

UPPER ASSABET
RIVERWAY
PLAN

Upper Assabet Riverway Plan

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Preface

Quick, what does the phrase “Assabet River” bring to mind?

You might picture a slowly winding river, meandering past houses, golf courses, a few town centers, and a surprising amount of forested land with no sign of human habitation. You might see broad floodplains dotted with cattails, painted turtles, and the occasional great blue heron flying overhead. Or narrow, intimate passages, with leafy trees forming a shady canopy above. This is the river that inspired Thoreau, Hawthorne, and Emerson, and continues to inspire canoeists, kayakers, photographers, and poets today.

Or... perhaps you live near, drive by or canoe the river in the summer. If so, you’re likely familiar with the Assabet’s seamier side – its unlovely summer carpet of green plants and algae, its late-summer smell that mimics the odor of sewage.

A study in contrasts, the Assabet holds tremendous promise, but bears the burdens and scars of many years of abuse. A federally- designated Wild and Scenic River, the Assabet boasts wonderful white and flatwater boating, scenery, and wildlife. Yet seven wastewater treatment plants send sewage effluent down the mainstem of this 31-mile stream, and the mounting demand for water (and sewer) exerted by the growing communities in the watershed means that in the summer, the river is increasingly a river of effluent, and the tributaries are losing flow.

It is our hope that this plan will help the Upper Assabet communities (Westborough, Marlborough, Northborough, Berlin, and Hudson) realize the Assabet’s promise, and work together toward better stewardship of this precious regional resource. Intended as an update to the 1986 Assabet Riverway Plan, this new Plan focuses on just the five upstream Upper Assabet communities, although many of its recommendations are applicable to the whole watershed.

This work is truly a joint effort. Town volunteers and conservation staff from Marlborough, Westborough, Northborough, and Hudson, together with representatives from the Organization for the Assabet River and Sudbury Valley Trustees, first came together to discuss collaboration for riparian land protection in 1999. After a few meetings, we realized we shared a vision of a more connected watershed. We envisioned trails along the river, connecting the communities, traversing protected lands along the river. We envisioned

cleaner water, and better river stewardship. We envisioned more river-related recreation – and more boat launches in the less-accessible upper reaches of the river. We envisioned more collaboration among the communities to protect river related lands and the river itself.

Working on this plan brought the four communities and two conservation organizations together in what we hope will be a lasting partnership to protect the Upper Assabet and its watershed.

Quick, what is your vision for the Assabet River?

If you're like us – the authors of this plan – you imagine a river that quietly enhances the communities it flows through – a clean, flowing river where humans and wildlife coexist in harmony. A place where children and adults go to fish, to canoe and kayak, to observe wildlife, and perhaps, someday, to swim. A river whose residents take such good care of it that it no longer needs an annual cleanup... A river that connects its communities to each other and to nature.

We invite you to join us in enjoying, restoring, and protecting the Assabet River and its watershed.

Introduction

Purpose

The purpose of this plan is to give municipal governments, planning agencies, town volunteers, conservation organizations, and interested others a set of useful planning tools – maps, suggested bylaws, and recommendations -- to help them protect the upper Assabet River and its watershed. The specific goals – improving water quality, and protecting water quantity (flow), protecting habitat for biodiversity, and improving recreational opportunities in and around the river, – are meant to preserve and enhance the quality of life for both people and wildlife along the upper Assabet.

Upper Assabet Riverway Plan goals

1. Improve the water quality and quantity of the Assabet River
2. Protect the biodiversity of the Assabet River and its corridor
3. Enhance the recreational resources of the Assabet River

History

The original Assabet Riverway Plan, published in 1986, was considered ahead of its time. Sixteen years later, the document remains surprisingly relevant, and has proved remarkably prescient.

