (Buchsbaum et al., 2000).



Map 4: Shellfish suitability areas

Crustacea

In addition to the above mentioned shellfish species, Plum Island Sound also supports crustacean populations, including American lobster (Homarus americanus) and green crab (Carcinus maenas).

Lobster

Lobsters are fished recreationally on a seasonal basis from about the 30th of May to the 30th of September. A lobster pot marker survey conducted as a spot check on August 19, 1997 by Massachusetts Audubon Society biologists identified 224 pot markers within the Sound, most of which were clustered in the deepest portions of the Sound, with the largest cluster (56 pot markers) near the mouth of the Ipswich River. However, there were many areas of lone pot markers (Buchsbaum et al., 2000).

Crabs

Although originally introduced from Europe years ago, the green crab has been on the Atlantic coast and in Plum Island Sound for so long it has become a naturalized species and is rarely considered an invader anymore. The green crab is among the most dominant predators in the estuary, consuming large quantities of juvenile soft-shell clams. Its abundance makes it a major concern to clammers throughout the ACEC region. Attempts at commercial harvesting of green grabs have been unsuccessful due to the lack of a sustainable market, and today green crabs are used primarily as bait for the sportfishing industry (Buchsbaum et al., 2000).

Finfish

The vast network of tidal creeks in the ACEC provide outstanding spawning, nursing, and feeding habitat for many important species of finfish. For example, forage species such as sticklebacks and silversides spawn in the estuary's emergent salt marsh vegetation; winter flounder use the marsh creeks for nursery areas; and blueback herring and alewives spawn in upper watershed streams. Historically, finfish populations in the area were of great importance, providing a bountiful source of food and revenue. However, the commercial fisheries declined markedly by the early 1990s and no longer make a substantial contribution to the local and regional economy. At the same time, sportfishing has increased in popularity, with striped bass, white perch, winter flounder, and smelt among the most sought-after gamefish species.

Common Name	Latin Name	Years Seen	
		1965	1993-4
Spiny dogfish	*Squalus acanthias*	■	
Little skate	*Raja erinacea*	■	
Winter skate	*Raja ocellata*	■	
Skate species	*Raja spp.*		■
Atlantic sturgeon	*Acipenser oxyrhynchus*	■	
Blueback herring	*Alosa aestivalis*	■	■
Alewife	*Alosa pseudoharengus*	■	■
Shad	*Alosa sapidissima*		■
Atlantic menhaden	*Brevoortia tyrannus*		■
Atlantic herring	*Clupea harengus*		■
Thread herring	*Opisthonema oglinum*		■
American smelt	*Osmerus mordax*	■	■
Brown trout	*Salmo trutta*		■
Golden shiner	*Notemigonus chrysoleucus*		■
American eel	*Anguilla rostrata*	■	■
Mummichog	*Fundulus heteroclitus*	■	■
Banded killifish	*Fundulus diaphanous*		■
Atlantic cod	*Gadus morhua*	■	
Atlantic tomcod	*Microgadus tomcod*	■	■
Hake	*Urophycis spp..*	■	■
Four-spined stickleback	*Apeltes quadricus*	■	■
Three-spined stickleback	*Gasterosteus aculeatus*	■	■
Black-spotted stickleback	*Gasterosteus wheatlandi*		■

Table 3: Finfish Species Collected at Parker River – Plum Island Sound Sampling Stations, 1965 DMF Study and 1993-94 MAS-WH Study (Buchsbaum et al., 1996)

Common Name	Latin Name	Years Seen	
		1965	1993-4
Nine-spined stickleback	*Pungitius pungitius*	■	■
Northern pipefish	*Syngnathus fuscus*	■	
White perch	*Morone americanus*	■	
Striped bass	*Morone saxatilis*	■	
Bluegill sunfish	*Lepomis macrochirus*		■
Yellow perch	*Perca flavescens*	■	
Bluefish	*Pomatomus saltatrix*	■	■
Moonfish	*Vomer setapinnus*	■	■
Cunner	*Tautogolabrus adspersus*		■
American sand lance	*Ammodytes americanus*		■
Sea raven	*Hemipterus americanus*		■
Longhorn sculpin	*Myoxodephalus octodecemspinousus*		■
Grubby	*Myoxocephalus aenaeus*	■	■
Lumpfish	*Cyclopterus lumpus*		■
Atlantic wolffish	*Anarhichus lupus*		■
Ocean pout	*Macrozoarces americanus*	■	■
Atlantic Silversides	*Menidia menidia*	■	■
Rock gunnel	*Pholis gunnellus*		■
Windowpane	*Scopthalmus aquosus*	■	
Yellowtail flounder	*Limanda ferruginea*	■	■
Winter flounder	*Pleuroneties americanus*	■	■
Goosefish	*Lophius americanus*	■	■

Table 3: (continued)

Physical and Biological Conditions and Trends

Studies of the estuary's finfish populations by the Massachusetts Division of Marine Fisheries (Jerome et al., DMF, 1968) and the Massachusetts Audubon Society and Woods Hole Ecosystem Center (MAS-WH, 1993-4) identified the presence of a wide array of finfish species (Buchsbaum et al., 1996). A checklist of the species collected and the years at which they were observed are noted in Table 3. A total of 28 species were collected by DMF in 1965, while 34 species were collected by MAS-WH in 1993-4 (Buchsbaum et al., 1996). Aside from Atlantic silversides and mummichogs, which were observed in much larger numbers in the 1993-4 study (five-fold and eleven-fold increases over 1965, respectively), the number of individuals of other finfish species were not found to be significantly different.

Diadromous fish

Diadromous fish migrate between fresh and marine waters for at least part of their life cycles. A further clarification of these species splits them into catadromous and anadromous species. Catadromous fish live in fresh water and spawn in marine waters. Anadromous fish are the opposite, living in marine waters and spawning in fresh waters. Some anadromous fish die after spawning while others will make the trip several times in their life. In the Newbury ACEC the most common examples of anadromous fish are alewife (*Alosa pseudoharengus*) and herring (Clupea harengus). An additional species of potential importance is the Rainbow smelt (*Osmerus mordax*). Rainbow smelt are anadromous as well, growing and maturing in shallow coastal waters before spawning in freshwater streams. Smelt move into estuaries in the fall and to streams after the spring thaw. Smelt are currently under review for listing as an endangered species under the Endangered Species Act of 1972 (ESA). The American eel (*Anguilla rostrata*) is an example of a catadromous fish and is also present in the Newbury ACEC. The American eel was recently petitioned to be listed as "endangered" under the ESA and will soon be under status review (Personal communication, Brad Chase).

An anadromous fish passage survey (North Shore region) will soon be completed and will list all fishways in the region along with recommendations for restoration. For more information on this survey Brad Chase at the Division of Marine Fisheries (DMF) should be contacted.

In addition, a smelt population study is underway on the Parker River as well as other rivers in Massachusetts. This two-year year pilot study was initiated in 2004 to develop monitoring protocols for biological and population parameters of smelt runs in Massachusetts. The monitoring will focus on the adult smelt during the spring spawning runs and produce estimates of size composition, age composition, sex ratio, survival, total mortality and a catch per unit index of abundance. This pilot effort will result in an annual monitoring project conducted by DMF. Given the potential listing of both American eel and Rainbow smelt, this information will prove very useful in creating appropriate management actions in the Newbury ACEC (Personal communication, Brad Chase).

Wildlife

The Newbury estuarine system is one of the richest wildlife habitats in Massachusetts. The abundance of waterfowl, fish, shellfish, and mammals has served as a magnet to people for thousands of years. Few know that the primary productivity in estuarine systems rivals that found in rain forests.

Species Name	Scientific Name	Type	Catch	Frequency (# of hauls)
rainbow smelt	Osmerus mordax	Diadromous	3	1
American eel	Anguilla rostrata	Diadromous	46	6
lamprey	*Petromyzon marinus*	Diadromous	3	3
mummichog	*Fundulus heteroclitus*	Estuarine	3	1
fourspine stickleback	*Apeltes quadracus*	Estuarine	82	15
threespine stickleback	*Gasterosteus aculeatus*	Estuarine	22	6
white sucker	*Catostomus commersoni*	Freshwater	1	1
pumpkinseed	*Lepomis gibbosus*	Freshwater	2	2
banded sunfish	*Enneacanthus obesus*	Freshwater	3	3
golden shiner	*Notemigonus crysoleucas*	Freshwater	1	1
yellow bullhead	*Ameiurus natalis*	Freshwater	2	1
green crab	*Carcinus maenas*	Arthropod	1	1
crayfish		Arthropod	1	1
tadpole		Amphibian	1	1

Table 4: Parker River, Newbury Smelt Net Catch Data (2004) (Massachusetts Division of Marine Fisheries)

Bird Habitat

The salt marshes on the North Shore of Massachusetts represent the largest contiguous area of coastal marshes in the State. Extending from Cape Ann to the New Hampshire border for a distance of 17 miles, the marshes are interlaced with rich tidal flats, hundreds of upland islands, numerous bays and sounds, and 9 rivers. The entire area is spread over 56,750 acres of which 16,000 acres are coastal marshlands. The North Shore marshes have been designated by the Mass Fish and Wildlife Northeast Management Plan as a Focus Area for species and hunting.

The Newburyport/Merrimack River estuary has been identified as an international migratory shorebird stopover site on the Atlantic Flyway.

The North Shore marshes support breeding, migration and winter habitats for a long list of waterfowl species. The marshes are also home to a broad range of migratory birds including Least Bitterns, Pied Billed Grebes, Piping Plovers, American Bittern, Common Moorhen, Common Tern, Roseate and Least Terns. The North Shore marshes are used by dozens of species of wading birds, shore birds and neo-tropical migrants. Table 6 lists these and other species that are found in the marshes along with an indication of their

endangered status as accepted by the Massachusetts Natural Heritage and Endangered Species Program (MNHESP). The Core Habitat column of this table indicates whether or not the North Shore marshes would conserve viable populations of the corresponding rare species. Such habitat should provide for long-term protection of species.

Area Designations

The "Great Salt Marsh" has been nominated and designated as an "Important Bird Area" by the Massachusetts Important Bird Area Program (IBA). This program is carried out cooperatively by staff from Mass Audubon, a volunteer Technical Committee and various partner organizations. An important bird area provides essential habitat to one or more species of breeding, wintering, and/or migrating birds. The Newbury salt marsh is part of this important regional resource. For more information on this program, please visit the following website, http://www.massaudubon.org/Birds_&_Beyond/IBAs/index.php (MAS, 2005).

In November, 2004, the "Great Marsh" was designated a "site of regional importance" in the Western Hemisphere Shorebird Reserve Network. It is described as, "one of the most important coastal ecosystems in northeastern North America. The Great Marsh is the largest contiguous salt marsh north of Long Island, NY. It is composed of a barrier beach dune/salt marsh system and also encompasses the estuaries of five rivers (Essex, Ipswich, Rowley, Parker, and Merrimack Rivers)" (Manomet Center for Conservation Science, 2005).

The mouth of the Merrimack River and its adjacent areas has been identified in the "Category Plan for Preservation of the Black Duck Wintering Habitat – Atlantic Coast" by the U.S Fish and Wildlife Service.

Rare Species

Table 6 lists the rare species found in Newbury as well as the surrounding region. The core habitat column indicates that core habitat for this species is found in the the North Shore marsh region. Core habitat may not exist in Newbury. The most recent observation indicates town-specific documented observations of species. This table was replicated using information available online from the Massachusetts Natural Heritage and Endangered Species Program.

Species	Breeding	Migration	Wintering
American Black Duck	■	■	■
Mallard	■	■	■
Greenwinged Teal		■	
Gadwall		■	
Wood Duck	■	■	
Greater Scaup		■	
Common Goldeneye		■	■
Bufflehead		■	■
Red Breasted Merganser		■	■
Scoter Species		■	■
Common Eider		■	■
Canada Goose	■	■	■
Atlantic Brant		■	

Table 5: Waterfowl Species of the North Shore Marsh Focus Area

Mammals

Wildlife abounds in and around the ACEC and its bordering uplands due both to the abundance and diversity of open space. In general, the mammal species present in Newbury are characteristic of those found throughout much of the rural Northeast, and include both resident and transient populations. Some are present in large numbers throughout much of the town; others are rare and confined to smaller, more localized habitats.

Table 7 lists common mammal species in Newbury. The largest of these is the whitetail deer, which inhabits mixed and deciduous woodlands with an understory, the edges of forest, farms, and wetlands, and salt marsh knolls or "islands". In the past, townspeople have spotted an occasional moose, but this is a transient, not resident, species.

At the time Table 7 was originally produced by the US Army Corps of Engineers, coyote, otter, and fisher were listed as "status uncertain" in the Merrimack River watershed. Today, these species are considered common (Personal communication, David Mountain). Two common species, mink and flying fox were also missing from the 1974 table. While bobcat are still present in Newbury, they are rarely seen, and may be on the decline (Personal communication, David Mountain).

Taxonomic Group	Scientific Name	Common Name	State Rank	Federal Rank	Core Habitat	Most Recent Obs
Amphibian	Ambystoma laterale	Blue-Spotted Salamander	SC			1990
Amphibian	Hemidactylium scutatum	Four-Toed Salamander	SC			1986
Amphibian	*Scaphiopus holbrookii*	Eastern Spadefoot	T		Yes	1983
Reptile	*Clemmys guttata*	Spotted Turtle	SC			2000
Reptile	*Clemmys insculpta*	Wood Turtle	SC			1994
Reptile	*Emydoidea blandingii*	Blanding's Turtle	T			1985
Bird	*Bartramia longicauda*	Upland Sandpiper	E		Yes	1994
Bird	*Botaurus lentiginosus*	American Bittern	E			1953
Bird	*Charadrius melodus*	Piping Plover	T	(LE,LT)	Yes	1996
Bird	*Circus cyaneus*	Northern Harrier	T			1958
Bird	*Cistothorus platensis*	Sedge Wren	E			1985
Bird	*Podilymbus podiceps*	Pied-Billed Grebe	E			1973
Bird	*Pooecetes gramineus*	Vesper Sparrow	T		Yes	1982
Bird	*Rallus elegans*	King Rail	T		Yes	1956
Bird	*Sterna antillarum*	Least Tern	SC	(PS:LE)	Yes	1998
Bird	*Sterna dougallii*	Roseate Tern	E	(PS:LE,LT)	Yes	1980
Bird	*Sterna hirundo*	Common Tern	SC		Yes	1998
Bird	*Tyto alba*	Barn Owl	SC			1993
*Bird	*Ixobrychus exilis*	Least Bittern	E	Not determined		NA
*Bird	*Accipiter striatus*	Sharp-shinned Hawk	SC	Not determined		NA
*Bird	*Gallinula chloropus*	Common Moorhen	SC	Not determined		NA
Snail	*Cincinnatia winkleyi*	New England Siltsnail	SC		Yes	1986
Snail	*Littoridinops tenuipes*	Coastal Marsh Snail	SC		Yes	1986
Vascular Plant	*Aristida tuberculosa*	Seabeach Needlegrass	T		Yes	1995
Vascular Plant	*Bidens hyperborea var colpophila*	Estuary Beggar-Ticks	E			1981
Vascular Plant	*Elymus villosus*	Hairy Wild Rye	E			1897
Vascular Plant	*Equisetum scirpoides*	Dwarf Scouring-Rush	SC			1900
Vascular Plant	*Eriocaulon parkeri*	Estuary Pipewort	E			1924
Vascular Plant	*Gentiana andrewsii*	Andrews' Bottle Gentian	E			1954
Vascular Plant	*Rumex verticillatus*	Swamp Dock	T			1951
Vascular Plant	*Sagittaria calycina var spongiosa*	Estuary Arrowhead	E			1981
Vascular Plant	*Sanicula odorata*	Long-Styled Sanicle	T			1902
*Vascular Plant	*Rumex pallidus*	Seabeach Dock	T	Not determined	Yes	NA
*Vascular Plant	*Suaeda calceoliformis*	American Sea-Blite	SC	Not determined	Yes	NA
*Amphipod	*Crangonyx aberrans*	Mystic Valley Amphipod	SC	Not determined		NA

STATE RANK KEY

SC Special Concern

T Threatened

E Endangered

Table 6: Newbury Rare Species

The eastern cottontail is the most abundant species of rabbit in the area. The New England cottontail and varying hare are also present, especially in thickly wooded upland areas. Raccoons, weasels, and skunks live throughout the town. The latter are present even in the most densely developed areas because of their ability to eat almost any food and to inhabit almost any place that will afford shelter.

Predator species such as red and gray fox inhabit the region, although their local populations are not large. Fishers are also present, but are rare. The New England coyote is increasing its range and abundance across the state and in Essex County, although detailed knowledge of this species is still sparse. According to Newbury conservation personnel, local coyote sightings have increased dramatically over the last decade, and encounters with domestic pets – sometimes with tragic consequences - are on the rise.

In terms of actual numbers, the area's most successful mammals are the rodents. The largest of these – beaver and muskrats – are found in a number of the area's undisturbed streams, ponds, and wetlands, including tranquil reaches of the Little and Mill Rivers. According to state wildlife officials, the beaver population statewide experienced "exponential" growth - from 24,000 in 1996 to some 70,000 today – following the adoption of stricter trapping laws. Town conservation personnel also report a significant increase in the beaver population in Newbury, although no actual survey numbers are available.

Family	Common Name	Scientific Name	Status
Cervidae	Whitetail Deer	Odocoileus virginianus	C
Leporidae	Eastern Cottontail	Sylvilagus floridanus	C
	New England Cottontail	S. Mutalli	C
	Varying Hare	Lepus americanus	C
Mustelidae	Striped Skunk	Mephitis mephitis	C
	Short-tailed weasel	Mustela erminea	C
	Long-tailed weasel	Mustela frenata	C
	Mink	Mustela vison	C
	Otter	Lutra Canadensis	C
	Fisher	Martes pennanti	C
Procyonidae	Raccoon	Procyon lotor	C
Didelphidae	Opossum	Didelphis marsupialis	R
Felidae	Bobcat	Lynx Rufus	P/R
Canidae	New England Coyote	Canis latrans	C
	Gray Fox	Urocyon cinereoargenteus	C
	Red Fox	Vulpes fulva	C
Sciuridae	Eastern Gray Squirrel	Sciurus carolinensis	C
	Red Squirrel	Tamiasciurus judsonicus	C
	Southern Flying Squirrel	Glaucomys volans	C
	Eastern Chipmunk	Tamies striatus	C
	Woodchuck	Marmota monax	C
Castoridae	Beaver	Castor Canadensis	C
Erethizontidae	Porcupine	Erethizon dorsatum	P
Cricetidae	White-footed mouse	Peromyscus leucopus	C
	Meadow vole	Microtus pennsylvanicus	C
	Muskrat	Ondatra zibethica	C
Zapodidae	Meadow jumping mouse	Zapus hudsonius	C
	Woodland jumping mouse	Napaeozapus insignis	C
Muridae	Norway rat	Rattus norvegicus	C
	House mouse	Mus musculus	C
Talipidae	Eastern mole	Scalopus aquaticus	C
	Hairytale mole	Parascalops breweri	C
	Starnose mole	Condylura cristata	C
Soricidae	Masked shrew	Sorex cinereus	C
	Shorttail shrew	Blarina breveccuda	C

KEY

P present, status uncertain

C common

R rare

A absent

Adapted from Merrimack Wastewater Management – Key to a Clean River – Northeastern United States Water Supply Study, Appendix IV-B, Biological Impacts, Volume I. New England Division, US Army Corps of Engineers, 1974.

Table 7: Mammals of Essex County, Massachusetts

Squirrels and mice are found in abundance in nearly all habitats, including the most densely developed residential and commercial areas. Mice are especially prevalent in areas of active farming.

BioMap

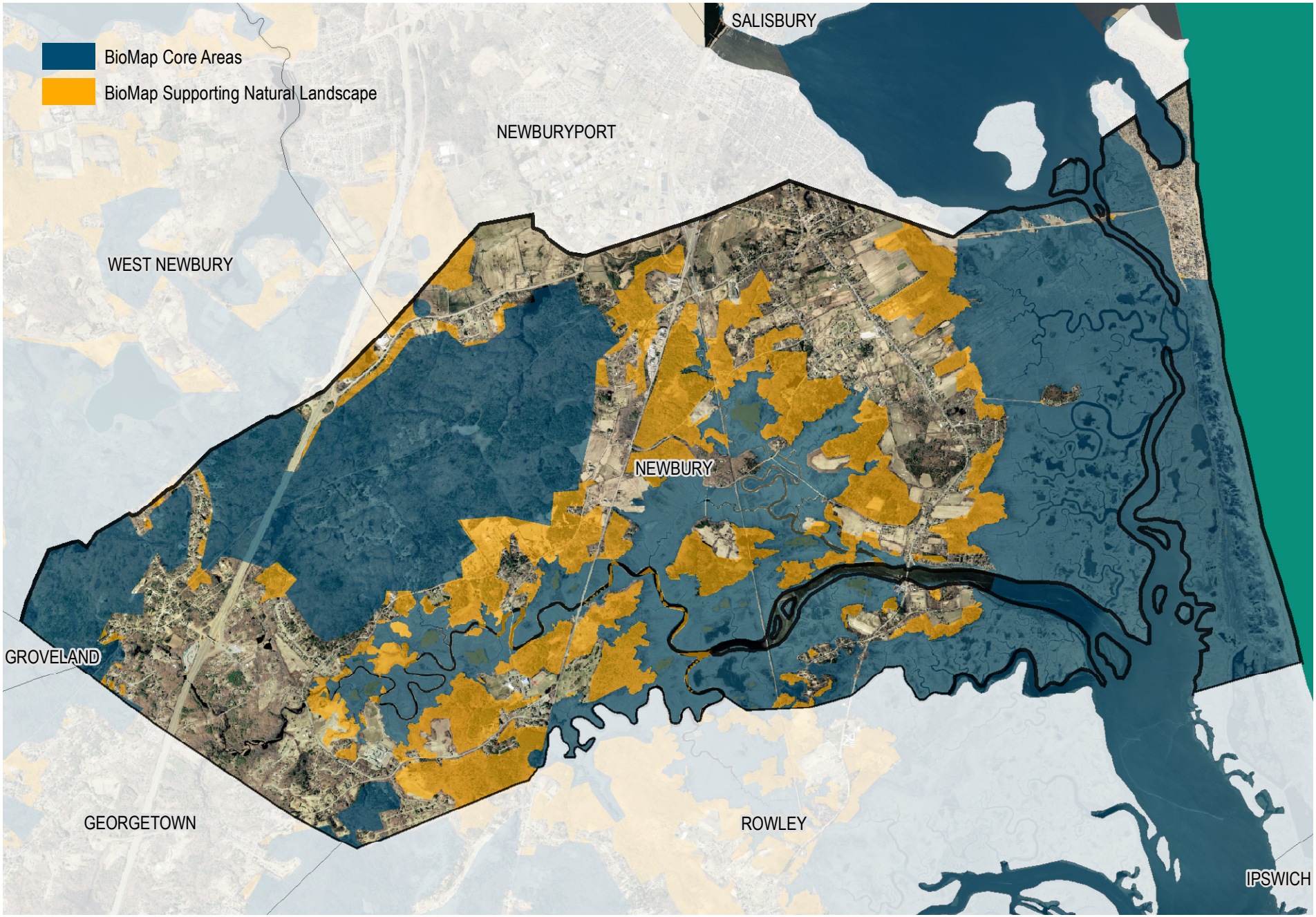
The Mass Natural Heritage and Endangered Species Program created the BioMap in 2001 to identify the areas most in need of protection in order to preserve native biodiversity in Massachusetts. While it focuses on state-listed rare species and exemplary natural communities it also seeks to include the full breadth of Massachusetts' biological diversity. The goal of the BioMap is to promote strategic land protection by identifying those areas of the landscape that, if protected, would provide suitable habitat over the long term for the maximum number of plant species, animal species, and natural communities. BioMap "core" areas identify the lands that, if protected, would preserve the rare and exemplary species and communities of Massachusetts. BioMap "supporting natural landscape" identifies those areas that directly surround core habitats, connect core habitat together, or are large undeveloped patches of vegetation (MNHESP, 2001).

Almost 53% of Newbury (8,200 acres) lies in BioMap core areas. An additional 2,600 acres (17%) of Newbury lies in the BioMap supporting natural landscape areas. Map 5 shows the parts of Newbury that fall in the core and supporting natural landscape areas.

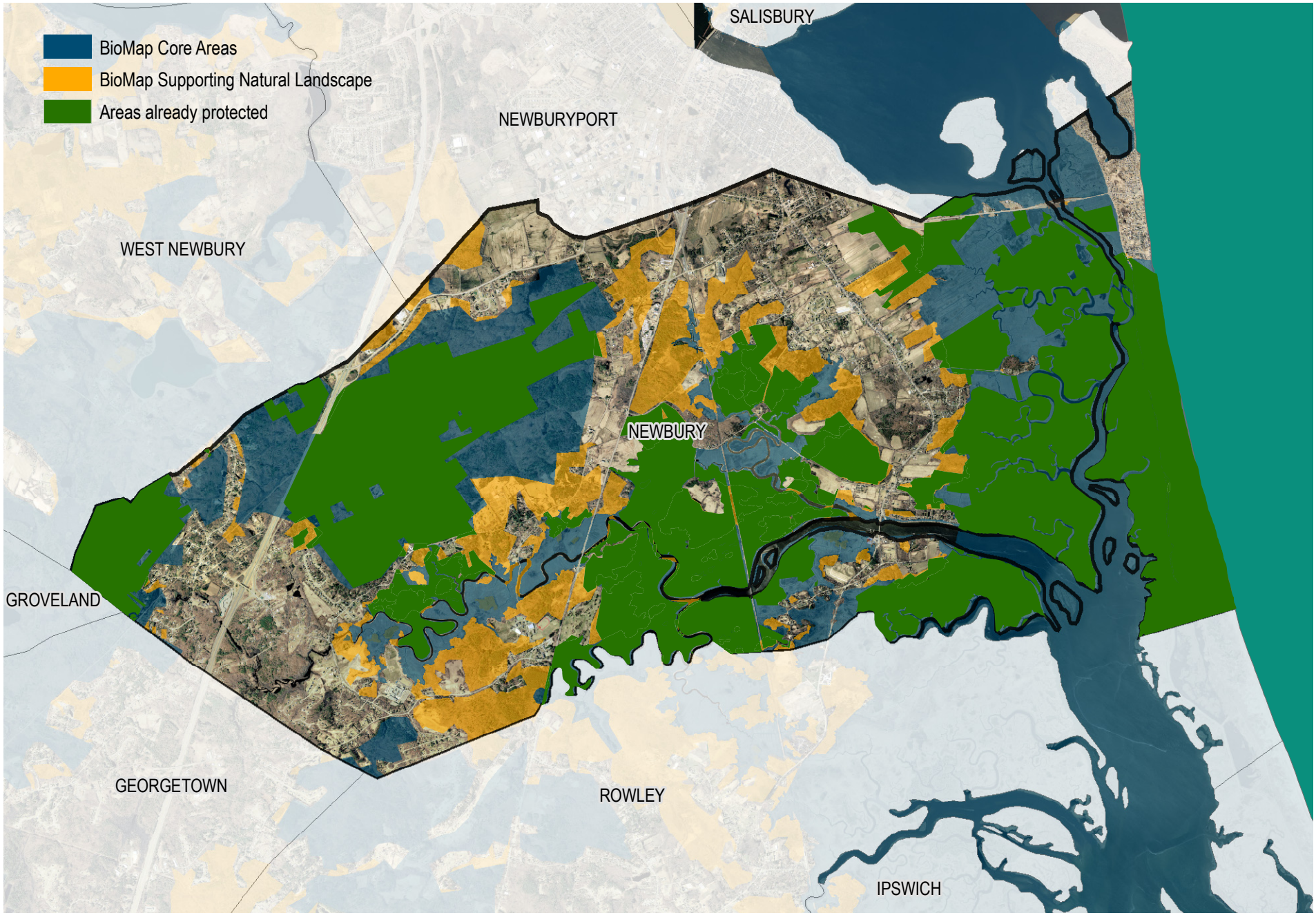
67% of the BioMap core areas are already protected in Newbury while 32% of the supporting natural landscape is protected. 5517 acres of BioMap Core is protected

Map 6 identifies the BioMap areas in blue (Core) and orange (SNL) that are still unprotected. The dark green areas are already protected by federal, state, municipal, or non-profit ownership.

The MNHESP program completed the "Living Waters" study in 2004. This study is similar to the BioMap. However, rather than focusing on terrestrial protection of species, it identifies those aquatic habitats that must be protected in order to protect rare species and unique aquatic communities in Massachusetts (MNHESP, 2004). There is no living waters "core" area in Newbury. Only a very small amount of living waters "critical supporting watershed" area falls in Newbury. In addition, the Living Waters project concentrated on freshwater biodiversity, not salt or estuarine communities. For these reasons, the living waters study will not be considered.



Map 5: BioMap Core and Supporting Natural Landscape Areas



Map 6: Unprotected BioMap Areas in Newbury

Hunting, Shellfishing and Finfishing

Introduction

The section below describes the habitat and hunting resources of the salt marshes on the North Shore of Massachusetts. With the presence of multiple organizations, both federal, state, and non-profit, such as the Parker River National Wildlife Refuge and the Mass Audubon Joppa Flats Sanctuary, this is one of the premier birding areas in Massachusetts as well. If interested in learning more about birding in this area, go to the Joppa Flats Education Center and Wildlife Sanctuary, or follow links from their web-site,http://www.massaudubon.org/Nature_Connection/Sanctuaries/Joppa_Flats/index.php.

The Newbury ACEC contains only a portion of these resources. While information exists on the number of waterfowl that are shot each year in Newbury, it is not useful to summarize this information. Newbury is only one small piece of the entire Atlantic coast flyway. Attempting to draw conclusions about the health of waterfowl populations based on information obtained from only one portion of the entire flyway is not useful (Personal communication, H.W. Heusmann).

Rather than attempting to discuss the health of waterfowl populations, considering the quality of habitat is perhaps a more productive approach to take. The North shore marsh contains some of the last habitat in the whole Northeastern United States suitable for black ducks. This species is observed to winter in the estuarine ponds in North shore towns (Personal communication, H.W. Heusmann). The black duck could serve as a good indicator species for the overall quality of habitat in these marshes for waterfowl.

In recent years, money derived from Ducks Unlimited has allowed the purchase of additional equipment to damn up ditches on some parts of the marsh in order to create panes (pools of water) attractive to ducks and other bird species. The Massachusetts Mosquito Control District implements such "Open Marsh Water Management" techniques and is partnering with the Parker River National Wildlife Refuge in an effort to improve habitat for waterfowl on the refuge. Funding for additional restoration work may be available if Newbury applies to the North American Wetlands Conservation Act (NAWCA) Grants Program. Small scale grants are available to municipalities for up to $50,000. Applications are accepted twice a year to these grants (Personal communication, H.W. Heusmann). This restoration technique assumes that the creation of additional ponds is good for ducks and is also good for the marsh. However, the next section explains why this management approach needs to be used carefully.

"Open marsh water management" is a technique that generates habitat for waterfowl as well as provides control for mosquito populations. In addition, it allows for the establishment of fish populations in parts of the marsh that were previously drained. However, closing up ditches will result in inundation of areas of the marsh that were previously drained. This will inhibit access to parts of the marsh that used to be harvested for salt marsh hay. Seen from this perspective, open marsh water managers must be sensitive to the income that farmers generate from the salt marsh. Coordinated efforts are needed to review potentially conflicting goals, with maps and data to support salt marsh haying areas, bird habitat protection, and marsh restoration where possible.

In addition, researchers at the Marine Biological Laboratories are not certain if the creation of additional ponds on the marsh is in fact a desirable state to create. Recent research by MBL shows that in comparison to 1940 images of the salt marsh, there are many more ponds on the marsh today (Valentine et al. 2005, submission to Estuarine, Coastal and Shelf Science).

The light blue areas in Figure 4 show hydrological features derived from 1953 NOAA topographic survey sheets. These features were overlaid upon ortho-rectified aerial photography. It was then possible to compare the amount of ponding present in the 1950s to that present today. These images show several areas in the Rowley River marshes. Some ponds were lost due to ditching. However, a much larger area of ponds has been created since the 1950s. When discussing these patterns, the researchers offered the following:

> "The research leads to the question of whether the ponding represents a process where marsh is returning to a natural condition (i.e., with ponds) following the abandonment and infilling of ditches or reflects an imbalance between sea level rise (the rate of which is predicted to rise with global warming) and

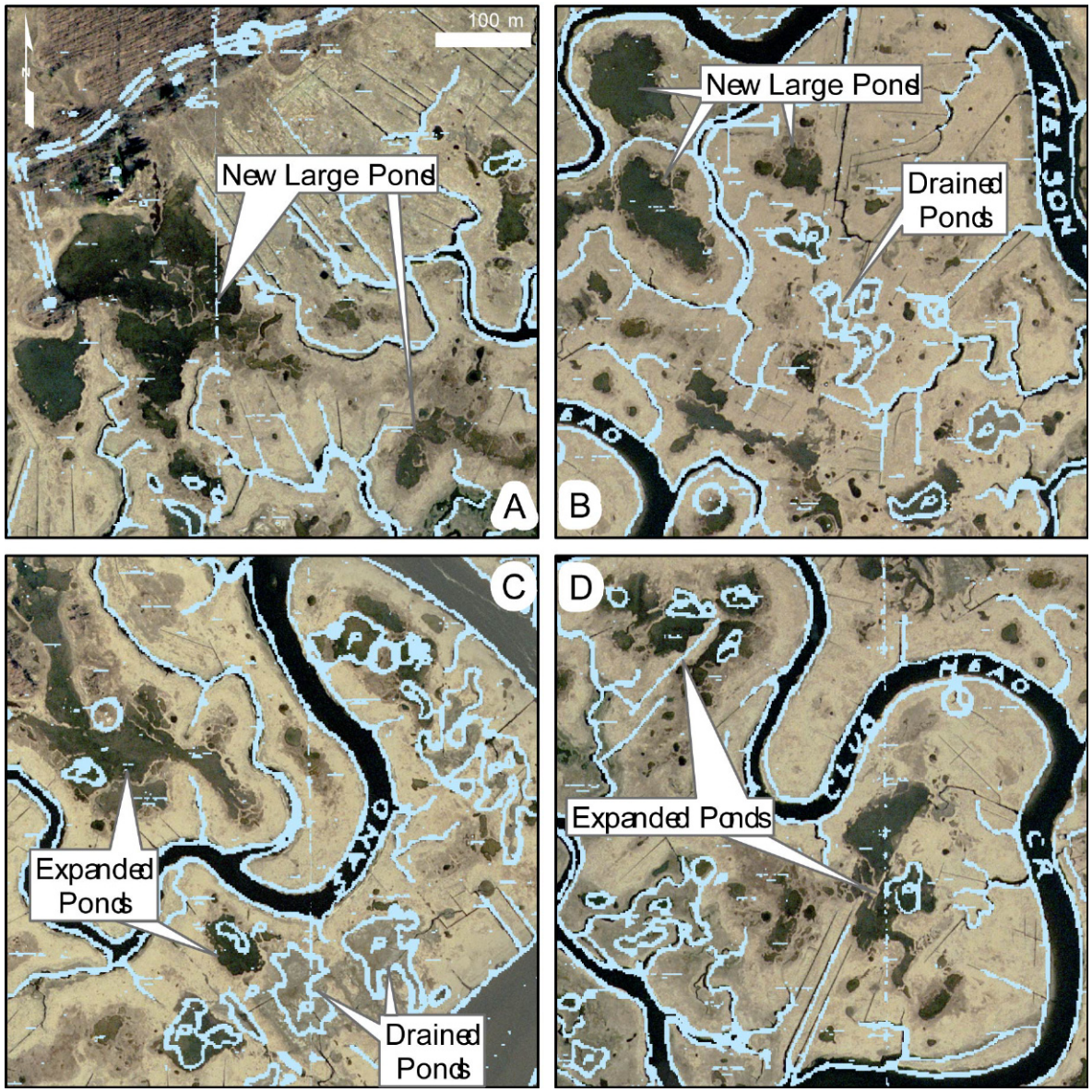


Figure 4: Comparison of 1940 marsh conditions to current marsh conditions

marsh accretion. If the former, there is the additional question of whether the very large ponds we observe are part of a natural marsh landscape or a type of transitional feature that could possibly persist and prevent a return to a pre-colonial condition. If the observed ponding reflects an imbalance of marsh building forces, could a renewed program of marsh ditching offset the effects of sea level rise? A program of this sort would run counter to current attempts to plug ditches to promote open water habitat and wildlife use on the marsh."

They are unsure if the ponding is natural or if it represents a symptom of marsh degradation. If it is natural, then "open marsh water management" is a beneficial practice, helping to restore the marsh as well as creating habitat for waterfowl. However, there is the alternative that ponding is actually damaging the marsh and that open marsh water management is thus exacerbating marsh degradation (Valentine et al. 2005, submission to Estuarine, Coastal and Shelf Science).

This example highlights the need for Newbury officials to keep in touch with researchers from the PIE-LTER and MBL. The salt marsh system is not completely understood. The results of future research will have direct impacts on the type of management actions that are taken.

Human Uses and Trends

Hunting

The following section was prepared by the Newbury Estuarine Plan Committee.

The upper one third of the Parker River/Essex Bay ACEC, and the marshes and wetlands on the North Shore have historically been the most prodigious hunting, fishing and shell fishing area in the Northeastern United States (if not the country). The area between the Merrimack and Ipswich Rivers, in particular, are rich in abundant sources of food and water that waterfowl, ducks and other birds require. The natural resources of the area were clearly recognized by the first settlers of Old Town who arrived in 1630. These settlers carved out small tracts of land along the Parker River and associated wetlands for farming and livestock. They often supplemented their diet by consuming local ducks and waterfowl.

Late in the 1700s, the inhabitants of what is now designated an ACEC recognized that the waterfowl numbers in the area could also represent a significant source of income to them by selling the harvested birds to the markets, inns and restaurants that were found in the growing town centers of coastal New England.

The economic benefits of the harvest resulted in a rapid increase in the number of people who participated in the harvest and led to the coining of the "market gunning" term. By the early 1900s, there was an excess number of people who were market gunners and the over hunting in the ACEC culminated in the passing of the Migratory Bird Treaty Act of 1918. The act provides the basis for the harvesting limits in force to this day and it contributed to the cessation of market gunning as an activity in the ACEC. The act is also credited for creating the recreational hunting movement that is one of many tools in successfully managing wildlife numbers in the ACEC.

There has been a significant decline in the number of hunters in the Atlantic Flyway since the early 1970s as can be seen in Table 8, but the importance of the North Shore marshes to hunters remains undisputed. The data in Tables 9 - 11 indicate that Essex County accounted for 20.4% of the state harvest for divers and 19.3% of the state harvest for dabblers. According to H.W. Heusmann (Mass Wildlife), "Though hunter numbers are a fraction of what they were, the Essex County marshes remain a popular venue for Bay State waterfowl hunters as well as our New Hampshire neighbors and other out of state residents." Heusmann continues, "The Parker River Wildlife Refuge is a popular destination."

Heusmann notes that, "The Essex County marshes have also been important for waterfowl research since the 1930s." He cited the example of the discovery that ,"At one time, it was believed that there were two species of black ducks; the common black duck and the northern, or red legged black duck. However, biologists in Newbury collected and examined specimens from hunters by offering to clean the birds for free and determined that the so called red legged black ducks were merely adult males that migrated south from Canada later than did females and young of the year."

Year	Estimated Number of Active Waterfowl Hunters	Estimates of Days Hunted by Active Waterfowl Hunters
2001	6787	62901
2000	6949	67376
1999	*7247*	54822
1998	*8848*	71947
1997	*7697*	61797
1996	*9893*	79517
1995	*9433*	68239
1994	*11289*	91185
1993	*11228*	77860
1992	*11486*	81780
1991	*13450*	108100
1990	*15776*	119700
1985	*14325*	117000
1980	*16720*	143500
1975	*20560*	178200
1970	*23928*	159500
1965	*16200*	107400
1961	*12700*	96300

Table 8: Massachusetts Waterfowl Hunter Statistics for the Atlantic Flyway from 1961 through 2001 (source: Harvest Information Program)

	Essex	State Total	Essex (% of state total)
Redhead	-	-	-
Canvasback	-	20	0
G. Scaup	16	42	0.381
L. Scaup	-	87	0
Ringneck	10	167	0.06
C. Goldeneye	196	389	0.504
B. Goldeneye	14	19	0.737
Bufflehead	206	2255	0.091
Ruddy Duck	7	15	0.467
Oldsquaw	10	220	0.046
Harlequin	-	-	-
Stell. Eider	-	-	-
C. Eider	1577	9898	0.159
King Eider	-	-	-
Black Scoter	181	407	0.445
W.W. Scoter	834	1619	0.515
Surf Scoter	596	1293	0.461
H. Merganser	27	207	0.13
R.B. Merganser	111	1597	0.07
C. Merganser	4	314	0.013
Total Divers	3789	18549	0.204
All Species	10183	51733	0.197

Table 9: Portion of the Average Annual Harvest of Diving Ducks from Essex County in the Atlantic Flyway During 1991-2000

	Essex	State Total	Essex (% of state total)
Mallard	1588	13782	0.115
Mallard X B.	139	469	0.296
Mallard H.R.	31	150	0.207
Black Duck	3179	9838	0.323
Mex-Mallard	-	-	-
Mottled Duck	-	-	-
Gadwall	11	427	0.007
A. Wigeon	31	347	0.089
G.W. Teal	801	1996	0.401
B.W.-Cinn. Teal	26	85	0.306
Muscovy	-	-	-
N. Shoveler	6	6	1
Pintail	25	105	0.238
Wood Duck	537	5966	0.09
B.B. Whistling	-	-	-
F. Whistling	-	-	-
Misc. Hybrids	-	-	-
E. Wigeon	-	13	0
Misc. Ducks	-	-	-
Total Dabblers	6394	33184	0.193
All Species	10183	51733	0.197

Table 10: Portion of the Average Annual Harvest of Dabbling Ducks from Essex County in the Atlantic Flyway During 1991-2000

	Essex	State Total	Essex (% of state total)
Snow Geese White Morph	-	17	0
Snow Geese Dark Morph	-	-	-
Ross Geese	-	-	-
Whit Fronted Geese	-	-	-
Canada Geese	2388	14970	0.16
Atlantic Brant	9	342	0.026
Pacific Brant	-	-	-
Emperor Geese	-	-	-
Misc. Geese	-	8	0
Total Geese	2397	15337	0.156

Table 11: Portion of the Average Annual Harvest of Geese from Essex County in the Atlantic Flyway During 1991-2000

Other research initiatives identified by Heusmann include food habit studies on black ducks in Massachusetts in the 1940s.

Banding of ducks has been conducted in the region since the 1940s and based on this work Heusmann states, "From this we have learned that the black ducks that winter in the Essex County marshes come primarily from Maritime Canada."

Shellfish

Permits Issued

The following statistics relate only to Newbury shellfishing permits. It is interesting to see the trends between 1967 and 1996. Unfortunately, the number of permits issued since 1996 is not available because the data was no longer collected. The number of recreational permits issued over the years has steadily been declining (Figure 5). Figure 6 shows a corresponding decrease in the recreational soft shell clam harvest over the same period. The number of commercial permits more than doubled between 1967 and 1996 from less than 50 to very close to 100. In just the last few years the number of commercial licenses being issued has dropped again to around 50. While there is a lot of variability in the commercial soft shell clam harvest, the trend seems to be fairly flat over the entire period, remaining near 30 – 35,000 pounds of clams harvested. One can speculate that this indicates a fairly stable limit to what is removed from the marsh each year and what the marsh can replenish by the next year. There is spotty information collected about oyster, razor clam, eel, and mussels being harvested. This information is available upon request.

Monitoring & Enforcement

Map 7 shows the designated shellfish areas in Newbury. Currently the tidal portions of the Parker River, Little River, and Mill River are off limits to shellfishing due to the periodically high levels of fecal coliform in these areas. However, there is some interest in exploring the removal of the prohibited designation from the lower portion of the Parker River.

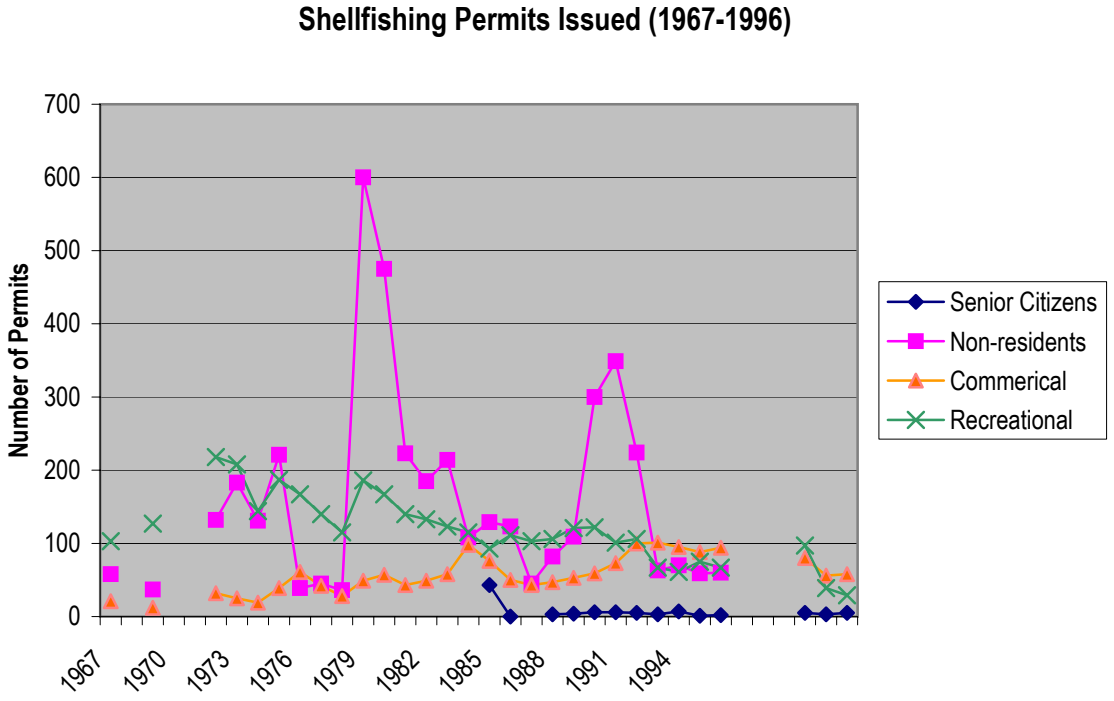


Figure 5: Shellfishing permits issued (1967 – 1996)

Shellfish Management

Currently, there are roughly 40 commercial clammers that make use of the Newbury boat ramp to gain access to the local shellfisheries (Personal communication, John Keville). At times, this results in a very busy boat ramp with a significant queue to put in or pull out boats. However, no concerns were voiced by the harbormaster about the volume of boats making use of the ramp.