Looking at the watershed as an ecologic unit when most planners still confined their thinking within political boundaries, the authors advocated an integrated program of land and water protection throughout the Assabet basin. In order to protect the river and restore fisheries, they argued, municipalities needed to invest more in wastewater treatment, and do a better job of protecting the region's natural resources from its growing population. Instead of passively accepting development where it occurred, the communities should decide where it should go, and importantly, where it should not. This meant permanently protecting land, especially land along the Assabet River. Land and easement prices were "relatively low," the authors pointed out, and urged communities to take advantage of opportunities to purchase riverfront land (or development rights) while this was still possible. To aid in this purpose, the Riverway Plan's town-by-town maps (USGS topos with hand-drawn overlays) depicted land use and ownership of riverfront parcels. Finally, stated the Riverway Plan, the Assabet River needed a watershed association, a group dedicated to its protection.

While land along the Assabet has ceased to be a bargain, many of the conditions described in the 1986 Plan remain true of the upper Assabet today. These paragraphs, for example, could have been written in 2002:

The Assabet River flows through one of the fastest growing areas of New England. Industry and business are growing along the Interstate-495 corridor in Massachusetts, causing unprecedented development in the Assabet watershed. This development is also bringing rapid population growth to many of the towns along the Assabet, and together these changes multiply the stresses on the region's natural resources, including those of the Assabet River.

The Assabet suffers from severe water pollution caused mainly by overloaded wastewater treatment plants. At the same time, towns bordering the river are discovering the [Assabet's] potential...for outdoor recreation opportunities and natural resource protection...

Progress since 1986 -- and challenges

Some important changes since publication of the 1986 Plan have improved water quality, biodiversity, and river-related recreation in the upper Assabet watershed:

- ❖ **Water quality improvement in 1987.** A new Westborough/Shrewsbury Regional Wastewater Treatment Plant, located just below the Assabet headwaters, came on-line in spring 1987, causing a dramatic improvement in water quality. Prior to this, fecal coliform counts, an indicator of raw sewage pollution, had often greatly exceeded water quality standards.
- ❖ **Over 1700 acres of land protected.** Since 1986, approximately 1750 acres of land were permanently protected in the five communities.¹
- ❖ **Bylaws strengthened.** Since 1986, several regulatory measures have been added to community zoning in order to protect the Assabet River watershed's natural resources. For example, each of the five upper Assabet communities now has adequate hazardous materials, earth removal, groundwater, and floodplain protection bylaws, due in part to

¹ The over 1750 acres protected in the five communities were not all within the Assabet River watershed, as portions of the communities lie outside the watershed.

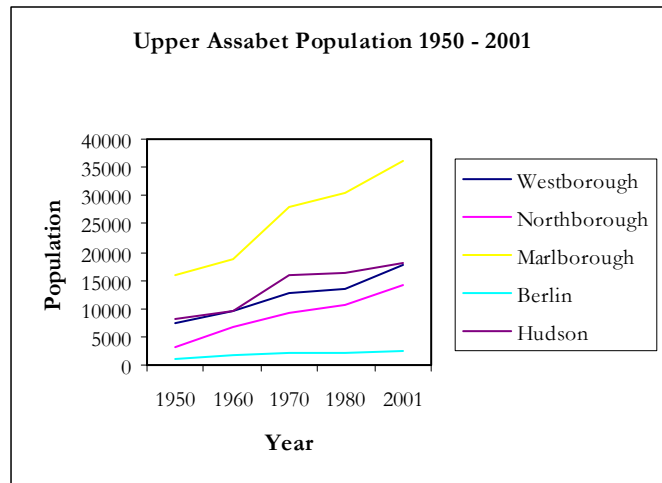
the suggestions made by the 1986 Assabet Riverway Plan. (This plan looks at each community's bylaws, and makes additional suggestions; see the regulatory section and individual town sections).