Boating

Boating Facilities and Service

The table below shows the number of permits issued since 1990 in Newbury.

Moorings

There are currently 284 mooring permits that have been granted in the town of Newbury. There is only one "designated mooring area" in Newbury, located upstream of the route 1A bridge on the Parker River. Water uses are limited in this designated area. Additional moorings have also

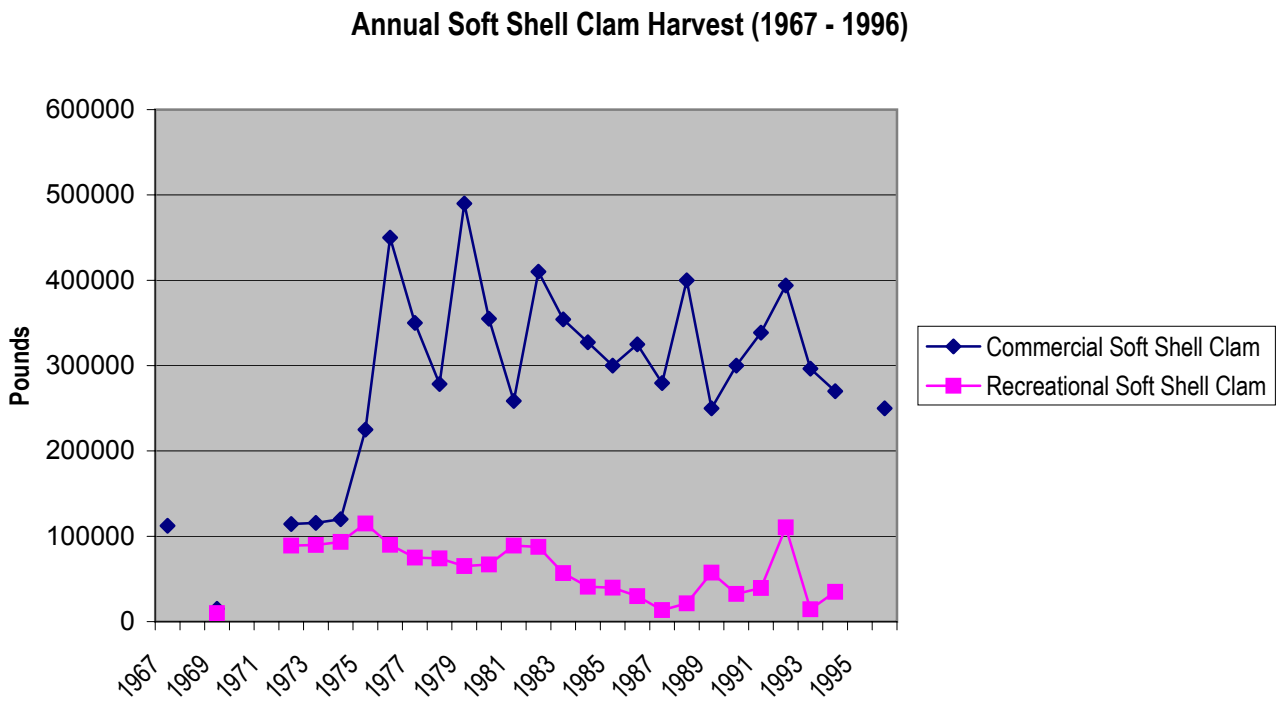


Figure 6: Annual soft shell clam harvest (1967 – 1996)

been placed in Plum Island Basin which is a multi-use area. Activities such as sailing, water-skiing, jet-skiing, and wind-surfing are allowed (Personal communication, John Keville). Several private organizations exist that have multiple permits. These include Pert Lowell (8 moorings), Old Town Country Club (15 moorings), Fernalds Marine (30 moorings), and Riverfront Marine (10 moorings).

Slips

Slips can be rented or leased from the two marinas in town or one can apply for a permit. Fernalds Marine has 12 slips while Riverfront Marine has a large number of slips that are available. The total number of slip permits issued in Newbury is 205.

Ramps

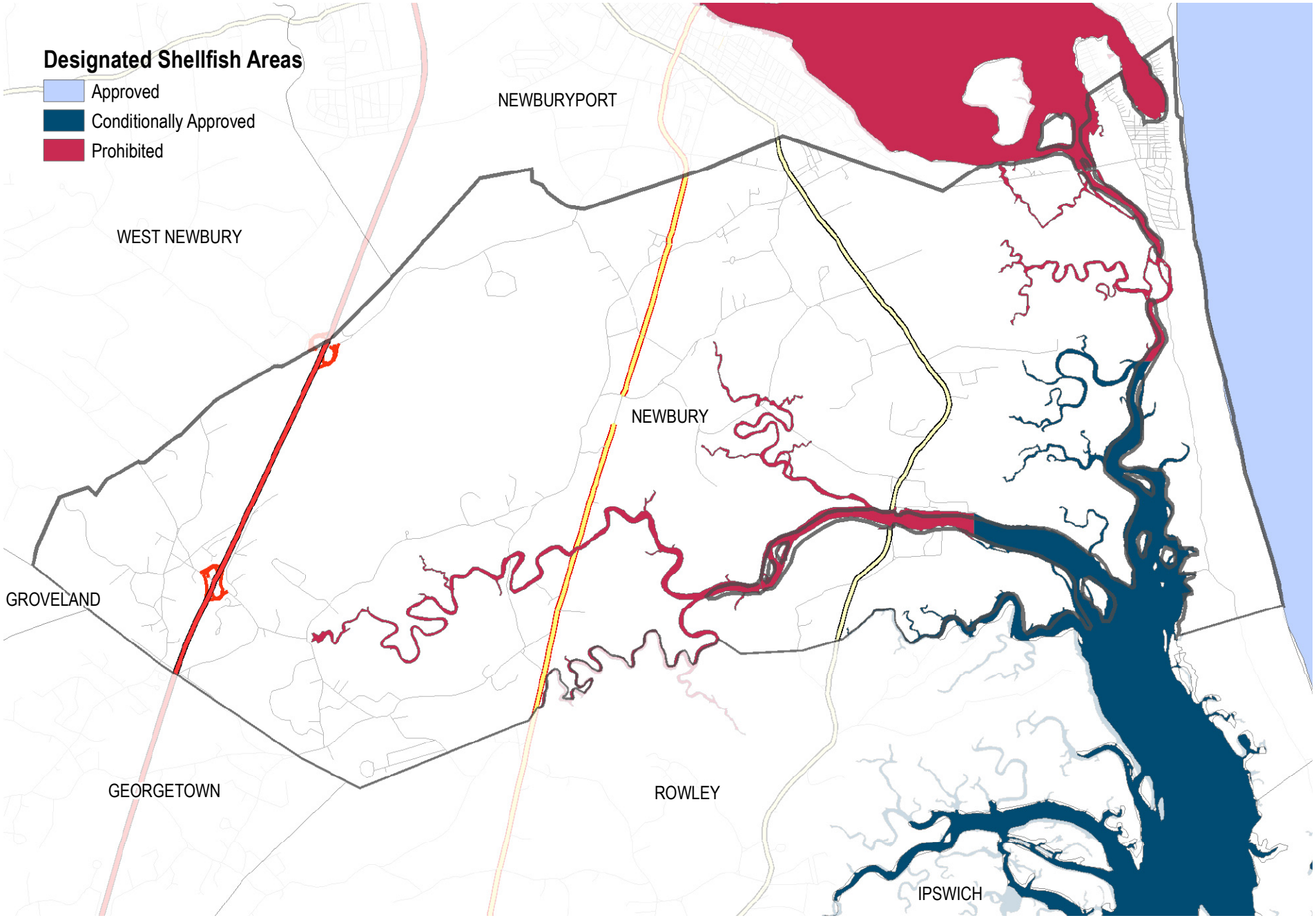
There is only one boat ramp in the town of Newbury, located at the crossing of route 1A over the Parker River. Access to the town ramp is automatically granted to anyone who has a mooring permit. Additional stickers are also sold to those interested in making use of the ramp. However, the ramp sticker does not permit parking at the ramp, only use of the boat ramp. Currently 716 ramp stickers are active. At peak usage, almost 200 boats will make use of the ramp to access the Parker River, Plum Island Sound and beyond. Parking at the ramp is only available to town residents who have the appropriate sticker.

Docks

There are currently 52 temporary or seasonal docks that are permitted locally by the harbormaster under Chapter 91, section 10A, of the Massachusetts General Laws. Chapter 122 of the town bylaws also pertains to docks. Each of these docks applied to the Newbury Conservation Commission for a permit. Once approved, a 10A permit was issued and the structures (floats or rafts held by anchors or bottom moorings) were created. There are 4 docks that are permitted by the State (DEP) rather than Newbury. Riverfront Marine Sports, Inc. is an example of the state permitted docks.

As summarized on the ACEC Program website, one section in the Department of Environmental Protection (DEP)'s Chapter 91 Waterways Regulations, 310 CMR 9.32 (1)(e)(4), relates to any "privately-owned structure for water-dependent use below the high water mark" located in a state-designated ACEC. In effect, a state-approved RMP allowing private water-dependent structures within an ACEC is required for any private structure built after October 4, 1990. Specifically:

- This regulation establishes that the DEP can license private water-dependent structures (including docks and piers) in an ACEC if they



Map 7: Designated Shellfish Areas

	Moorings	Slips	Ramp	Total Permits	10A Permits	Mooring Docks
1990	188	81	60	349		
1991	207	75	125	407		
1992	244	73	127	444		
1993	196	119	143	458		
1994	237	125	161	523		
1995	227	153	193	583		
1996	258	169	203	630		
1997	244	190	204	638		
1998	255	216	212	683	37	
1999	285	200	219	704	41	
2000	314	173	226	712	47	12
2001	328	188	218	734	50	12
2002	268	196	198	662	48	15
2003	248	205	209	662	52	18
2004	284	221	201	706	52	21

Table 12: Boating Related Permits Issued

were built before October 4, 1990. If a resource management plan has been locally adopted and state-approved, the structures must be consistent with the RMP.

- However, for private water-dependent structures built after October 4, 1990, DEP can only license those structures where there is a locally adopted and state-approved RMP, and where the structures are consistent with that RMP.

A state-approved plan identifies where water-dependent structures may be appropriate, or after thorough analysis and review, the plan may simply recommend the continuation of the Chapter 91 prohibition for these structures within the ACEC. This estuarine plan for Newbury is not intended to address Chapter 91 and does not seek state approval for any changes to Chapter 91 review.

Traffic

Volume

Newbury has never had so many watercraft in the waterways that traffic direction was necessary (Personal communication., John Keville) The lack of traffic in Newbury stands in contrast to the situation in the Merrimack River in Newburyport, which frequently requires traffic direction.

Locations

Motorized watercraft will travel downriver from the Newbury mooring field into the Plum Island Sound and beyond. It is rare for motorized craft to travel upstream of the mooring field the Parker River. Canoes, kayaks, and sailboats are the predominant type of craft that venture upstream (Personal communication, John Keville).

Erosion

There is concern that power-boating in the Parker River and Plum Island Sound may exacerbate erosion of the shoreline due to increased wave action. No research on this subject was found relating directly to the Parker River or Plum Island water bodies. Massachusetts CZM compiled a management guide for Personal Watercraft (PWC) use in coastal areas. Studies reviewed for this CZM document found no significant difference between PWC-induced sediment suspension and that caused by other outboard motorboats (Anderson, 2000). Another study concluded that when operated according to manufacturer recommendations, PWC do not significantly affect erosion rates or ambient turbidity levels (Continental Shelf Associates, 1997). More research

is necessary before any specific recommendations can be made.

Canoe / Kayak / Non-motorized boat access

Public access to the estuary using canoes and kayaks is fairly limited in Newbury. There are eight access points to the estuarine resources of Newbury that residents and non-residents use (Map 8). Not all are accessible to non-residents, and do not provide access to the river at all times of day due to the tidal changes.

1) "Route 1" access near William Forward Wildlife Management Area (Kents Island) - The Massachusetts Public Access Board provides information on the "Route 1" access point to the Parker River. A detailed map and description of this access is available online.

2) "Hay Street" access - The access near Hay St is difficult. The access itself is located off of the road that leads out to Kent's Island where a bridge crosses Kent's Creek. The road to the island is closed to cars.

3) Newbury "Town Landing" - At the Newbury town landing, town residents can launch boats that require trailers. Non-residents can also launch boats with the appropriate ramp sticker. However, non-residents are not permitted to leave cars at this ramp. Parking at the town green and walking your boat to the ramp is also not usually permitted.

4) Cottage Road – Cottage Road provides access to the Parker River just downstream of the Newbury Landing. However, this is a residential street with no available parking. Unless you live on Cottage Road or have obtained permission to make use of a resident's driveway, this access is functionally off-limits to most residents and non-residents alike.

5) "Plum Island Turnpike" bridge - The Plum Island Turnpike access provides access to the Plum River. However, this point is available for only a portion of the tidal cycle (plus or minus 2 hours from high tide). At other times, water levels make this point very difficult. Paddling south brings you to the confluence of the Parker River and the Plum Island Sound. There may be heavy power boat traffic and winds at this point. Paddling upstream against the tide is not feasible.

6) Parker River National Wildlife Refuge ("PRNWR") – The Refuge has been allowing some river access from Parking Lot 1 with permission from the Refuge Management. It is very important to contact the refuge before using this access point.

7) "Middle Road" near Governor Dummer Academy – While parking is available at this location, it is difficult to access the river due to erosion taking place on the bank. This point allows only a short trip upstream or downstream with no convenient take out in either direction.

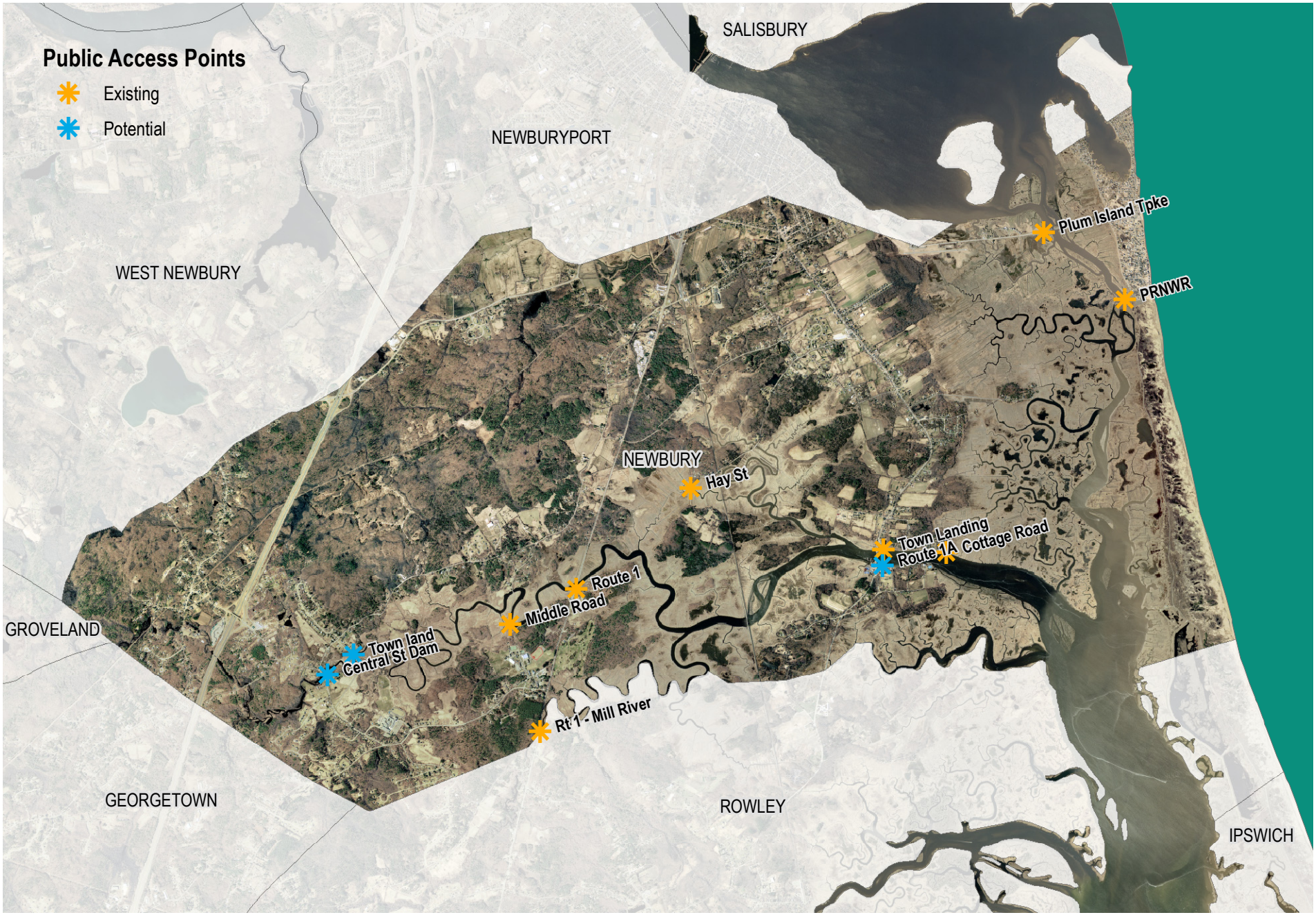
8) "Rt 1 – Mill River" – On the border between Rowley and Newbury there is an area just off of Route 1 where limited parking is available and provides access to the Mill River. Access, however, is not simple at this point.

There are three potential access points that the PRCWA and other groups, including the Massachusetts Public Access Board are working to create in Newbury.

1) Downstream side of "Central St Dam" – The PRCWA in cooperation with Massachusetts Riverways Program has submitted a grant for technical help to investigate what would be involved in establishing this access point.

2) "Route 1A" bridge by Fernald's Marine – This access point received funding from the Massachusetts Public Access Board and is in queue to be built. Initially, creation of this point would have taken place concurrently with the renovation of the bridge. However, most recently these two projects have been separated. It is likely that the renovations to the bridge should happen prior to creation of the access point (Pers comm, Russ Cohen).

3) Town-owned Central street recreational land ("Town land") – This put-in would have access to some parking that is nearby and is near the recently purchased town land. A boardwalk over the existing marshy areas would need to be constructed to facilitate access.



Map 8: Existing and Potential Public Access

Inland and Shoreline Use and Development

Transportation/Utilities

Roadways, parking lots, rail lines, and other utilities have some of the most significant impacts on the estuarine and river systems. Roads fragment larger pieces of habitat into multiple smaller chunks, that are not as valuable to resident species. There are also many points where roads cross estuarine streams. If not properly engineered, these crossings can result in restriction of normal tidal flow. An example of one such tidal restriction is shown in Figure 7. Rail lines cause similar restrictions to tidal flow and are also discussed below. Stormwater runoff is the other major type of impact of roads and impervious surfaces. Storms wash oil, sediments, nutrients, and even bacteria, such as e-coli, into the water systems. In addition, high percentages of impervious surface can contribute to flooding and thermal pollution.

Tidal Restrictions

The Great Marsh stretches at least 6 miles inland at some points, resulting in multiple points where roads and railroads have crossed tidal streams and rivers. In Newbury, there are 34 documented tidal crossings (PRCWA, 1996). At each of these points, tidal flow into the upstream side of the marsh is potentially restricted due to the materials used in and around the crossing or due to the small size and type of culvert that was used under the road. The impacts on marshes due to tidal restrictions are multiple:

Figure 7: Newman Road Tidal Restriction (photo courtesy of MVPC)

1. The size of the marsh can decrease because the normal amount of salt water that enters into the marsh is decreased, effectively filling less of the marsh. Upland plant species will begin to encroach on areas that were traditionally salt marsh.
2. With less salt water flowing in and out of the marsh, the normal flushing regime is disrupted. Freshwater that enters the marsh will have a greater residence time before being flushed out by the salt water. This gives some species, most notably Phragmites (Phragmites australis), a competitive advantage over salt marsh species. Phragmites will more easily establish in salt marsh environments that have higher levels of fresh water. Other freshwater species such as cattails (Typha spp.) also indicate impaired flow.
3. If the culvert is placed too high, water can flow in at high tide, and then become trapped at low

Priority	Name of Tidal Restriction	Difference in tidal range (upstream vs. downstream)	Number of times difference in upstream and downstream side of the restriction was more than 5 inches apart
High	N15 - Unnamed Creek - Newman Rd.	33.5	4
High	N2 - Unnamed Creek - Plum Island Turnpike	22.8	5
Medium	N28 - North Branch Mud Creek - Rt. 1A	9	1
Medium	N26 - Unnamed Creek - Rt. 1	19	2
Medium	N14 - Unnamed Creek - The Trustees of Reservation Rd.	5.5	1
Medium	N12 - Little River - Hay Street	0.5	1
Medium	N20 - Parker River - Middle St.	0	2

Table 13: Priority tidal restrictions

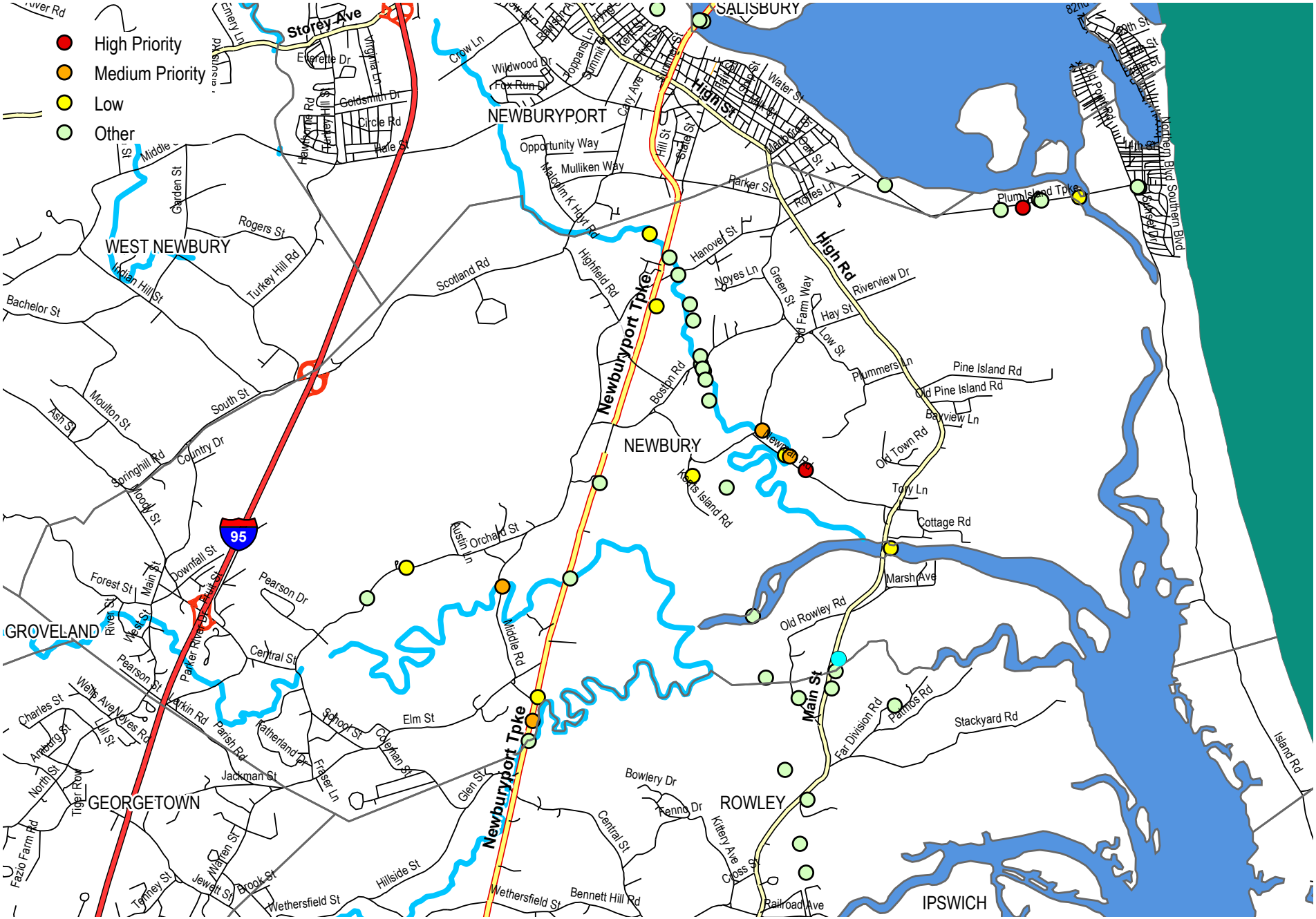
tide as the water recedes. The Newman Road salt marsh (Figure 7) suffers from just such a restriction. The salt marsh is roughly 20 acres and lies upgradient of Newman Road. This Trustees of Reservations-owned / privately-owned marsh does not receive full tidal flows due to an undersized culvert.

A detailed study entitled "Tidal Crossings Inventory and Assessment" was undertaken in 1996 to inventory and prioritize tidal restrictions in the towns of Essex, Gloucester, Ipswich, Newbury, Newburyport, Rockport, Rowley, and Salisbury. The inventory was split into three phases. Phase I assessed all known restrictions in each town and quantified the impairment based on biological and physical conditions. In Newbury, 28 restrictions were assessed during Phase I. Phase II identified all sites that had a score of 14 or greater (15 sites in Newbury). Phase III collected more detailed information for 5 crossings where a tidal differential of greater than 5 inches was recorded. Upon review of the data for the "Estuarine Management Plan", a total of 7 crossings actually had > 5 inch differentials, although the additional two restrictions were not as severely impaired.

Table 13 lists the 5 tidal restrictions identified in Phase III of the inventory. The two additional restrictions where the tidal differential was greater than 5 inches are also shown in the table in italics.

Each of the above restrictions deserves more research as well as funding in order to make eventual restoration more likely. Another factor that might also be considered is the number of acres of upstream marsh that might benefit from removal of a tidal restriction. This factor is not considered in the above analysis.

Map 9 shows all 34 crossings in Newbury. The seven priority locations are denoted by the high and medium priority symbol. The additional locations that were assessed in Phase II of the study are identified by the low priority symbol. The remaining points (shown in green) were part of Phase I of this study.



Map 9: Tidal Restrictions in Newbury

Other projects are underway by state and federal agencies to identify potential restoration sites. The section on Restoration describes the NRCS Wetlands Restoration Planning effort as well as the Massachusetts Office of Coastal Zone Management's "Great Marsh Coastal Wetland Restoration Plan".

Flooding Areas

Although flooding is a natural occurrence, there are conditions that exacerbate flooding and can be mitigated. Areas that have high percentages of impervious cover due to roads, parking lots, and buildings, will result in increased levels of runoff and potentially flooding. There are several locations where flooding is regularly recorded and there are actions that could be taken to remediate these conditions. Further information needs to be collected to identify the flood-prone areas that could benefit from further research and evaluation of potential restoration alternatives.

Shoreline structures and erosion control

No information was collated on the existing locations of seawalls, docks, rip-rap, and other erosion control structures in the Newbury estuarine area. Revetements, sea walls and other similar structures will often block access along the shoreline. These structures can also pose threats to shellfish resources, natural shoreline movement, wetlands, vegetation, and water quality (Pleasant Bay Technical Advisory Committee, 1998). Inventory of structures such as this should be undertaken.

The Pleasant Bay ACEC Resource Management Plan provides an example of some of the issues and solutions that can arise surrounding this issue. Due to negative or unknown impacts to ACEC resources, a moratorium was placed on issuance of new licenses for docks and piers in the ACEC. In the management plan, they made several recommendations:

- Develop a methodology for a shoreline resource assessment to measure impacts on shoreline wetland resources from docks, piers, and erosion control structures.
- Develop performance standards and design criteria for docks, piers, and erosion control structures.
- Keep the moratorium in place until the performance standards and design criteria are adopted into regulation.
- Make the moratorium permanent in areas designated "resource sensitive".

Further research is needed in the Newbury ACEC to determine what actions might be appropriate.

Navigational Dredging

No navigational dredging has taken place in the Parker River. The Harbor Patrol closely monitors the location of buoys in relation to changing tidal conditions. Buoys will sometimes be moved up to 9 times during the boating season to keep boats from running into the shifting shallow areas (Personal communication., John Keville).

DEP's Wetlands and Waterways Regulations provide added protection to resources in ACECs. Thus, improvement (new) dredging is prohibited within an ACEC except for the sole purpose of fisheries and wildlife enhancement. Maintenance dredging remains eligible for a permit.

Major Project Impacts

Commuter Rail Reconstruction Project

The Newburyport MBTA rail line runs through multiple portions of the Parker River / Essex Bay ACEC. In 1998, the commuter rail extension project was completed. This project initially created a potential window of opportunity to ameliorate the tidal restrictions that exist on the inland portion of the marsh at multiple points along the railroad line. In the town of Newbury, there are 11 tidal restrictions that exist along the MBTA line in the ACEC (PRCWA, 1996). Of these multiple restrictions, one of the culverts was replaced with a more appropriately sized pipe, allowing for unrestricted tidal flows into and out of the marsh. However, the remaining culverts were left as is. An additional challenge was created by the placement of rip-rap that was too small in order to stabilize the creek beds. While it did serve to stabilize the beds, the rip-rap has also served as a sediment and organic material trap, further restricting the flow of tidal waters into and out of the marshes. There are additional anecdotal claims made by upstream residents that the flow capacity of the river through this span was significantly reduced by the reconstruction (Personal communication, Ed Reiner). It is difficult to corroborate these claims and only a comparison of pre-construction

to as-built surveys could allow the determination of the actual impacts of the construction (Personal communication, Ed Reiner). A restoration project at the Redgate salt marsh has been undertaken by the MBTA as (at least partial) mitigation for the rail line project impacts.

There are several issues that remain unresolved currently in relation to this project:

- Determination if the Parker River bridge abutments and retaining walls are in compliance with the approved plans and maintain the same flow capacity volume as the old bridge. There are over 1000 acres of tidal wetlands upstream of the bridge and even a minor reduction in tidal range / flow volume could cause significant negative impacts (pers comm. Hunt Durey to Ed Reiner).
- What actions are still necessary and appropriate to mitigate the impacts of the improperly sized rip-rap placed to stabilize the culverts?

Community Facilities and Services for Solid Waste

Since the early 1960s, the Town has operated a solid waste disposal facility on Boston Road just west of the Little River. The "dump" was originally an unlined landfill that served the Town well for many years. In the early 90s, MA DEP began to seek the closure of unlined landfills. The landfill was also nearing capacity. It is uncertain what the ongoing impacts of this landfill are on the water quality of the Little River. The solution in 1996 was to bond $4.4 million of town money to "mine and line" the landfill. In relation to the costs of disposal in other towns this initially was a relatively cheap solution. However, the project began to run into difficulties in 1998 culminating in the August, 2000 closure of the facility by the Massachusetts Department of Environmental Protection (DEP). Since this time, other options for the disposal of town waste have been considered. Camp, Dresser, and Mckee (CDM) was hired and presented various disposal options to the town, including a transfer station, curbside collection, or curbside collection with a "convenience center" or small citizen drop-off location. The transfer station option was approved by the board of health and subsequently by a special town meeting in the summer of 2002. At present the Newbury Solid Waste Facility is complete and fully operational.

Currently the old landfill is capped and normal post-closure monitoring is occurring. It is uncertain if this monitoring data may be of use to determine if any impacts result from storm water runoff. At the time of the closing and capping of the old landfill, there was concern that the freshwater run-off from the landfill would improve habitat conditions for the invasive Phragmites. At this time it is unclear if such a situation was created by the two large sedimentation basins that have been created at the landfill site (Personal communication, Ed Reiner).

Plum Island Project

The following section was prepared by the Newbury Estuarine Plan Committee.

The City of Newburyport and the Town of Newbury are in the process of extending wastewater and water service to Plum Island, in Newbury and Newburyport. The recommended plan includes extension of the Newburyport water supply and collection of wastewater via vacuum sewers for conveyance and treatment at the Newburyport Wastewater Treatment Facility.

Plum Island is a barrier island surrounded by the Merrimack River, the Atlantic Ocean, the Parker River, and the Plum Island River. The northern end of the island is populated by dense housing on small lots that are serviced by private drinking water wells and on-site sewage disposal systems. Approximately 60 percent of the Plum Island population resides in the Town of Newbury, and the remaining 40 percent resides in the City of Newburyport. Plum Island is comprised of developed land, as described above, including primarily private residences, some small businesses and a large undeveloped and protected region to the south (the USFWS Parker River National Wildlife Refuge). The state DMF Shellfish Purification Plant and a national Coast Guard station are located at the northern end of the island.

This project has evolved in response to growing environmental and public health threats on Plum Island. The small lot sizes, sandy soils, high groundwater table, and shallow septic systems create an environment poorly suited to support both individual drinking water wells and individual septic systems. Both the City of Newburyport and the Town of Newbury have proposed and support

the replacement of individual on-site septic systems with City of Newburyport sewer service and the replacement of individual on-site drinking water wells with drinking water, also supplied by the City of Newburyport. These proposals for water and sewer service have been incorporated into the Administrative Consent Order (ACO) issued to the City of Newburyport and the Town of Newbury by the Massachusetts Department of Environmental Protection (DEP). The ACO contains stipulations and deadlines for implementing "a combined water and sewer project to solve the problem."

Construction associated with this project is within a portion of the Parker River/Essex Bay Area of Critical Environmental Concern. However, construction is on developed properties. Haybales and siltfence are being installed where and when the work area abuts salt marsh or waterways, to prevent the transport of sediment to down gradient wetlands and waterways during construction. Directional drilling was used underneath the Plum Island River (and the Basin in Newburyport) to minimize environmental impacts. Installation of the house connections will require the use of a backhoe to excavate the trench and move materials. Soils are being stockpiled next to the trench after excavation. Dependent on existing soil conditions, following completion of the trench screen gravel maybe placed as a bedding material. The sewer/water line will then be installed and tested. Once tested the trench will be filled and covered with excavated materials removed from the trench. All vegetated areas disturbed by the construction will be returned to pre-construction conditions. The trench will be final graded and restored to match pre-construction grades and surface composition. Any excess material will be disposed on island as directed by the Conservation Agent. Previously paved driveways and roadways damaged will be patched and repaired to match existing grades.

Stormwater Management

Current Regulations

The following section was prepared by Doug Packer and modified slightly.

The Town of Newbury with a population of less than 100,000 must comply with EPA's National Pollutant Discharge Elimination System (NPDES) Phase II stormwater regulations for operators of municipal separate storm sewer systems. Although Newbury does not have extensive stormwater collection systems it does have numerous isolated systems of various sizes including single catch basins. Compliance with EPA's NPDES regulations requires the Town to apply for and obtain a permit which is issued jointly by EPA and the Massachusetts Department of Environmental Protection (DEP). A NPDES permit was obtained in April 2003 and required the Town to prepare a Stormwater Management Plan (SWMP) that identifies how the Town will comply with the permit's requirements for eliminating pollutant discharges through a series of Best Management Practices (BMPs).

The Town completed its SWMP in July 2003. The SWMP identified 7 BMPs that the Town is committed to implementing by March 2008. The Town acting through its Highway Department and Conservation Commission has been working on implementing the BMPs which include developing for the first time a comprehensive plan of the Town showing all known stormwater facilities. Implementation of the BMPs will also require the Town to organize a Stormwater Advisory Committee that will include, in addition to the Highway Department and the Conservation Commission, a member of the Planning Board and the Board of Health. Implementation of all 7 BMPs will ultimately involve all the Town's residents.

To date, the town has sent out brochures in a town mailing describing storm water management practices. They also participated in Biodiversity Day by distributing information and answering questions at a booth/table. Members of the DPW have begun to map storm water outfalls and catch basins for Newbury (Map 10). In addition, a review of storm water management regulations that have been enacted by other towns is underway to see if similar approaches can be used in Newbury. The Stormwater Advisory Committee will soon be assembled to assist with reviewing regulations and to come up with a recommendation.

Non-point source management

The Massachusetts Office of Coastal Zone Management (CZM) is leading other agencies in an effort to develop a "Nonpoint Source (NPS) Monitoring and Analysis Framework". This framework will develop tools to: assess the effectiveness of NPS control methods; identify relationships between development patterns and their impacts on aquatic resources; determine

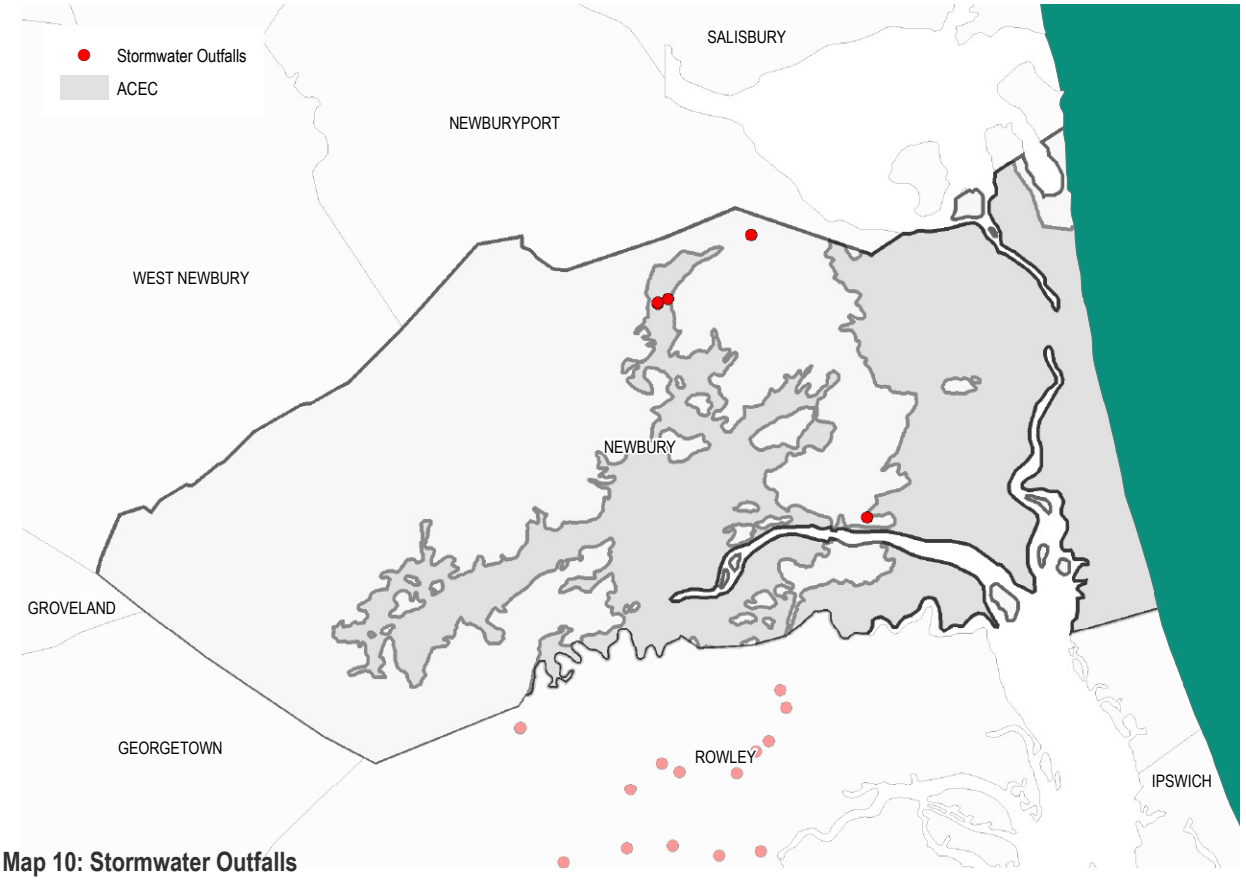
where monitoring stations should be established; identify sources of nonpoint source pollution; and decrease nonpoint source pollution (CZM, 2002).

A pilot project is well underway and fortunately for the town of Newbury, CZM has chosen the Parker River Watershed as a study area. Newbury lies almost entirely in this watershed. Various pieces of information are being assembled in this effort that will be useful in the development of the recommendations of this management plan:

1) Estimates of percent developed (derived from the MacConnell land use layers for 1971, 1985, 1991, and 1999 maintained by MassGIS).
2) Estimates of impervious cover in the watershed
3) Detailed riparian buffer land use classification
4) Septic system inventory (Map 11 and 13)
5) Locations of stormwater outfalls (Map 10)
6) Collation of all water quality monitoring information (Map 1)
7) Locations of agricultural uses (Map 12 and 14)

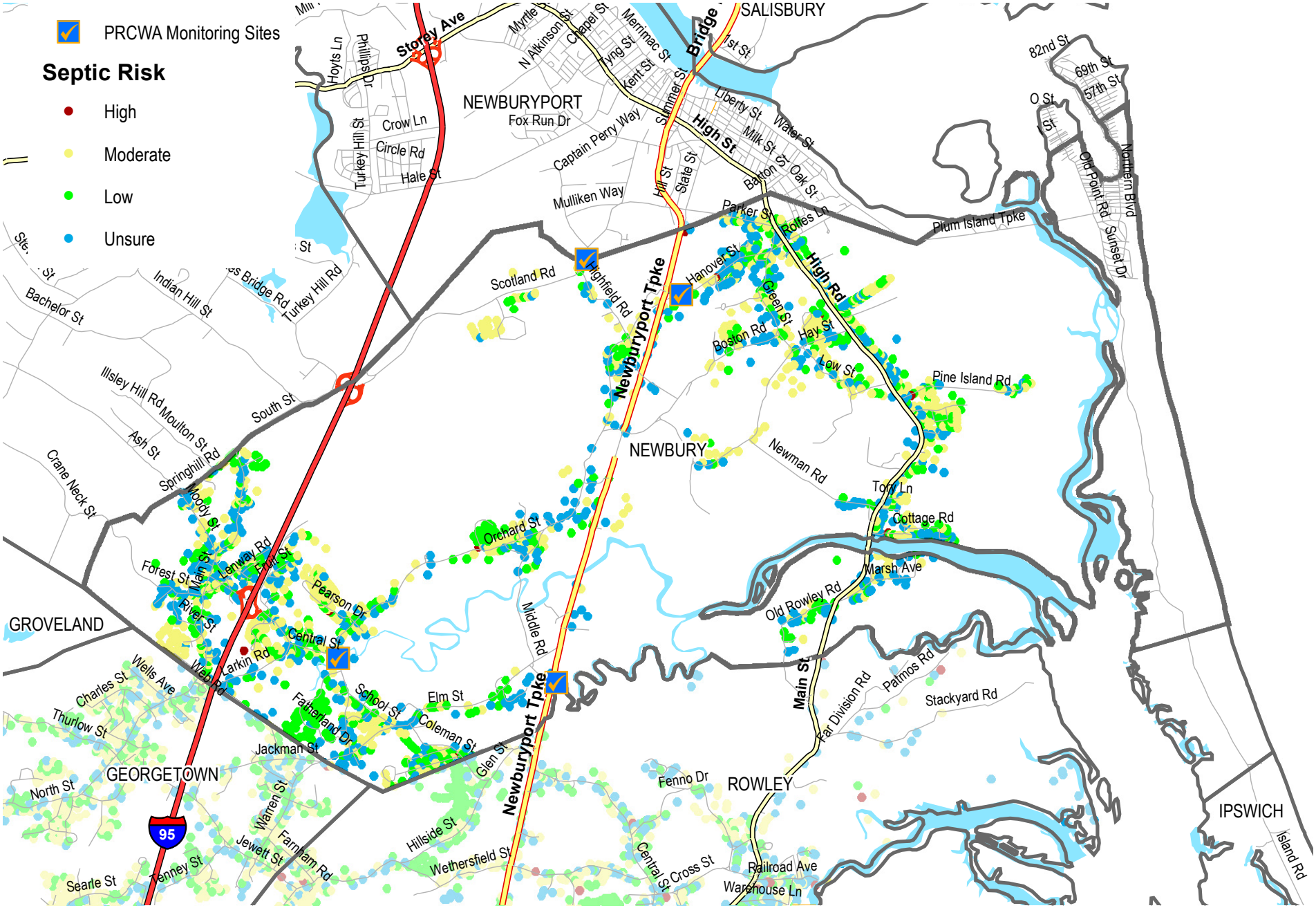
All of the information generated by this project is potentially relevant to the management plan. For instance, Map 13 shows the overlap of the septic inventory with the ACEC boundary.

Locations of septic systems are approximate as they are based on aerial imagery. The inventory identified 1826 septic systems in Newbury. Of these, 79 are located within the Newbury ACEC boundary. The septic risk of these 79 sites varies with 1 in high, 26 in medium, 21 in low, and 31 in the unknown category. Many more systems are located close to the ACEC border. A similar analysis can be done with agricultural land use information. Map 14 shows the crop land and pasture land uses that lie within the ACEC.