- ❖ **New recreational opportunities and biodiversity protection:**
Assabet River Rail Trail, Assabet River National Wildlife Refuge. Planning for the Assabet River Rail Trail, a 12-mile rail-to-trail conversion along the Assabet from Marlborough to Acton began in 1992; completion of the trail is expected in the next five years. In 2001, the US Army transferred ownership of the former Ft. Devens Annex, a 2200-acre parcel in Maynard, Stow, Hudson, and Sudbury to the US Fish and Wildlife Service, which has been established as the Assabet River National Wildlife Refuge.
- ❖ **Creation of OAR.** The Organization for the Assabet River was created in 1986, as a result of the 1986 Assabet Riverway Plan. A non-profit membership organization serving the entire Assabet watershed, OAR has a small professional staff and a fifteen-member board. Based in Concord, OAR runs an EPA-approved volunteer water quality monitoring program of the river; organizes an annual cleanup at sites all along the river; advocates for improved water quality and quantity; and offers a series of recreational and educational programs for the public. Recent activities in the upper watershed include a Shoreline Survey in 2002, and the expansion of OAR's annual cleanup to include Northborough (2001) and Westborough (2002).
- ❖ **SVT expands focus to include Assabet Valley.** With a broadening of its focus to include the Assabet watershed, Sudbury Valley Trustees has devoted time and resources to conserving land in this area. Notable successes in the upper Assabet include Cedar Swamp in Westborough, Cedar Hill in Northborough, and Garfield Woods in Berlin.
- ❖ **Increased attention to the Assabet River and its problems.** A state-funded Total Maximum Daily Load study of the Assabet River (to see how much nutrient pollution the river can assimilate and still meet water quality standards) and the formation of the Assabet Consortium (see below) are two signs that the Assabet is on decision makers' "radar screens."

The challenges posed by the continuing population growth, however, are daunting.

- ❖ **Population growth.** The population in the five upper Assabet communities rose from about 73,000 in 1980 to over 87,000 in 2000. This growth pressure has created a heavy demand for water and sewer services, and developable land.

- ❖ **Summer water quality problems.** As the volume of wastewater treatment plant effluent discharged to the Assabet River has increased, the river has suffered. A heavy summer growth of duckweed and other aquatic plants infests many parts of the river in the summer, making boating unpleasant, and harming fish habitat. In the fall, these plants die, creating sewage-like odors. This problem has made the Assabet River the subject of a state-sponsored nutrient TMDL (Total Maximum Daily Load study). The Assabet Consortium, a group of sewered communities in the Assabet watershed (Westborough, Shrewsbury, Marlborough, Northborough, Hudson, and Maynard) is currently undergoing comprehensive wastewater management planning in anticipation of stricter new permits, scheduled to be issued at the end of 2003.



- ❖ **Unsustainable water use exacerbates water quality problems in the Assabet and tributaries.** As the communities grow, they are withdrawing more and more water for water supply, and sending it down the river as effluent. (Currently approximately 64% of the water withdrawn from the upper watershed is sent down the river). This water is not available to replenish the aquifers. As a result, water quality in the river suffers through lack of clean water for dilution, and the drawdown of groundwater may threaten future water supply.
- ❖ **Continuing development pressure.** Rising real estate values caused by a thriving state and local economy in the 1990's created strong incentives for landowners to sell or develop their property. Competing with rapid development and escalating property costs, land trusts and municipalities are increasingly challenged in their efforts to protect land with conservation value.

Creating this Plan

A committee of representatives from each community, the Organization for the Assabet River, and Sudbury Valley Trustees initially began meeting to explore ways to work together to protect the Assabet River for habitat and recreation. Here in the headwaters, where the river is small, wastewater discharges and land uses make a big difference to the river. However, perhaps because it is small, the river is less visible to residents. How could we raise the visibility of this important resource, we wondered, how could we better protect it, and how could we enhance its recreational potential?

Once we decided on an updated Assabet Riverway Plan as a vehicle to accomplish these goals, we met monthly for about two years to exchange ideas and information. We were fortunate to obtain funding for the project from the Massachusetts Department of Environmental Management and Intel Massachusetts. Project Coordinator Heather Bruce worked with the community representatives to gather information on current planning regulations, protected lands, water quality, and recreational resources. We analyzed this information on both an individual community and regional basis, and together developed recommendations.

The committee presented a draft to each community in the Upper Assabet watershed and requested feedback in June 2002.

Using the Riverway Plan

This Plan is intended to be a tool for staff and volunteers in municipal governments, conservation organizations, and others interested in improving the water quality, water quantity, biodiversity, and recreational opportunities in the upper Assabet River corridor. The Plan will help answer such questions as:

“Can we continue this river trail to the neighboring community?”