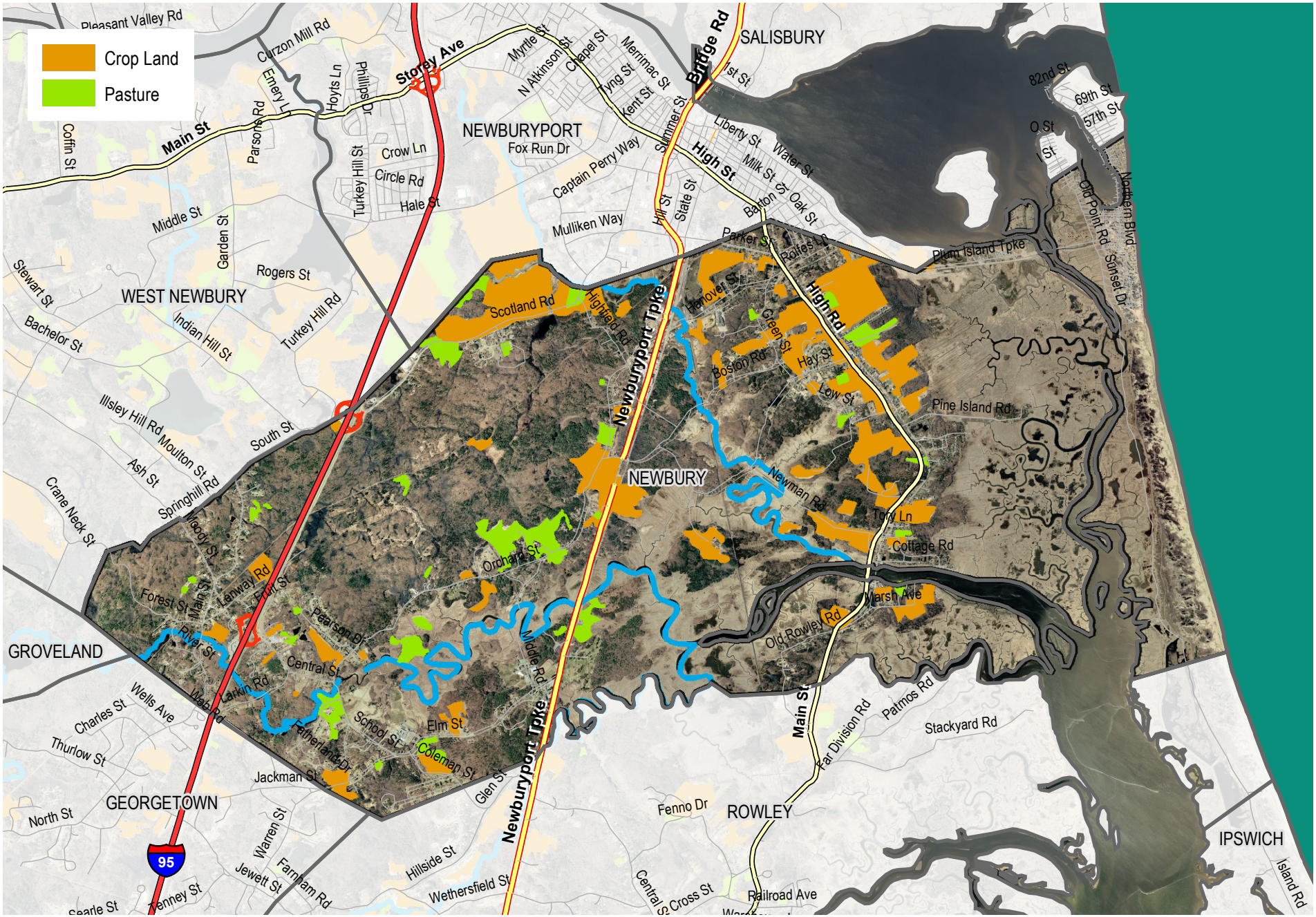


Map 10: Stormwater Outfalls

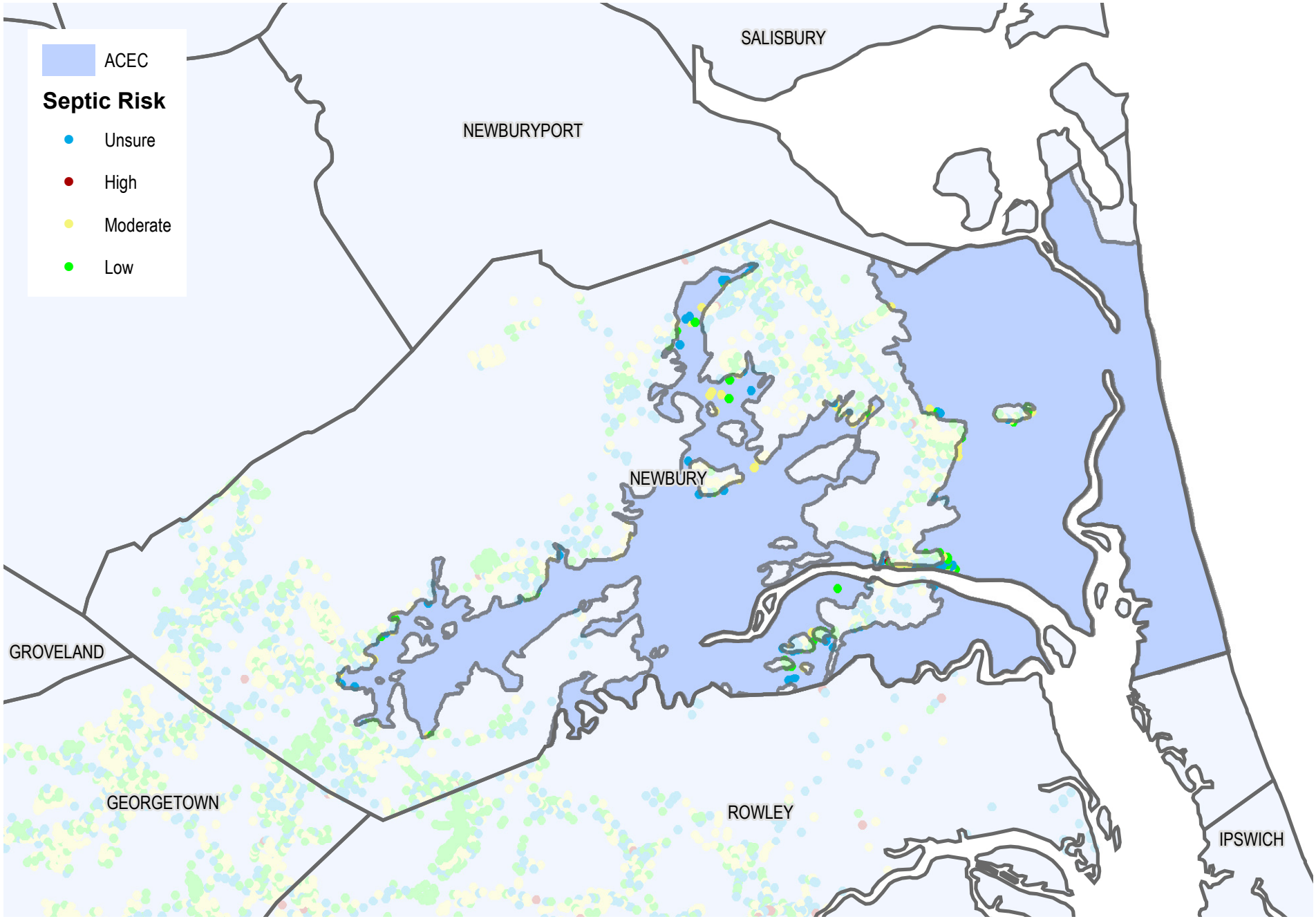
In the entire Parker River watershed, CZM was able to identify areas experiencing significant development pressure and show water quality impacts in these area. They were also able to identify several water quality "hotspots" in the headwaters and in the Little River subwatershed. The information that they generated is a good baseline for tracking the success in implementing Title V as well as the stormwater management plan. The project also led to a better understanding of where to focus pollution mitigation efforts (CZM, 2004). However, since this was a pilot study, the results were general. For more information on this project, contact Jason Baker at the Office of Coastal Zone Management.



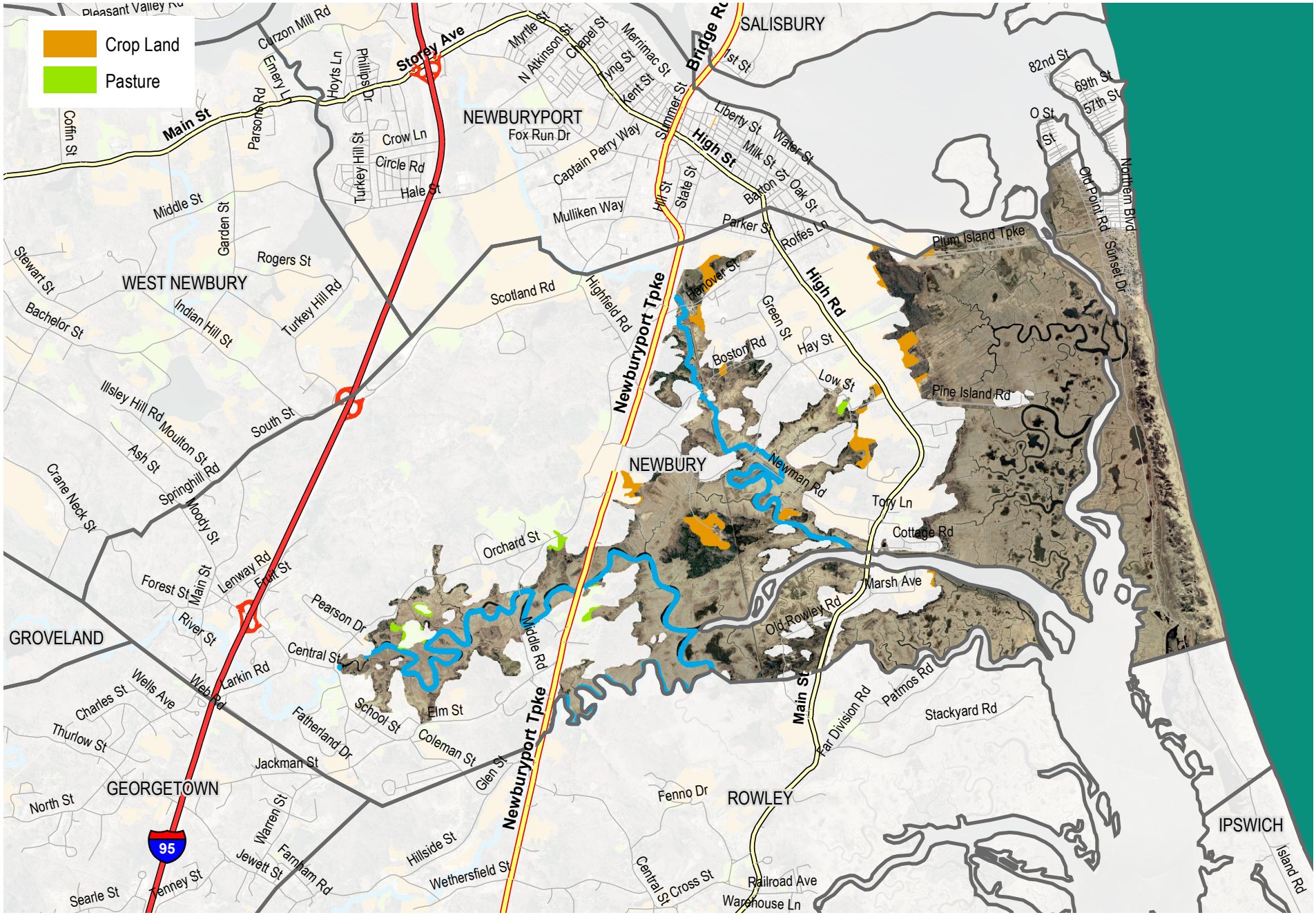
Map 11: PRCWA Water Quality Monitoring Sites and Septic System Inventory Points



Map 12: Crop land and pasture in Newbury



Map 13: Septic systems in the ACEC



Map 14: Agricultural uses in the ACEC

Alterations

Ditching

Draining of the marshes is a practice that likely took place since European colonization of Newbury. However, the extent to which ditching took place prior to the 20th century is uncertain and anecdotal.

In the 1930's the Works Progress Administration of the Roosevelt administration initiated thousands of projects in the interest of stemming unemployment. One such project has created a lasting imprint on the salt marshes of Newbury. Many of the ditches that can still be seen today were created by this relief program.

The ditches were created to reduce mosquito populations on the salt marshes. The program dug parallel and perpendicular trenches in salt marshes connecting to primary channels, allowing for more efficient draining of the marsh and soil pore water (Vincent, 2005). They hoped to reduce excess standing water, which was believed to serve as breeding habitat for salt marsh mosquitoes (*Ochlerotatus sollicitans*). Studies have since indicated that ditching altered the natural hydrologic regime of the salt marsh, resulting in drained pools, lowered ground water levels, and alterations of the vegetation communities. Since the 1930s, some of these ditches have become degraded, resulting in pooled surface water suitable as mosquito breeding habitat (Vincent, 2005).

Figure 8: Ditches leading into Little Pine Island and Plumbush Creek, Newbury

In response to this type of degradation in New Jersey salt marshes, the state mosquito control and wildlife agencies collaborated in the 1960s to develop "Open Marsh Water Management" (OMWM) as a method to control mosquito populations in coastal areas. OMWM is an approach focused on reducing the breeding habitat of mosquitoes. Salt marsh mosquitoes require fluctuating water levels providing periods of moist ground for egg laying and surface water for larval development. OMWM consists of excavating interconnected shallow pools and ditches in the marsh surface and plugging existing ditches to retain surface water. The intent is to alter existing mosquito breeding habitat, making it unsuitable for egg laying and larval development, and increase habitat for predatory fish that consume mosquito larvae (Vincent, 2005). OMWM benefits some salt marsh species. The Parker River National Wildlife Refuge is using this technique to create additional habitat for bird and fish species.

However, closing up ditches will result in inundation of areas of the marsh that were

previously drained. This will inhibit access to parts of the marsh that used to be harvested for salt marsh hay. Seen from this perspective, estuarine management must be sensitive to the income that farmers generate from the salt marsh (Personal communication, Doug Packer). Coordinated efforts are needed to review potentially conflicting goals, with maps and data to support salt marsh haying areas, bird habitat protection, and marsh restoration where possible.

In addition, researchers at the Marine Biological Laboratories are not certain if the creation of additional ponds on the marsh is in fact a desirable state to create. Recent research by MBL shows that in comparison to 1940 images of the salt marsh, there are many more ponds on the marsh today (Valentine et al. 2005, submission to Estuarine, Coastal and Shelf Science).

Haying

Portions of the following section were prepared by the Newbury Estuarine Plan Committee.

Salt marsh haying has been an enduring part of the coastal landscape and cultural heritage of Newbury since Colonial times. Salt hay was used by the early settlers for thatching roofs and for cattle bedding and fodder. From June to September, crews cut, raked, and stacked the salt hay on circles of wood posts, called "staddles", constructed on the marsh. The hay was retrieved during the winter months when the frozen marsh could safely bear the weight of the loaded sleds pulled by horses. Later, horses equipped with "bog shoes" to prevent sinking in the marsh were used to draw mowing machines. Huge scows or "gundalows" were poled and floated up the tidal creeks to reach many salt marsh areas that were inaccessible from the upland. The gundalows were often floated over the marsh on extreme high tides, filled with salt hay, then floated back out on the next high tide. Since the 1960s, tractors with mechanical hay balers have been used to harvest salt hay (Jerome et al. 1968). In recent decades, salt hay has been in popular demand as mulch for gardens and areas freshly seeded for grass. Salt hay makes an excellent mulch because its seeds do not germinate under conditions normally found in upland areas, nor do the weed seeds that are typically found with other types of farmed hay.

The harvesting of large quantities of salt hay, as in historical times, may have potentially significant ecological consequences. Haying removes large amounts of vegetation that would otherwise enter into the detritus-based food web and ultimately into the surrounding estuary. Haying may also stimulate plant and algae productivity by allowing greater light penetration to the marsh surface. In addition, by reducing the buildup of plant litter, haying may also increase the foraging efficiency of fish and birds on salt marsh invertebrates.

At present, only a few individuals still regularly harvest salt hay to any extent. Thus, the bulk of this organic material remains in the marsh and eventually contributes to the overall productivity of the surrounding waters.

Some research has been conducted into the impacts of haying on the salt marsh ecosystem. In an article dated in 2002, research by the Plum Island Estuary Long-Term Ecological Research project (PIE-LTER) was described. Haying caused a short-term increase in the growth of benthic algae, caused a shift in the diet of some marsh invertebrates to a greater percentage of algae, and resulted in a change in plant species composition. In 2002 the above results were unpublished by the PIE-LTER (Ludlam et al. 2002).

Dams

There are several dams on the Parker River that impede the movement of herring and alewife out of as well as into the upstream freshwater spawning areas. There are six dams on the Parker River at the former sites of the Drummer-Spencer Mill, Wheeler Saw Mill, Pearson Grist Mill, Byfield Snuff Mill, Main Street Grist Mill, and Thurla Grist Mill (Map 15).

The Drummer-Spencer Mill, otherwise known as the Woolen Mill is a good example of the challenges that exist due to the presence of dams. The flow of the Parker River at the Woolen Dam directs out-migrating river herring (both adults and juveniles) over the downstream face of the dam. The exposed dam face is constructed of irregular boulders. Out-migrating river herring suffer high mortality during low flows as they become trapped in the boulders. This situation prompted the Massachusetts Division of Marine Fisheries to seek and successfully obtain permission to improve the passage for out-migrating river

Map 15: Parker River Dams in Newbury

herring by adding a notch in the dam to direct flows through a chute over the boulders. This project is currently underway and should result in less mortality during out-migration events (Personal communication, Brad Chase). An anadromous fish passage survey (North Shore region) will soon be completed and will list all fishways in the region along with recommendations for restoration. For more information on this survey the Division of Marine Fisheries (DMF) should be contacted or the technical report will be available at the following website, http://www.mass.gov/dfwele/dmf/publications/technical.htm.

Restoration

Potential restoration projects in various parts of the Newbury ACEC are some of the most important outcomes that could carry forward from this document. Restoration of freshwater as well as the estuarine portions of the river has great potential to improve the quality of habitat and the water quality in the ACEC. For instance, removing tidal restrictions will have multiple beneficial impacts such as increasing salt water flushing of marshes (which will likely reduce the health of the invasive Phragmites), restoring historic flow regimes to salt marshes, and reducing scour in tidal streams. Restoration at dam sites in and beyond the ACEC will also improve the health of populations of diadromous fish.

Several potential restoration projects were brought to our attention during conversations with organizations active in the Newbury ACEC. Basic project information is listed below in an effort to capture current potential restoration projects relevant to the Newbury ACEC. Projects that have already been completed are also listed in the interest of collating "lessons learned".

Plumbush Creek Project 1

Plumbush Creek is one potential restoration project. The potential restoration action would be the installation of a new culvert beneath Plum Island Turnpike to re-connect the severed creek between the Merrimack River and the Sound. However, at present it is unsure what benefits would result from this action and how much it would cost to implement. At this time, it is unclear if restoration of a hydrologic connection between the Merrimack brackish water and marshes south of the Turnpike would in fact be beneficial. Such an action might increase the presence of Phragmites in the southern marshes (Personal communication, Hunt Durey).

Plumbush Creek Project 2

Separate from the Turnpike, there is a marsh area on the north side of the Turnpike, opposite the airport and just west of Plumbush Creek, that also has restoration potential. It is actively hayed for salt marsh hay. The tidal feeder creeks within the marsh are partially clogged with peat and could be cleaned out to increase tidal flow. This project might be undertaken by the Mosquito Control District (Northeast Massachusetts Mosquito Control and Wetlands Management District) (Pers onal communication, Hunt Durey).

Newman Road Salt Marsh Tidal Restriction

This potential project was discussed above in and also needs to be considered among the other potential restoration projects.

Wetlands Restoration Planning

An effort is currently underway by the Natural Resources Conservation Service (NRCS) to "engage in wetlands restoration planning to identify agriculturally-impacted wetlands in Massachusetts' North Shore" (Personal communication, Hunt Durey). In addition, "this information will be used to solicit applications from landowners to the NRCS Wetlands Reserve Program (WRP). Selection of high-value opportunities will be achieved through a landscape-level planning approach that identifies, evaluates, and prioritizes potential restoration sites. Landowners of priority sites will then be engaged to discuss the restoration potential of their properties and review the benefits and details of the Wetlands Reserve Program (WRP). Interested landowners will be encouraged to submit applications with assistance from NRCS and project staff. The project will begin with a focus on the North Shore of Massachusetts and may broaden in geographic scope to other coastal regions depending on the number of sites found and their level of restoration potential under WRP." (Personal communication, Hunt Durey) The majority of the wetlands identified by this project will lie outside of the ACEC boundary. If possible,

the town of Newbury should focus this program on the agricultural areas located near or directly adjacent to the ACEC boundaries. Maps 12 and 14 show the crop land and pasture in Newbury and adjacent towns and its relationship to the ACEC boundary.

Great Marsh Coastal Wetland Restoration Plan

The Massachusetts Office of Coastal Zone Management (CZM), Wetlands Restoration Program, is currently preparing the Great Marsh Coastal Wetland Restoration Plan. This document will result in meetings with the Newbury Conservation Commission in early 2005 to review a preliminary list of potential restoration sites. Based on these meetings a subset of sites will be selected for more detailed review to be completed in spring 2005. The final interactive document will be published by the end of the 2005 fiscal year (June 30).

Previously Completed Restoration Projects

In addition to future restoration projects, attention should be paid to projects that have already taken place. A project on the Trustees of Reservations (TTOR) "Old Town Hill" property was recently completed. New swales were excavated across the gravel access road from Newman Road to Old Town Hill that bisects the marsh. This site is now being monitored to observe the effects of the new swales on flood tide flows. The results of the monitoring could inform the design of future restoration projects.

Invasives

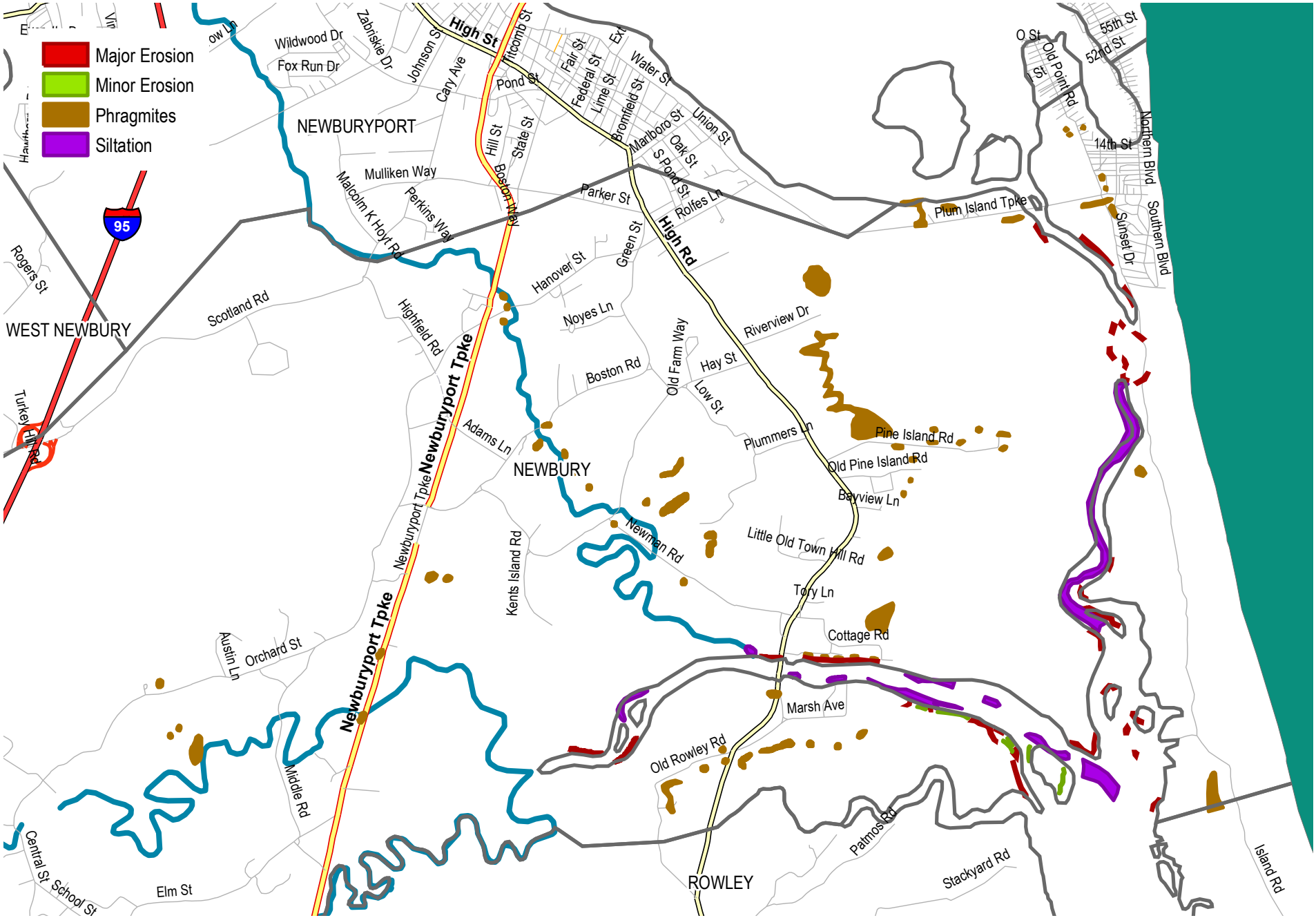
A major threat to the health, productivity, and diversity of the salt marsh ecosystem is encroachment by invasive plant species, especially common reed (*Phragmites australis*), purple loosestrife (*Lythrum salicaria*), and cattails (*Typha angustifolia*). This encroachment has increased where tidal restrictions formed by under-sized road and railroad bed culverts impede the natural flow of seawater in the upstream marsh. As the saline water flow has become restricted, native salt marsh species have been displaced, habitat has been lost, and biodiversity has decreased.

Of the discussed invasives, Phragmites is of most concern. This familiar tasseled grass typically grows along the transition zone of a salt marsh where water is brackish. Occasionally it will grow in the middle of the marsh where elevations are slightly higher or where fresh water is present. Its growth may be enhanced where elevated nutrient levels from septic systems or lawn fertilizers interact with groundwater near the marsh edge. Phragmites marshes are generally considered to be low quality foraging and nesting habitat for birds, waterfowl, and wildlife, although some species (red-winged blackbird, for example) are known to use Phragmites for nesting. Restoration of intertidal wetlands through eradication of Phragmites and revegetation by native, non-invasive plant species can be expected to improve habitat quality for fish and wildlife species and to maintain important tidal marsh-open water trophic linkages.

The Parker River Clean Water Association report, "Tidal Crossings Inventory and Assessment, PRCWA" (1996) inventories sites where the natural flow of seawater is restricted by culverts or dikes. A study of Phragmites location and density in the Plum Island Sound region by the Massachusetts Audubon Society (Buchsbaum et al., MAS, 1996) indicated that invasive Phragmites has not yet taken over a large percentage of the region. Nevertheless, it was found to be widespread, occurring in stands ranging from a few plants to several acres. Map 16 identifies the most obvious areas of Phragmites presence based on a visual survey conducted in Newbury. It also shows areas of potential erosion.

The largest patch covers several acres off Pine Island Road in Newbury. Most of the stands are much smaller. Since Phragmites is regarded by scientists and resource managers as being of less value to wildlife than native salt marsh species, efforts are underway to restore and monitor tide-restriction sites. To date, these efforts have been focused on eliminating Phragmites stands by restoring tidal flows. The gradual accumulation of sulfides (an important component of seawater) in flooded marsh soils inhibits the ability of Phragmites to take up nutrients. Eventually, the Phragmites stands lose vigor and height, and die back. This process can take up to several years.

Robert Colby, a Newbury farmer, has been harvesting salt marsh hay for many years. While harvesting hay, he will often cut back stands of Phragmites that are accessible by tractor. These



Map 16: Areas of Phragmites presence and Potential Erosion in Newbury

stands contain trash or other debris that could damage the sickle bars used to cut hay. While cutting down the Phragmites stands does not represent an ultimate cure for the invasive, it does slow its rate of spread. Colby's actions are an excellent example of incorporating "management" activities into normal routines. Fostering communication between municipal officials and town residents is potentially a cost-effective means of tackling management issues.Cultural and Visual Resources

Cultural and Visual Resources

Historic and Archaeological

Long before the arrival of the first settlers in 1635, the Agawams, a sub-tribe of the Massachusetts Indians, had established villages near the ponds, waterfalls and valleys along the Parker River, which they called "Quascunquen". The falls at Central St was a favorite spot for the Indians because of the great abundance of fish they found there at all times of the year. Many believe that Vikings visited the Parker River area in pre-colonial times. Remains of their moorings are said to be seen from time to time along the river, although these findings have not yet been scientifically confirmed (Parker River Committee and the Massachusetts Scenic Rivers Program, undated). Like the Native Americans, the first settlers were undoubtedly attracted to the area by the easy navigation and rich resources of the Parker River. Led by the Reverend Thomas Parker, the settlers soon established a permanent settlement on the banks of the river. A year later, the first mill was built at Central Street near the site of the original Native American Village. Many other mills processing lumber products, grain, wool, felt, shoes, snuff, textiles and swords soon sprang up along the river as far west as Boxford. While most mills were located along the freshwater portion of the Parker, there was a mill on the Mill River driven by the tides. Today mills continue to operate on water power along the Parker - part of a vital, 350 year-old tradition of small-scale manufacturing which has co-existed with the Parker River since the earliest colonial days (Parker River Committee and the Massachusetts Scenic Rivers Program, undated).

Shipbuilding soon became another important industry. Shipyards were established near Middle and High Streets. This tradition continued well into the 20th century when town class sailboats were made at the Parker River Boat Yard at the lA Bridge. Today, the boat yard and Fernald's marina continue the nautical tradition so closely linked with the Parker River (Parker River Committee and the Massachusetts Scenic Rivers Program, undated).

While it provided easy access inland by boat, the Parker River presented a considerable physical obstacle to overland traffic bearing north or south along the coast. Thurlow's Bridge, built before 1654, is the oldest bridge in Massachusetts still in active use. Built by a local farmer, it allowed Middle Street to become the main overland route from Boston to Newburyport. Dr. John Clark, the first doctor in Massachusetts Bay Colony, lived near the Thurlow's Bridge. Further up and down Middle Road, toll houses were set up to levy fees from travelers to compensate private landowners for maintenance expenses (Parker River Committee and the Massachusetts Scenic Rivers Program, undated).

Land use regulation was also a part of the early life of the area. For example, the town of Newbury ordered that every house lot be four acres in 1643! The early settlers were also keenly aware of the need to protect and to regulate the natural resources of the Parker River. They were willing to tolerate self-regulation for the common good and the preservation of the Parker. In the 17th Century for example, the town put strict limits on the amount of fish caught from the river. Timber harvesting was also carefully controlled. The early settlers regulated themselves, and their use of the river , in order to ensure their survival and improve their lives (Parker River Committee and the Massachusetts Scenic Rivers Program, undated).

Historic landscapes are as valuable as historic buildings and should be given adequate protection. Enacting the Scenic Rivers Program would help preserve many important sections of the historic Parker River landscape. In addition, towns could help preserve historic landscapes by promoting agriculture preservation through the state's Agriculture Preservation Restriction Program (APR). Taking full advantage of the Scenic Roads Act (M.G. L. Ctl. 40 s. 15C) would "also help towns protect scenic stone walls, ancient trees and other features such as milestones found on small non-state roads". Other Massachusetts towns,

including Ipswich, have a scenic roads bylaw that could be used as models.

Plum Island Sound and Plum Island

Newbury is located at the northern end of Plum Island Sound. The first description of Plum Island and the Sound came from the explorer John Smith in 1614 who indicated the marsh grass was fit for pasture, with, "...pines, walnuts, and other woods to make this place an excellent habitation, being a good and safe harbour" (USFWS, 1992). In 1649, the General Court divided Plum Island among the townships of Newbury, Rowley, and Ipswich. For the first 150 years of settlement in these towns, the marshes and meadows of Plum Island were treated primarily as a resource for grazing of hogs, cattle, horses, and sheep (USFWS, 1992; Weare, 1993). Eventually this unrestricted grazing took a toll on the marsh. In 1739, one of the first resource management actions was taken, and the General Court passed an act declaring it unlawful for livestock to roam free on the island (USFWS, 1992). During the 1800s and early 1900s, the southern portion of Plum Island contained cottages, farms, some hotels, waterfowl hunting camps, and fishing camps scattered throughout the salt marsh. In the early 1900s, Plum Island became a vacation destination as hotels, regularly scheduled ferries, and even a casino were established (Weare, 1993). When development of the northern end of Plum Island threatened to spread south, the Massachusetts Audubon Society and the Federation of Bird Clubs of New England purchased approximately 1,600 acres on the central section of the island. In 1942, this land was purchased by the U.S. Fish and Wildlife Service to form the Parker River National Wildlife Refuge, which currently includes a total of 4,662 acres. Approximately 120 acres of privately owned land at the southern tip of the island was acquired by the Commonwealth of Massachusetts and became Sandy Point State Reservation managed by the Department of Conservation and Recreation (USFWS, 1992).

Figure 9: Salt marsh hay gathered with historic techniques

Historic Use of Salt Marshes

In the seventeenth century, salt marshes served as a source of home insulation, roofing, livestock feed and livestock bedding (USFWS, 1992). The marshes were used not only by locals but were also owned or leased by farmers who lived further inland. Such "non-resident" farmers would travel to the marshes during the haying season and then bring the marsh hay back to their farms (Weare, 1993). The tools used to harvest hay developed

over the decades. In the late 1800s, bog shoes were invented, allowing horses access onto the wetter, softer marsh areas. Horse drawn mowing and raking machines soon replaced the seasonal laborers that did the work with scythes and rakes by hand. Eventually the horses were replaced by tractors and mechanical mowers, rakes, and balers.

Widespread harvest of marsh hay continued until the 1930s when demand for salt marsh hay diminished as local farms and dairy operations began to shrink or close. By 1965, only five individuals were harvesting hay from the salt marshes from the ACEC (Jerome et al. 1968). Today, hay continues to be harvested in several areas within the ACEC. A demonstration of the old harvest methods can be seen off of Route 1 just north of the intersection of the Parker River and Route 1.

Archaeological Resources

The following section is obtained from the work of Thomas F Mahlstedt, Archaeologist for the Department of Conservation and Recreation.

"The Town of Newbury currently has twenty-six prehistoric Native American sites recorded within its corporate boundaries. The North Shore in general has several hundred recorded prehistoric sites, placing it among the highest site densities in New England. The principal reason for such a high number of archaeological sites is the extensive estuarine system, which is one of the richest natural resource bases in the world, and which characterizes the coastal zone and in places extends a considerable distance inland. The Great Marsh, created by the Parker, Rowley, Ipswich and Essex rivers was particularly important during the summer months when local Native American hunters and gatherers would take up residence adjacent to the expansive salt marshes and exploit the wide range of marine resources that were located there.

Of considerable interest in Newbury is a cluster of sites on the upper Parker River, well inland and far from the estuary. These sites would have been fishing stations that were occupied in the spring to take advantage of the herring and alewife spawning runs. At this time people would have traveled considerable distances to be at rapids and small falls which impeded fish movement, causing them to "pond", and making them very easy to literally harvest in nets and baskets and with spears. This spring fishery was probably the most important subsistence activity that took place in any given year, because a surplus of food could be set up (after smoking and drying) with a very modest expenditure of energy.

Unfortunately, all of the archaeological information for Newbury is derived from avocational archaeologists and relic hunters, and except for four sites only the site locations are known. But placing Newbury within the broader geographical context allows us to speculate that Paleo Indian hunters roamed the region from as early as 12,000 years ago, having arrived shortly after the glacier had finally receded. Regional sites show that Native Americans continued to occupy the area despite considerable environmental change, and through each successive phase of prehistory: Early, Middle and Late Archaic and Early, Middle and Late Woodland. Significantly, one of the few Contact Period sites known in Massachusetts (ca 450 years old) has been identified in Newbury on the basis of trade glass beads.

Summary: The existing archaeological record for Newbury and the North Shore in general suggests a high degree of human adaptation and adjustment to constantly changing environments. The local populations must have had a high degree of cultural flexibility and resiliency. Site frequencies that increase through time suggest that the local inhabitants accepted the challenge that the changing habitats presented them -- from freshwater to saltwater habitats and resources. It appears that the local peoples adapted their toolkit to be best suited for the available resources, and thus took advantage of the opportunities that the environmental changes presented. Although, existing site densities are highest along the coast and estuaries, the data is too uneven to state with certainty the degree to which this is a true reflection of prehistoric settlement and subsistence patterns.

When considered in the context of 12,000 years of human habitation, most of Newbury, particularly those undeveloped areas near the salt marshes and the Parker River must be considered archaeologically sensitive for prehistoric resources. At the same time prehistoric hunters and gatherers could also move to more sheltered interior areas

adjacent to freshwater springs, ponds and lakes which were equally close at hand."

Heritage Landscapes

A recent study has been conducted by the Division of Conservation Resources (DCR) with cooperation from the Essex National Heritage Commission to identify the "Heritage Landscapes" in 24 of the region's towns. Newbury elected to participate in this project, and as a result a variety of areas in town have been identified as heritage landscapes. The survey is a reconnaissance level survey and has identified priority landscapes in Newbury and also considered the level of threat to the landscape. Although there was not time to review this document, it must be consulted when considering the historical and visual resources in Newbury.

Existing Protected Areas

The following analysis was completed using the "ACEC" and "open space" layers available from MassGIS. Roughly 43%, or 6,724 acres of the town of Newbury is protected. Newbury is roughly 15,636 acres in size. The current ACEC boundary includes 6,570 acres of Newbury. Table 14 shows the amount of protected land in Federal, Land Trust, Municipal, Private non-profit, Private, and State ownership.

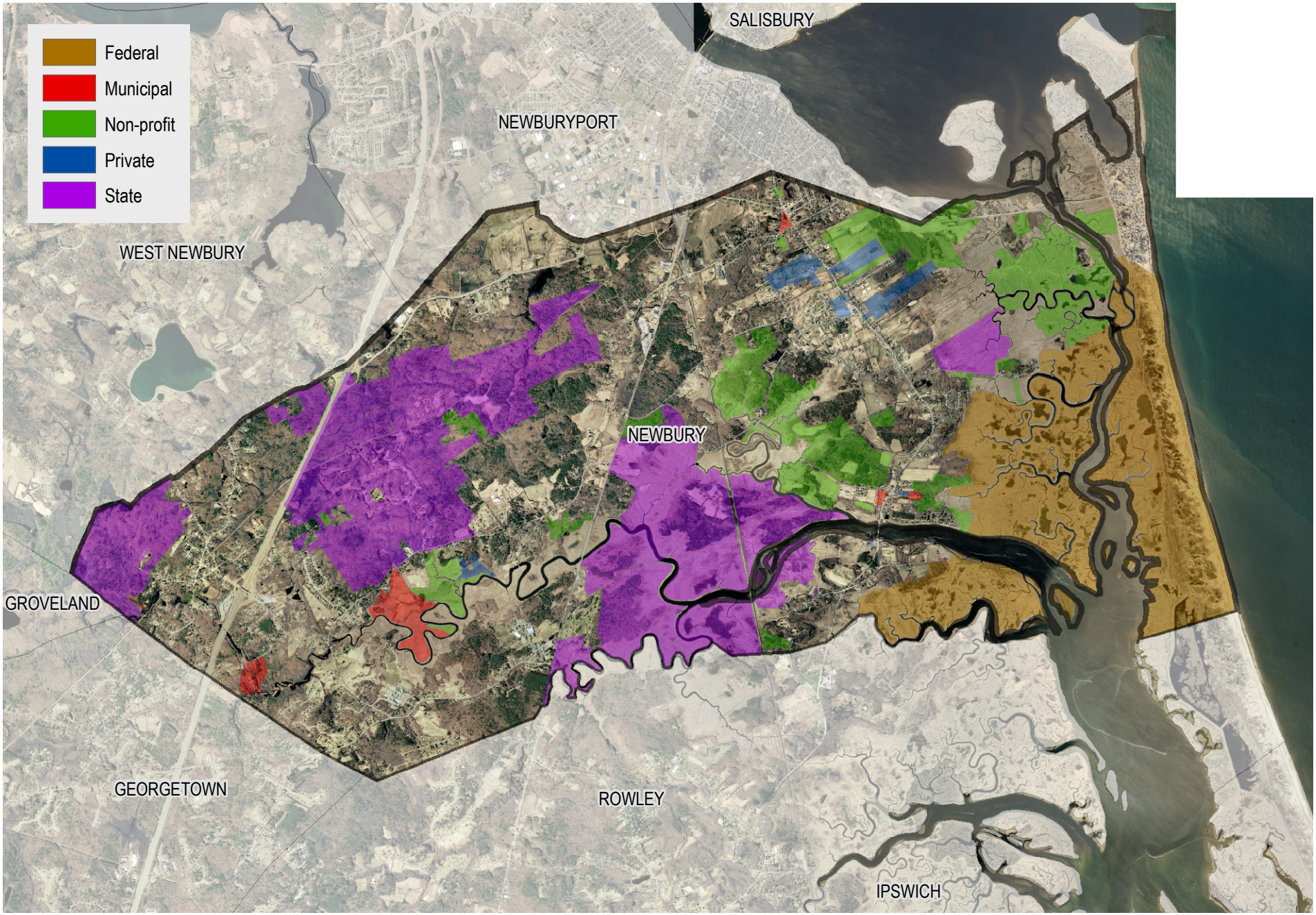
Of the roughly 6,570 acres of the Parker River and Essex Bay ACEC found in Newbury, 63% is protected (see table 15). The Parker River National Wildlife Refuge and the State Wildlife Management Areas are the major contributors to the high percentage of the ACEC that is protected.

Town-wide open space by ownerhip	Town-wide acres protected in perpetuity	ACEC acres protected in perpetuity
Federal	2066	2051
Land Trust	938	669
Municipal	148	78
Private non-profit	236	153
Private	150	22
State	3185	1177
TOTAL	**6724**	**4150**

Table 14: Acres of protected land in Newbury and in the Newbury ACEC

Percent Protection (Town-wide and within the ACEC)	Percent of Newbury protected by ownership	Percent of Newbury ACEC area protected by ownership
Federal	13.2%	31.2%
Land Trust	6.0%	10.2%
Municipal	0.9%	1.2%
Private non-profit	1.5%	2.3%
Private	1.0%	0.3%
State	20.4%	17.9%
TOTAL	**43.0%**	**63.2%**

Table 15: Percent of Newbury and of the ACEC protected by ownership category



Map 17: Protected lands in Newbury

Table 16 shows the percentage of land protected in Newbury and in the Newbury ACEC.

Map 18 shows the Newbury ACEC and highlights the protected pieces of the ACEC. More importantly, this map highlights the portions of the ACEC that are not currently protected; land to the south of the Parker River, areas adjacent to the Little River, and significant areas of salt marsh in the northeastern portion of Newbury.

It is useful to place the protection status of the Newbury ACEC into a regional context. Table 16 shows that of the five ACEC towns, Newbury contains the largest amount of ACEC land and has the highest percentage protection of its ACEC lands. It is clear that Newbury plays an important role in stewardship and protection of the ACEC resources. However, it is equally clear that the other four towns, especially Ipswich, Essex, and Rowley, need to focus attention on the management of their estuarine resources as well. Parker River Wildlife Refuge, USFWS

Roughly 2,050 acres of the Refuge's 4,662 acres lies in Newbury and protects a large portion of the salt marsh at the mouth of the Parker River. It also protects the northern end of Plum Island sound and Plum Island. The refuge was established in 1942. It is located along the "Atlantic Flyway" and provides feeding and resting habitat for migrating birds during pre- and post-breeding periods. A variety of habitats exist on the refuge, including sandy beach and dune, shrub/thicket, bog, swamp, freshwater marsh, salt marsh, and the associated creek, river, mud flat, and salt panne (USFWS, 2004).

	Total Acres in Town	ACEC Acres	ACEC Acres Protected	Percent of town in ACEC	Percent of the ACEC protected
Essex	9313	2482	940	0.267	0.379
Gloucester	17146	496	173	0.029	0.348
Ipswich	21449	6982	3381	0.326	0.484
Newbury	15636	6569	4150	0.42	0.632
Rowley	11911	2998	1491	0.252	0.497
TOTAL	**75455**	**19527**	**10135**	**0.259**	**0.519**

Table 16: ACEC area and protection status in the five ACEC towns

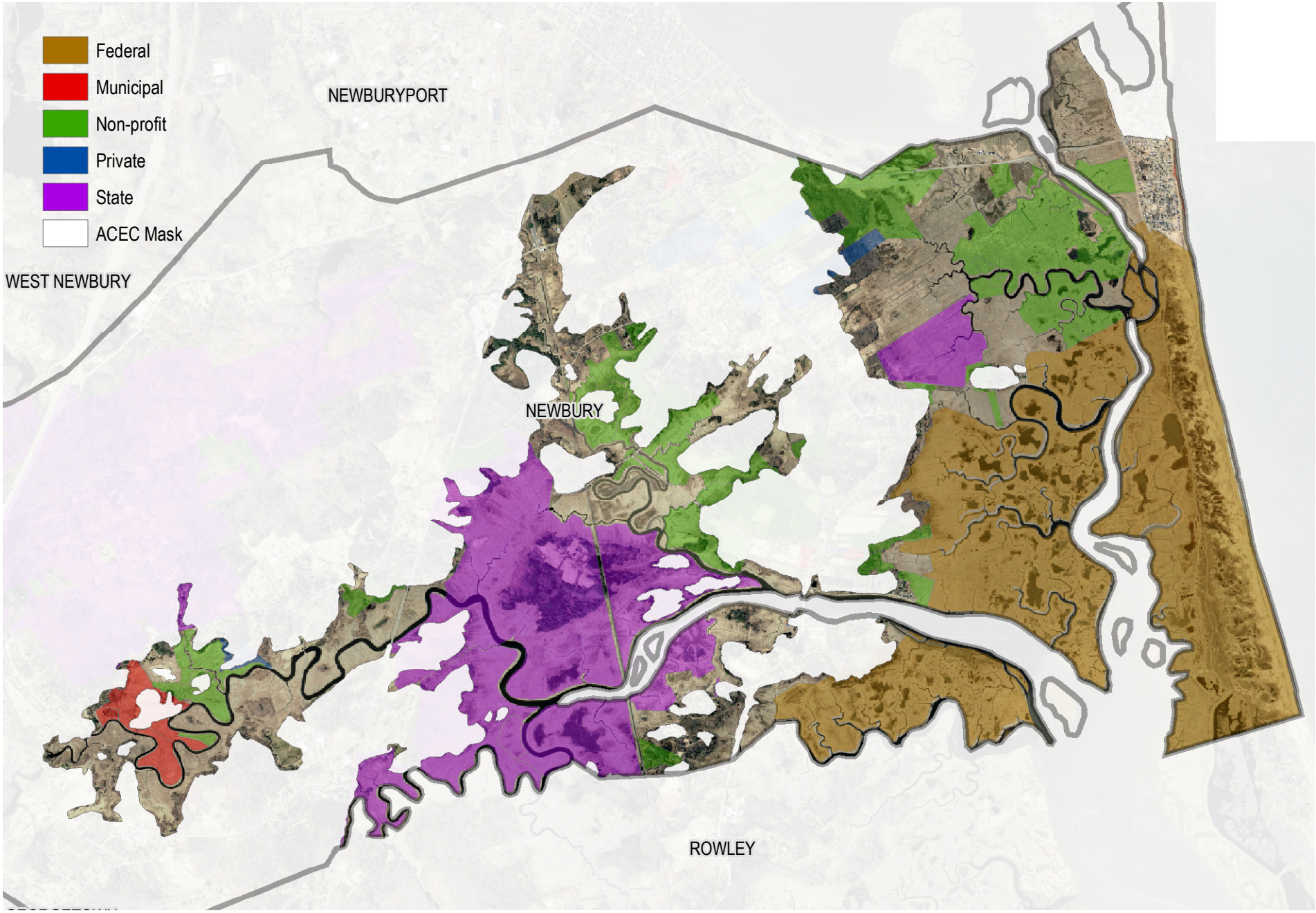
Thousands of acres of marsh act as a vital filter of the fresh water that is deposited into the Parker River by various tributaries. The tides act to flush and filter the water of solids and chemicals before it enters Plum Island Sound.

The Refuge is currently undergoing a "Compatibility Determination" to determine if the current uses of the refuge are consistent with the purpose of the Refuge. There are 5 priority uses currently allowed on the refuge and 7 secondary uses. Table 17 below lists these uses. Only the secondary uses are being reviewed at this time.

In addition to the Compatibility Determination, a Habitat Management Plan is underway. A draft of the plan will be issued in Spring, 2005 and formal comments can be made at this time on the management plan. The document should prove useful for resource inventories, assessment, and management recommendations, some of which may be useful if applied to areas outside the Refuge.

Division of Fisheries & Wildlife (MassWildlife) Wildlife Management Areas

Map 18 shows (in purple) the significant amounts of land that are protected by the Wildlife Management Areas (WMA) in the ACEC. The small purple WMA in the eastern portion of Map 18 represents the 110 acres of the Fish and Wildlife Management Area just north of the Pine Island Road. The larger purple area in south central Newbury is a combination of the Mill Creek WMA and the Kents Island (William Forward) Wildlife Management area and represents 1315 acres. Moving out of the ACEC, we find two more WMAs: the Downfall (Martin H Burns) WMA and the Crane Pond WMA, 1450 acres and 310 acres respectively. In contrast to the properties described above, these



Map 18: Protected lands in the Newbury ACEC

two WMAs protect significant upland habitat, primarily woodland and some open spaces. These areas provide valuable protection to some of the headwater areas of the Parker River watershed.

Non-profit Parcels

The areas shown in green in Map 18 represent land protected by the various non-profit organizations important in the Newbury and Essex County areas. The two green areas in the northeast portion of Newbury represent areas protected by the Essex County Greenbelt Association (ECGA) and the Society for the Protection of New England Antiquities (SPNEA). The ECGB property protects valuable salt marsh habitat surrounding Little Pine Island Plumbush Creeks. The SPNEA property which spans the border of the ACEC protects the Spencer Peirce Little Farm, an important agricultural property with a small part directly on the edge of the Joppa tidal flats.

Another significant amount of land is protected directly east of the Little River by The Trustees of Reservations (TTOR). The Old Town Hill Reservation protects 500 acres of upland and tidal salt marsh habitat, and significant historical and recreational resources. The upland consists of second-growth woodland as well as fields, while the tidal salt marsh areas protect salt meadow grass, cordgrass, seaside goldenrod, and sea lavender. Native Americans called this site "Quascacunquen," meaning waterfall, referring to the falls on the Parker River. In 1634, Newbury's first Meeting House was built on the Lower Green at the base of the 168-foot "Great Hill" and, shortly thereafter, a sentry box was erected on the crest of the hill. Old Town Hill is also a link in the Bay Circuit Trail (The Trustees of Reservations, 2004). This trail currently connects 150 miles of trails forming a ring around the entire Greater Boston area and runs through more than 50 cities and towns.

The ECGA protects additional parcels within the ACEC farther up the Parker River near South Byfield. These properties, located on the northern side of the Parker River and south of Orchard Road protect additional marsh habitat. Other non-profit groups such as the Essex Rod and Gun Club and the Essex County Sportsmen also own and protect parcels in Newbury.

Priority Uses	Secondary Uses under Review
Hunting	Off-Road-Vehicles
Fishing	Field Trials
Wildlife Observation	Clamming
Wildlife Photography	Boating
Environmental education and interpretation	Cycling
	Berry Picking
	Jogging

Table 17: Priority and secondary uses in the Parker River Wildlife Refuge

Municipal Areas

Roughly 100 acres of town land near Byfield protects additional salt marsh habitat. These areas, which fall in the ACEC are shown in red on Map 18. Outside of the ACEC, several additional municipal parcels protect additional resources.

Regulations

A variety of town, state, and federal regulations and related strategies impact the Parker River/ Essex Bay ACEC. Table 18 below summarizes these regulations and their major requirements. The result of these regulations is an increase in the protection that is afforded the Newbury ACEC as well as the resources of the entire town.

Some believe that the Board of Health regulations would provide better protection and enforcement capabilities if they were placed within the Newbury zoning bylaws themselves, perhaps as a Parker River Watershed Overlay Protection District (CZM, 2002). Both the Plum Island Overlay District and the wetlands bylaw are in the process of being reviewed by DEP. Changes will likely be made based on DEP's suggestions for tighter controls. In addition, Newbury and the city of Newburyport have had the PIOD and the wetlands bylaws in place for several years and they feel that it is time to review them to see what has worked and what hasn't.

Town

Regulation	Major Requirements/Effects
Newbury Zoning Code	Reduced frontage lots eliminated
	All ANR plans, Definitive Plans, Preliminary Plans and OSRD Concept Plans must show the ACEC (10ft. contour) boundary
	Not more than 20% minimum lot area in ACEC
	With a public water supply, the lot area minimum for a 2-family dwelling is 60,000 sq. ft.
Open Space Residential Subdivision Bylaw (2001)	To allow for greater flexibility and creativity in the design of residential developments
	To encourage the permanent preservation of open space, agricultural land, forestry land, wildlife habitat, and other natural resources
	To encourage a less sprawling and more efficient form of development
	To minimize the total amount of disturbance on the site
	To further the goals and policies of the open space plans
	To facilitate the construction and maintenance of housing, streets, utilities, and public service in a more economical and efficient manner.
Plum Island Overlay District (2001)	Reduce damage to public and private property resulting from flood waters
	Ensure public safety by reducing threats to life and personal injury
	Eliminate costs associated with the response and cleanup of flooding conditions
	Limit the expansion of nonconforming single and two family structures so as to prevent the exacerbation of existing problems with density and intensity of use
	As of right, single family dwellings, subject to the dimensional requirements:
	max. building height - 35 feet
	max. stories – 2
	max. floor area ratio – 25%
	max. lot coverage 20%
	1 additional bedroom allowed
	Non-conforming structures:
	no footprint increase
	no height increase or 35', whichever is least
	Rebuilding allowed with a number of restrictions
	Frontage required on a recognized street. Frontage on unconstructed way only with Planning Board approval
	Board of Appeals may issue Special Permit

Table 18: Regulation summary

Town (continued)

Regulation	Major Requirements/Effects
Newbury Wetlands Protection Bylaw (2001)	Applies to Plum Island Barrier Beach only
	No development or redevelopment within a FEMA V-Zone or AO-Zone
	Less than 50% damage (based on market value), repairs allowed to pre-damaged condition
	All new buildings and substantial improvements to FEMA and State Building Code regulations for high flood hazard areas
	Development to have no adverse impact to coastal banks/dunes
	No change to elevations or flows in flood plain
	Not more than 20% of the minimum lot area (example 8,000 square feet of a 40,000 square foot lot) shall be in wetlands or in the Parker River - Essex Bay Area of Critical Environmental Concern
Newbury Board of Health Regulations (1974)	Require development to be set back 300 feet from the Parker River and its tributaries. The Board of Health of the Town of Newbury prohibits the installation of any sewage disposal system or drainage system or other devices by which pollutants might be introduced into the Parker River and/or its tributary river and streams, said prohibition to affect such installations upon land contiguous to such river, tributaries and streams for a distance of 100 yards on either side of the natural bank of such River, tributaries and/or streams, such prohibition to be applicable to said River, tributaries and/or streams from the Georgetown-Newbury town line to the Central Street Bridge.
Water Supply Protection District	Establishes three districts in Newbury that provide special protection to the water supplies of the town

Regulatory Framework

State

Regulation	Major Requirements/Effects
Wetlands Protection Act (1972) Wetlands Protection Act Regulations (310 CMR 10.00)	DEP regulations protect wetlands. The wetlands protection act officially recognizes that wetlands are crucial for the following interestes:
	Protection of public and private water supply
	Protection of groundwater supply
	Flood control
	Prevention of storm damage
	Prevention of pollution
	Protection of land containing shellfish
	Protection of fisheries
	Protection of wildlife habitat.
	For coastal resource areas within ACECs, the performance standard is raised to "no adverse effect" on the interests of the Act, except for maintenance dredging for navigational purposes of "Land Under the Ocean" (see section 10.24(5)(b)).
	A higher performance standard also applies to the inland (freshwater) wetlands resource area known as "Bordering Vegetated Wetland (BVW)." Within an ACEC, potential projects are prohibited that would result in the loss of up to 5,000 square feet or, in some cases, in the loss of up to 500 square feet of BVW (310 CMR 10.55(4)(e)). This standard for BVW applies to all ACECs. Work affecting BVW may be
Rivers Protection Act (1996)	Creates a 200-foot riverfront area that extends on both sides of rivers and streams in order to ensure protection of these resources. Performance standards are within the Wetlands Protection Act Regulations (310 CMR 10.00).
Solid Waste Facilities Site Assignment Regulations (310 CMR 16.00)	DEP regulations prohibit the siting of new solid waste facilities within an ACEC (see section 16.40(4)(d)). The regulations also prohibit the siting of such a facility located adjacent to an ACEC if such a siting "would fail to protect the outstanding resources of an ACEC."
Waterways (Chapter 91) Regulations (310 CMR 9.00)	DEP's jurisdiction extends to activities below mean high water in both coastal and inland areas, including construction, dredging, and filling in tidelands, previously filled tidelands, great ponds, and certain rivers and streams. Through Chapter 91 the Commonwealth seeks to preserve and protect the rights of the public by ensuring that such waterways are used only for water-dependent purposes or otherwise serve a proper public purpose.
	The Waterways Regulations do not allow new fill in ACECs and place increased limits on new structures within ACECs (see sections 9.32(1)(e) and 9.32(2)(d)). Proposed new, privately owned structures for water-dependent use below the high-water mark, such as private docks or piers, are only eligible for a license provided that such structures are consistent with an ACEC resource management plan adopted by the municipality and approved by the Secretary of Environmental Affairs.

State (continued)

Regulation	Major Requirements/Effects
	Improvement (new) dredging is prohibited within an ACEC except for the sole purpose of fisheries and wildlife enhancement. Maintenance dredging remains eligible for a permit. The disposal of dredged material is prohibited within an ACEC except for the purposes of beach nourishment, dune construction or stabilization with proper vegetative cover, or the enhancement of fishery or wildlife resources (see section 9.40(1)(b) regarding dredging or disposal).
MEPA Regulations (301 CMR 11.00)	Projects subject to MEPA review must involve some state agency action - that is, they are either proposed by a state agency or are proposed by private, municipal, or nonprofit parties and require a permit, financial assistance, or land transfer from state agencies. MEPA review occurs before state permitting agencies act, to ensure that they know the environmental consequences of their actions. The purpose of MEPA review is to ensure that a proposed project will avoid or minimize adverse impacts to the natural and cultural resources of an area.
	ACECs are addressed in the MEPA regulations at 301 CMR 11.03(11). The proponent of any project (as defined by the MEPA regulations) located within an ACEC must file an Environmental Notification Form (ENF) for MEPA review, unless the project consists solely of one single family dwelling. What this means in practical terms is that projects located within ACECs subject to MEPA jurisdiction require closer scrutiny than projects located outside of ACECs.
CZM Program Regulations (301 CMR 21.00)	CZM Program regulations call for all appropriate EOEA agencies to preserve, restore, and enhance complexes of coastal resources of regional or statewide significance through the ACEC Program. Through the federal Coastal Zone Management Act, CZM is empowered to ensure that all federal development activities, all federally licensed or permitted activities, or any federally funded activities in the Massachusetts coastal zone are consistent with state coastal policies, including those concerning ACECs.

Federal/State

Regulation	Major Requirements/Effects
NPDES Phase II Stormwater Management Plan (Completed in July 2003)	Identifies 7 Best Management Practices (BMPs) that the town is committed to implementing by March 2008.
	The town acting through the Highway Department and the Conservation Commission will implement the BMPs. This will include developing a comprehensive stormwater plan of the town showing all known stormwater facilities
	A Stormwater advisory committee has been organized which includes a member from above two departments and the Planning Board and the Board of Health

Resource Management Issues and Recommendations

Issues

Based on the information provided in the previous sections the issues have been divided into the following categories. Barrier beach issues are not reviewed in this estuarine plan. If possible, a separate barrier beach management plan will be produced at a later time.

- Water Quality/Quantity
- Waterfront Management
- Resource Protection – Biological
- Public Access
- Cultural / Historic / Archaeological
- Education and Outreach
- Implementation

Water Quality / Quantity

1. Increase the capacity to monitor water quality in estuarine and freshwater portions of Newbury.

Summary: In recent years it has been a challenge for the PRCWA to maintain historic levels of monitoring. Currently 10 sites are monitored throughout the watershed. In Newbury, the Stormwater Management Plan is currently underway and will identify many new potential monitoring sites in Newbury. Use the momentum from the completion of the plan to go after additional funding and establish new monitoring sites. It would be useful to place a monitoring site near the stormwater runoff below the landfill.

Implementation team: Parker River Clean Water Association, Newbury Stormwater Advisory Committee, Estuarine Plan Committee, Estuarine Plan Coordinator

Funding: Amount needed is uncertain. Approach the Essex Natural Heritage Corridor

Time frame: Intermediate (while Stormwater Advisory Committee is still meeting)

2. Improve implementation of best management practices.

Summary: With the implementation of the Phase II stormwater management plans, there is an opportunity to encourage the use of best management practices (BMPs) in many areas and thus improve water quality.

- Agricultural areas - especially those located adjacent to the river. Use of the GIS created for this project can identify agricultural uses that are located within or adjacent to the ACEC boundary. Outreach efforts can be targeted to these landowners.
- Residential areas - Place septic systems and lawns as far from wetland resources as possible, use vegetative buffers between lawns and water bodies. Outreach campaigns can make use of the septic inventory prepared by CZM and target the landowners whose systems may have the most impact on the ACEC. In addition, alternative septic systems that comply with Title V should be considered. A wide variety of these "Innovative/ Alternative" technologies exist. To learn more, go to: http://www.mass.gov/dep/brp/wwm/files/it/techsum.htm.
- Residential and town managed areas - Apply low impact development (LID) techniques in new development and when improving town infrastructure.
- Stormwater drains – Alternative stormwater treatment devices are available. The University of New Hampshire CSTEV program demonstrates and tests many such devices and is a good source of information.

Implementation team: Estuarine Plan Committee, Stormwater Advisory Committee, Conservation Commission, Estuarine Plan Coordinator

Funding: Apply for grants to enhance outreach and education efforts

Time frame: Intermediate

3. Newbury and Newburyport inspect the sanitary sewer system in the Industrial Park for potential sources of pollution.

Implementation team: Estuarine Plan Committee, Stormwater Advisory Committee, Newbury Planning Board, Newburyport Planning Board

Funding: $$

Time frame: Long-term

4. Newburyport and Newbury investigate and correct the causes of flooding in the Industrial Park.

Summary: The Industrial Park sits only a few feet above the high tide level and as a result is susceptible to periodic flooding. Flooding is costly to businesses located in the Park and is also a hazard to water quality.

Implementation team: Estuarine Plan Committee, Stormwater Advisory Committee, Conservation Commission, Estuarine Plan Coordinator

Funding: $$

Time frame: Long-term

5. Inventory all pollution sources in Newbury and Newbury ACEC, prioritize potential projects, identify funding and partners, and implement projects.

Implementation team: Estuarine Plan Committee, Parker River Clean Water Association, DEP information and databases

Funding: $

Time frame: Long-term

6. Submit a 319 non-point source implementation grant for the Little River in Newbury and Newburyport.

Summary: Section 319 of the Clean Water Act of 1987 established a national program to control nonpoint sources pollution. Each year Massachusetts DEP issues a Request for Responses (RFR) for competitive projects to be funded through section 319 grants.

Implementation team: Estuarine Plan Committee, Parker River Clean Water Association, DEP regional nonpoint source coordinator, Estuarine Plan Coordinator

Funding: Dependent on project scope

Time frame: Immediate

7. Take action to improve water quality of Little River and Mill Rivers.

Summary: In the Little River pay special attention to the river between Hale Street and Hanover Street.

Implementation team: Estuarine Plan Committee, Parker River Clean Water Association, Estuarine Plan Coordinator

Funding: $

Time frame: Intermediate

8. Create citizen education outreach concerning wildlife feeding issues.

Summary: Excessive feeding of wild geese and ducks, while entertaining, can lead to groups of these animals congregating in one area for periods of time. The fecal matter of such congregations of animals can result in elevated fecal coliform levels. Water quality monitoring is really interested in identifying fecal coliform of human origin, rather than animal. For this reason, removing incentive for birds to congregate in one area is better for monitoring efforts.

Implementation team: Estuarine Plan Coordinator, Parker River Clean Water Association, Mass Audubon

Funding: $

Time frame: Intermediate

9. Create collaboration between Newbury and Newburyport in order to improve water quality in the Little River.

Summary: Search for cooperative regional grants that would bring Newburyport and Newbury together to work on issues that involve both towns. The 319 nonpoint source pollution grant is an example of such a grant. While it will no longer by feasible to apply for the 2005 round of grants, preparation should begin for next year's application.

Implementation team: Estuarine Plan Committee, Parker River Clean Water Association, relevant officials in the towns of Newbury and Newburyport

Funding: Dependent on grants

Time frame: Immediate

Waterfront Management

10. Inventory and prioritize open space during the Open Space and Recreation Plan Update

Summary: Based on the area estimates found in section 3.4, roughly 43% and 63% of Newbury and the Newbury ACEC are protected respectively. The next update must research the existing ownership

and location of unprotected areas in the town and within the ACEC. Information gained from parcel level analysis of unprotected land in Newbury would be useful in the creation of the five year action plan for the town.

Implementation team: Estuarine Plan Coordinator, Conservation Commission, Open Space and Recreation Plan Committee

Funding: As part of Open Space and Recreation Plan Update process

Time frame: Intermediate

11. Develop capacity to protect land for conservation/recreational purposes

Summary: Land protection includes acquisition as well as conservation and agricultural preservation restrictions. Land acquisition is so expensive that projects with multiple acquisition partners are now common. Fostering relationships with local non-profits (ECGA, TTOR, Essex County Sportsmen's Association) can allow Newbury's protection priorities to be known and create the potential for combined resources to be accessed.

Implementation team: Estuarine Plan Committee, Estuarine Plan Coordinator, non-profit protection organizations

Funding: Potentially a municipal bond, Community Preservation Act can contribute if passed

Time frame: Intermediate

12. Consider incorporating a 300-foot setback into the Newbury zoning bylaws

Summary: The setback is currently in the Board of Health Regulations.

Implementation team: Planning Board, Board of Health, Estuarine Plan Committee, Conservation Commission

Funding: None

Time frame: Intermediate

13. Extend the 300-ft setback to estuarine waters

Summary: (currently it applies to only freshwater areas). Ipswich Wetlands Bylaws contain a 150 ft jurisdictional buffer to the ACEC and may offer some guidance in applying the setback to estuarine as well as freshwater resources.

Implementation team: Planning Board, Estuarine Plan Committee, Conservation Commission

Funding: None

Time frame: Intermediate

14. Expand the jurisdiction of the wetlands protection bylaw

Summary: (from Plum Island only to all of Newbury)

Implementation team: Planning Board, Estuarine Plan Committee, Conservation Commission

Funding: None

Time frame: Intermediate

15. Create a conservation land fund or open space bond for town open space acquisition

Implementation team: Planning Board, Estuarine Plan Committee, Conservation Commission, Open Space and Recreation Committee

Funding: None

Time frame: Intermediate

16. Explore use of ACEC boundary in other town bylaws (such as the wetlands regulations)

Implementation team: Estuarine Plan Committee, Planning Board

Funding: None

Time frame: Intermediate

Natural and Biological Resource Protection

17. Identify, prioritize, and complete projects to restore normal flow to tidal restrictions. Then begin to restore these crossings one at a time.

Implementation team: Estuarine Plan Committee, Estuarine Plan Coordinator, CZM Wetland Restoration Program, Possibly the Mosquito Control District

Funding: Project specific

Time frame: Immediate

18. Work with residents, MBL researchers, and state agencies to identify areas of marsh degradation.

Summary: The issue of marsh degradation is one that was mentioned in discussions with MBL researchers, town residents, and others in Newbury. However, not enough is known about the processes of long-term marsh degradation. It would serve the interests of Newbury and the Estuarine Plan Committee to initiate a dialogue with MBL researchers and other relevant organizations on this topic. The issue of the potential impact of boating on bank erosion was raised several times. Research for this management plan did not reveal any information on impacts of boating on bank erosion other than anecdotal, and more work is needed to uncover other relevant research. The Massachusetts Recreational Boating and Personal Water Craft Management Guide provided some information and is available online at http://www.mass.gov/czm/pwcmgntguide.htm.

Implementation team: Estuarine Plan Committee, Estuarine Plan Coordinator, MBL researchers, Division of Marine Fisheries, Local residents that use the marsh as a resource

Funding: Volunteer

Time frame: Intermediate

19. Protect BioMap core and supporting natural landscape areas.

Summary: This recommendation can most effectively be implemented when writing the Open Space and Recreation Plan Update.

Implementation team: Estuarine Plan Committee, Estuarine Plan Coordinator, Town Planner, Conservation Commission

Funding: Will ride on funding for Open Space and Recreation Plan Update

Time frame: Intermediate

20. Eliminate invasive wetland plants

Implementation team: Estuarine Plan Committee, Estuarine Plan Coordinator, Parker River Clean Water Association, school groups, eagle scouts, farmers who harvest salt marsh hay

Funding: Project specific

Time frame: Intermediate

21. Monitor status of Rainbow smelt and American eel.

Summary: Make use of information being provided by the smelt population study in the Parker River to enhance ACEC management.

Implementation team: Estuarine Plan Coordinator

Funding: None

Time frame: Intermediate

22. Create a restoration inventory.

Summary: There are many potential restoration projects that can be undertaken in Newbury. It is recommended that a restoration inventory be created. This inventory should contain basic information on any potential restoration projects, location, cost, details, additional data needed, potential partners, and feasibility. Utilize CZM's "Great Marsh Coastal Wetlands Restoration Plan" as the baseline for the restoration project inventory and augment it with local data and priorities.

Implementation team: Estuarine Plan Committee, Estuarine Plan Coordinator, CZM Wetland Restoration Program, TTOR, Mass Audubon

Funding: Project specific

Time frame: Immediate

23. Rehabilitate the shellfish resources in the tidal portion of Little River, Parker River, and the Plum Island River.

Summary: A dialogue should begin with clammers to determine if they are interested in making use of additional shellfishery resources.

Implementation team: Estuarine Plan Committee, Estuarine Plan Coordinator, Newbury Harbormaster, Shellfish Commisioners

Funding: Uncertain

Time frame: Intermediate

24. Review and implement the DMF anadromous fish passage survey (North shore region).

Summary: This study will list all fishways in the region along with recommendations for

restoration. Close attention should be paid to these recommendations.

Implementation team: Estuarine Plan Coordinator

Funding: None

Time frame: Upon completion of study

25. Review the Parker River National Wildlife Refuge Habitat Management Plan.

Summary: Consider applying similar management practices in Newbury if applicable.

Implementation team: Estuarine Plan Coordinator

Funding: None

Time frame: When Management Plan is released in summer, 2005

26. Consider altering the mowing schedules on town-owned land to protect birds.

Summary: There are several species of grassland songbirds (e.g. Bobolink or Eastern Meadowlark) that can live in open fields. The haying season coincides with the peak nesting period of some of these species. If a town field, or a portion of a town field, does not need to be mowed between April and August, this could help restore local grassland bird species. Not all fields are appropriate habitat for grassland species. Size is often a constraint that will deter birds from establishing nests.

Implementation team: Estuarine Plan Coordinator, Newbury Department of Public Works, representative from Mass Audubon to gain information on habitat needs.

Funding: None

Time frame: Intermediate

27. Rehabilitate the shellfish resources in the tidal portion of the subwatershed (see recommendation 14)

Public Access

28. Improve public access to the estuary

Summary: Several access points were summarized in section 3.2.3 of the document. The implementation team should build on the information presented and move towards creation of the put-ins described.

Implementation team: Estuarine Plan Committee, Massachusetts Public Access Board, Mass Riverways Program, Parker River Clean Water Association

Funding: Project specific

Time frame: Immediate

29. Inventory and prioritize open space needed for recreational use.

Implementation team: Estuarine Plan Committee, Estuarine Plan Coordinator, Conservation Commission, Open Space and Recreation Committee

Funding: As part of Open Space and Recreation Plan Update process

Time frame: Intermediate

Cultural / Historic / Archaeological

30. Promote agricultural preservation with State APR program

Implementation team: Estuarine Plan Committee, Open Space and Recreation Committee, one or two representatives from the farming community in Newbury, Department of Agricultural Resources (DAR)

Funding: Project specific

Time frame: Intermediate

31. Review grants criteria from Essex National Heritage Commission and consider applying for projects to protect historic, cultural, scenic and archaeological resources.

Summary: ENHC grant applicants may be municipalities, non-profit organizations and institutions, educational institutions, or state government agencies. The goal of the Partnership Grant Program is to provide matching funds to projects that preserve and promote the historic, cultural, and natural resources of the Essex Natural Heritage Area, and to encourage organizations to work cooperatively on these projects. The Essex National Heritage Commission and the Parker River Clean Water Association are members of the Great Marsh Coalition and cooperate in Coalition projects. This estuarine plan might be useful to

bring focus on Newbury-specific and ACEC-wide projects.

Implementation team: Estuarine Plan Coordinator, Parker River Clean Water Association may participate in this effort if the Essex National Heritage Commission is interested in funding water quality monitoring efforts, Essex National Heritage Commission

Funding: Project specific

Time frame: Immediate

32. Take full advantage of Scenic Roads Act

Implementation team: Estuarine Plan Coordinator, Essex Natural Heritage Commission, Open Space and Recreation Plan Committee, Department of Conservation and Recreation (DCR)

Funding: None

Time frame: Immediate when the Essex Natural Heritage Commission releases the "Essex County Reconnaissance Survey"

33. Compile and collate Newbury's historical and archaeological information

Summary: Discussions with the Estuarine Plan Committee revealed a need to make it easier to access historical and archaeological information. Such information could be useful for municipal boards when considering potential developments, or simply for general public use. See recommendation 27 above for a potential match.

Implementation team: Estuarine Plan Committee, Newbury Historical Society

Funding: Uncertain

Time frame: Intermediate

Education and Outreach

34. Increase the profile of the Newbury estuarine management plan through education and outreach

Summary: Newbury residents are aware that successful management of the Newbury estuarine resources will require significant time and support. During the public meeting where draft issues and recommendations were presented, multiple residents emphasized the importance of gaining more support for the implementation of the management plan. More residents being involved will make it easier to implement the plan and to accomplish the management objectives. The estuarine plan committee should select two or perhaps three projects/events that could increase awareness of the management plan and hopefully attract volunteers to help in implementation. Local schools could incorporate the ecology and science of the estuary into a small portion of their curriculum. The Parker River Clean Water Association might lead some canoe/kayak trips to build support for the management plan. Presenting the management plan in other towns might also attract attention and volunteers.

Implementation team: Estuarine Plan Committee, Estuarine Plan Coordinator, local schools, possibly MBL researchers for presentations, possibly board members of the Parker River Clean Water Association

Funding: None

Time frame: Immediate

Implementation

35. Work with MBL to monitor sea-level rise in Newbury marsh systems.

Summary: Instruments are already in place at several locations in or near Newbury that allow precise measurements of sea levels in relation to the Salt Marsh. Upon establishing stronger links with MBL researchers, information on sea levels can be monitored.

Implementation team: Estuarine Plan Committee, Estuarine Plan Coordinator, MBL Researchers

Funding: None

Time frame: Long-term

36. Set up an "adaptive management system".

Summary: Gain input from multiple sources (MBL, residents, regional, state, and federal agencies, municipal boards). Convene a regional symposium each year or perhaps two years where recent research can be presented and the implications to management practices discussed. Incorporate monitoring programs into educational, research, and project permitting or local bylaws.

Implementation team: Estuarine Plan Committee, MBL Researchers, Mass Audubon, Mosquito Control District, Relevant state agencies

Funding: $

Time frame: Intermediate

37. Consider passage of the Community Preservation Act (CPA).

Summary: At the time of publication of this management plan 84 towns in the Commonwealth have adopted the CPA. The CPA is statewide enabling legislation that allows cities and towns to create a local Community Preservation Fund to fund open space, historic preservation, and low and moderate housing. It is funded through a surcharge of up to 3% of the real estate tax levy on real property (Community Preservation Initiative, http://commpres.env.state.ma.us/content/cpa.asp). To learn more about the CPA go to the above web-site.

Implementation team: Estuarine Plan Coordinator, town boards, town officials, and local citizens that support the initiative, Board of Selectmen

Funding: Mostly voluntary, although some educational materials and mailings will have to be created and sent out

Time frame: When sufficient public interest exists

38. Encourage extending the ACEC management plan from Newbury to the four other towns that have land in the Parker River / Essex Bay ACEC.

Summary: The DCR ACEC program is funding a project in FY05 to update municipal information gathered in the 2002 CZM document "An Assessment of Resource Management Strategies in the Parker River/Essex Bay ACEC" and to encourage regional cooperation in resource management and protection of the ACEC. Newbury will participate in this project, and the Estuarine Management Plan could be used as a catalyst to consider a regional management plan or regional coordination in resource management.

Implementation team: Estuarine Plan Coordinator and a powerpoint presentation of the plan

Funding: None

Time frame: Immediate

39. Continue to regularly convene meetings of the ACEC steering committee.

Summary: Maintain momentum generated by the assembly of the management plan, prioritize projects, and implement them. Create sequences of steps required and timelines for implementation. Attract more resident volunteers to take on specific steps such as writing of grant applications, writing of news articles, helping with open space research, creating public access points to the estuary, etc.

Implementation team: Estuarine Plan Committee and interested residents of Newbury

Funding: None

Time frame: Immediate

40. Consider funding an Estuarine Plan Coordinator (part-time)

Summary: A coordinator would assist in implementation of recommended actions of the management plan The coordinator would ensure that momentum generated from the creation of the plan would be maintained and would foster communication between residents and town officials to integrate "management" into daily activities.

Implementation team: Estuarine Plan Committee, Board of Selectmen, Planning Board, Conservation Commission

Funding: None

Time frame: Immediate

Issue	Recommendations		
	Immediate	**Intermediate**	**Long-term**
Water Quality / Quantity			
		1. Increase capacity for water quality monitoring	
		2. Improve implementation of BMPs	
			3. Newbury and Newburyport inspect sanitary sewer system at Industrial Park
			4. Newburyport and Newbury investigate and correct the causes of flooding in the Industrial Park
			5. Inventory all pollutions sources in Newbury and the Newbury ACEC
		6. Submit a 319 non-point source implementation grant for the Little River in Newbury and Newburyport	
		7. Take action to improve water quality of Little River and Mill Rivers	
		8. Create citizen education outreach concerning wildlife feeding issues	
	9. Create collaboration between Newbury and Newburyport in order to improve water quality in the Little River		
Waterfront Management			
		10. Inventory and prioritize open space during the Open Space and Recreation Plan Update	
		11. Develop capacity to protect land for conservation/recreational purposes	

Resource Management Issues and Recommendations

Issue	Recommendations		
	Immediate	**Intermediate**	**Long-term**
Waterfront Management (cont'd)			
		12. Consider incorporating a 300-foot setback into the Newbury zoning bylaws	
		13. Extend the 300 ft setback to estuarine waters	
		14. Expand the jurisdiction of the wetlands protection bylaw	
		15. Create a conservation land fund or open space bond for town open space acquisition	
		16. Explore use of ACEC boundary in other town bylaws (such as the wetlands regulations)	
Natural and Biological Resource Protection			
	17. Identify, prioritize, and complete projects to restore normal flow to tidal restrictions		
		18. Work with residents, MBL researchers, and state agencies to identify areas of marsh degradation	
		19. Protect BioMap core and supporting natural landscape areas	
		20. Eliminate invasive wetland plants	
		21. Monitor status of Rainbow smelt and American eel	
	22. Create a restoration inventory		

Issue	Recommendations		
	Immediate	**Intermediate**	**Long-term**
		23. Rehabilitate the shellfish resources in the tidal portion of Little, Parker, and Plum Island River	
		24. Review and implement the DMF anadromous fish passage survey (North shore region)	
		25. Review the Parker River National Wildlife Refuge Habitat Management Plan	
		26. Consider altering the mowing schedules on town-owned land to protect birds	
		27. Rehabilitate the shellfish resources in the tidal portion of the subwatershed	
Public Access			
	28. Improve public access to the estuary		
		29. Inventory and prioritize open space needed for recreational use	
Cultural / Historic / Archaeological			
		30. Promote agricultural preservation with State APR program	
	31. Review grants criteria from Essex National Heritage Commission		
	32. Take full advantage of Scenic Roads Act		
		33. Compile and collate Newbury's historical and archaeological information	

Resource Management Issues and Recommendations

Issue	Recommendations		
	Immediate	**Intermediate**	**Long-term**
Implementation			
	34. Increase the profile of the Newbury estuarine management plan through education and outreach		
			34. Work with MBL to monitor sea-level rise in Newbury marsh systems
		35. Set up an “adaptive management system.”	
		36. Consider passage of the Community Preservation Act	
	37. Encourage extending the ACEC management plan from Newbury to the four other towns that have land in the Parker River/Essex Bay ACEC		
	38. Continue to regularly convene meetings of the ACEC steering committee		
	39. Consider funding an Estuarine Plan + Coordinator (part-time)		

Introduction

This section describes a framework to implement the recommendations of the estuarine management plan. The framework outlines an organizational structure, a prioritized action plan, and discusses the resources needed for implementation.

The implementation plan is intentionally simple, focusing primarily on actions that will have immediate or short-term results. This approach is suggested because the estuarine plan was developed quite rapidly and has not had time to attract as large a group of volunteers to it as some other plans. Also, at this time, it is not clear if implementation actions will be undertaken on a volunteer basis or if a part-time coordinator could be hired to oversee management activities for Newbury and potentially coordinate regional projects with other towns with estuarine resources. After several successes have been obtained, the focus of implementation can begin to move to many of the intermediate and long-term recommendations listed above.

Organizational structure

The implementation plan must rely on the participants in the process thus far. This includes the Estuarine Plan Committee, which contains a member of the Planning Board, the town Planner, a CZM representative, an ACEC Program representative, a Merrimack Valley Planning Commission representative, and many other participants that represent other municipal boards as well as non-profit organizations such as the Parker River Clean Water Association. It is recommended that the Estuarine Plan Committee continue to meet in order to shift from preparation of the plan into implementation. The Conservation Commission should become involved in implementation of the management plan to facilitate communication and interaction between the different municipal boards. If possible, a part-time Estuarine Plan Coordinator should be hired to help oversee implementation and provide consistent communication between members of the steering committee.

Large amounts of information were collected in assembling the plan. Many questions still remain that may be answered by research that is currently underway at state agencies or by research institutions such as the MBL. For this reason, it is recommended that an Estuarine Plan Technical Committee be formed. See Action 10 below for a description of this committee and potential members.

Action Plan

The following actions make up Phase I of implementation. They represent the actions that deserve "immediate" action. Many of the recommendations were proposed for intermediate or long-term time frames. While these are also important, it is key to generate some early successes from the management plan. For this reason, the action plan devotes most of its attention to recommendations that are immediately relevant.

Action 1: Submit a 319 non-point source implementation grant for the Little River in Newbury and Newburyport (Recommendation 6).

Summary: The DEP program focuses on implementation of measures to control nonpoint sources (NPS) of water pollution. NPS pollution is caused by diffuse sources that are not regulated and are normally associated with precipitation and runoff from the land or infiltration into the soil. Common types of NPS pollution include phosphorus and nitrogen from lawn and garden fertilizers, bacteria from pet waste and waterfowl, oil and grease from parking lots, and sediment from construction activities and soil erosion. A preliminary conversation with Jane Peirce from the DEP 319 Program suggests that there is likely a good match between this grant and the Little River Subwatershed.

Responsible party: Estuarine Plan Committee

State contact: Jane Peirce, MA DEP, 319 Nonpoint source program coordinator.

Materials needed: Make use of the water quality data that has been collected in the Little River by PRCWA. The MVPC has also conducted a study specifically on "Assessment and Management of nonpoint source pollution in the Little River Subwatershed". Finally other agencies also have monitoring stations in the Little River such as the Division of Marine Fisheries.

Time frame: Preparation for application to next year's grant deadline should begin before September. This year's RFR was released on April 4th and proposals are due in early June. The RFR for 319 grants is posted on the Massachusetts

Comm-Pass web-site each year. Proposals are due at the beginning of June.

Action 2: Create collaboration between Newbury and Newburyport in order to improve water quality in the Little River (Recommendation 9).

Summary: The objective of this action is to create additional relationships between the two towns that foster cooperation and to create a successful shared water quality improvement project. Application to the 319 nonpoint source grant mentioned in Action 1 has great potential to create a project that involves both of the towns.

Responsible party: Estuarine Plan Committee in cooperation with Merrimack Valley Planning Commission

State contact: See above description of the 319 nonpoint source grant

Materials: See above description in Action 1.

Time frame: Begin dialogue with Jane Peirce immediately. Identify potential partners on the Newburyport municipal boards and begin a dialogue with them.

Action 3: Identify and prioritize projects to restore normal flow to tidal restrictions (Recommendation 17).

Summary: The estuarine management plan reviewed information that was collected on tidal crossings in 1996 and has prioritized the high and medium priority tidal restrictions. These projects need to be taken to the next level and brought to the attention of relevant state agencies such as CZM's Wetland Restoration Program. As CZM will soon be releasing their Great Marsh Coastal Wetland Restoration Plan and has also reviewed this data.

Responsible party: Estuarine Plan Committee

State contact: Jason Baker, CZM Coastal Monitoring Program; Hunt Durey, CZM Wetlands Restoration Program.

Materials needed: All materials needed have already been collected. Additional research should be conducted on the high and medium priority tidal restrictions so that grants can be submitted to the CZM Wetlands Restoration Program and other agencies.

Time frame: CZM is currently conducted interviews of Great Marsh communities. The prioritized sites should be brought to the attention of CZM at that meeting. CZM will be able to advise Estuarine Plan Committee members of the appropriate grants and additional meetings to have.

Action 4: Create a restoration inventory and prioritize potential projects (Recommendation 22).

Summary: Restoration potential exists for salt marsh, freshwater wetlands, shellfish beds, and diadromous fish passage. Impacts include tidal restrictions (Action 2), dams, invasive plant and marine species, and pollution. Potentially conflicting uses may require creating dialogues, such as with Parker River National Wildlife Refuge, Mosquito Control District, MBL, and local farmers regarding "open marsh water management," natural marsh degradation, sea-level rise, and salt marsh haying. Open marsh water management helps the Refuge create additional habitat for bird species. However, open marsh water management applied in other areas can restrict salt marsh haying.

Responsible party: Estuarine Plan Committee in conjunction with the Newbury Stormwater Advisory Committee

Time frame: This action is of slightly lower priority. There are no known funding sources available that could jump-start additional restoration projects. However, having a town-wide inventory of restoration projects ready will make acquiring funding much easier in the future. Grants flow much more easily to prioritized projects.

Action 5: Improve public access to the estuary (Recommendation 28).

Summary: The status of the potential access at Rt 1A should be closely monitored. Currently, it is believed that funding is already in place and approval obtained for this access point. Initially, creation of this access point would have taken place concurrently with the renovation of the bridge. However, most recently these two projects have been separated. It is likely that the renovations to the bridge will need to take place prior to creation of the access point (Personal communication, Russ Cohen). Preliminary plans for the other two potential access projects (downstream side of Central St Dam and town-owned Central Street

recreational land) could be created as well as cost estimates for their construction.

Responsible party: Estuarine plan committee (Marlene Schroeder is a good source of information about potential public access and is the natural to lead this action).

State contact: Russ Cohen, Riverways. Mass Public Access Board.

Materials: The GIS data set created for the management plan can be used to create additional educational materials and attract attention to this action. Communication between Newbury, the Massachusetts Public Access Board, and Massachusetts Riverways should be renewed.

Time frame: Renewal of dialogues should begin immediately.

Action 6: Review potential grants from Essex National Heritage Commission (Recommendation 31).

Summary: ENHC grant applicants may be municipalities, non-profit organizations and institutions, educational institutions, or state government agencies. The goal of the Partnership Grant Program is to provide matching funds to projects that preserve and promote the historic, cultural and natural resources of the Essex National Heritage Area, and to encourage organizations to work cooperatively on these projects. The Essex National Heritage Commission and the Parker River Clean Water Association are members of the Great Marsh Coalition and cooperate in Coalition projects. This estuarine plan might be useful to bring more focus to Newbury-specific and ACEC-wide projects.

Responsible party: Estuarine Plan Committee

Time frame: Upon publishing the management plan

Action 7: Extend the ACEC management plan from Newbury to the four other towns that have land in the Parker River / Essex Bay ACEC (Recommendation 37).

Summary: The DCR ACEC program has funded a project to update municipal information gathered in the 2002 CZM document, "An Assessment of Resource Management Strategies in the Parker River/Essex Bay ACEC". This document will provide useful information that encourages regional cooperation in resource management and protection of the ACEC. When published, this document can serve as the focal point for discussions within and between ACEC towns. In addition, it is recommended that members of the Newbury Estuarine Management Plan present the completed Newbury Estuarine Managment Plan to other ACEC towns. These presentations may spur interest in and funding for the creation of an ACEC-wide management plan. In the future, additional funding from CZM to extend the estuarine management plan to all of the ACEC communities may be available.

Responsible party: Estuarine Plan Committee

Materials: Powerpoint presentation summarizing the plan

Time frame: Upon completion of the management plan

Action 8: Continue to regularly convene meetings of the Newbury Estuarine Plan Committee (Recommendation 38).

Summary: This action is probably the most important one in the Action plan if recommendations are to be implemented and realized.

Responsible party: Estuarine Plan Committee

Time frame: Upon completion of the management plan

Action 9: Consider the creation of an Estuarine Plan Coordinator to assist in implementation of recommended actions of the management plan (Recommendation 39).

Summary: While significant progress can be made by the Estuarine Plan Committee, it is a volunteer committee and will be limited by time of its members. A part-time Estuarine Plan Coordinator would greatly enhance the ability of the Committee to implement recommendations. The coordinator could assist by organizing materials and keeping them centralized and would be the voice of the Estuarine Plan Committee. Discussions should begin immediately upon completion of the plan to determine if such a position is possible. Funding sources should be explored that provide resources for organizational capacity building.

Responsible party: Estuarine Plan Committee

Implementation Plan

Time frame: Immediate upon completion of the management plan.

Action 10: Consider the creation of an Estuarine Technical Committee

Summary: Many questions still remain that may be answered by research that is currently underway at state agencies or by research institutions such as the MBL. For this reason, it is recommended that an Estuarine Plan Technical Committee be formed in order to manage the data as well as digest new information that is constantly being generated. Representatives from MBL, DFG, and DMF should be invited to join this committee. The new research facility that MBL has recently acquired should facilitate MBL's physical presence on the marsh. Hopefully, it will make it easier for them to become active in Newbury as well. Some of the current members of the Estuarine Plan Committee may migrate to the Technical Committee. Representatives from Mass Audubon and the Parker River National Wildlife Refuge should also be considered.

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