“What can residents do to protect the Assabet River in my town?”

“Where can I put in my canoe in the Assabet?”

“Where are the protected – or unprotected – land parcels along the river in my town?”

“Can my town strengthen its bylaws to protect the river – is there a neighboring town with a bylaw we should adopt here?”

The Upper Assabet Riverway Plan provides information on both a regional scale and a community level. The introductions, including information on

biodiversity, recreation and water quality and quantity, discuss issues as they relate to the upper Assabet as a whole. This section is followed by overall recommendations for all the communities. Each community has a separate chapter, where local issues, as they relate to the river, are discussed. Here, the Plan looks at the scenery, history, recreational resources, biodiversity, and hydrology of each community. The community chapters each have recommendations specific to that city or town, as regulations, lands in need of protection, and other situations vary. Each community's section is illustrated by a series of maps depicting open space, biodiversity, recreation, and hydrology for the city or town.

It is the hope of the Upper Assabet Riverway Plan Committee that the Plan will inspire the five communities to continue to work to protect the valuable resource we all share in the Assabet River.

Recreation

In addition to the recreational value of the river for canoeing and fishing, the greenway surrounding the river provides other recreational opportunities as well, including walking and biking trails.

Walking and biking trails

The first completed portion of the Assabet River Rail Trail stretches along the old Marlborough Railroad. Eventually the 12-mile trail will continue through Marlborough, Hudson, Stow, Maynard and Acton, following the course of the Assabet River. In Marlborough, however, it begins in the center of town, and does not cross the Assabet until the trail reaches downtown Hudson. The Marlborough and Hudson sections of the trail will be completed in 2003, and the Assabet River Rail Trail, Inc. expects that the remaining sections of the trail will be completed in the next five years. The Assabet River Rail Trail is so named because the old railroad line followed the riverbed, the lowest and flattest sections of the landscape.

The Wayside Rail Trail Committee has proposed another rail trail, Wayside Rail Trail. It would create a biking trail - and possibly a bus line or train - along the former Central Massachusetts Railroad right-of-way. The Wayside Rail Trail would travel in an east-west direction from Belmont through Waltham, Weston, Wayland, Sudbury, Hudson and Berlin. The Assabet River Rail Trail and the Wayside Rail Trail would intersect and cross the Assabet River in Hudson. This project has been slowed down by opposition from the MBTA, which wants to retain the right of way. The Town of Weston has also opposed the project.

The Westborough Charm Bracelet is another walking trail project that will create recreational opportunities along the banks of the Assabet River. The Charm Bracelet is being planned, constructed, and maintained by volunteers working under the direction of the Westborough Community Land Trust and the Town of Westborough's Open Space Preservation Committee. The 26-mile Charm Bracelet circles the Town of Westborough and follows the river for much of the distance. The northeastern section of the trail crosses into Northborough where the opportunity exists to connect with Northborough's developing trail system.

Canoe launches

Canoeing is a major recreational opportunity on the upper Assabet. The river runs through a heavily developed region, but there are many stretches where, for a canoeist upon the river, civilization is out of sight and hearing. Access to the river is available at several unofficial boat launches along the upper Assabet River and at an official launch at Chapin Road in Hudson. Canoes can also be rented in Hudson.

Additional canoe access points are proposed in Marlborough along Robin Hill Street and Donald Lynch Boulevard, and in Hudson along the Assabet River Rail Trail.

Information about canoeing on the river as well as its history and wildlife can be found in Ron McAdow's book, "The Concord, Sudbury and Assabet Rivers" published by Bliss Publishing.

Fisheries

The SuAsCo Reservoir (Mill Pond) in Westborough is a popular fishing pond, with golden shiners, brown bullhead, yellow perch, pumpkinseed, largemouth bass, black crappie, white sucker and white catfish reported. Along the stretch of river from the SuAsCo Reservoir into Hudson, there are many fishing opportunities along the shoreline or by boat.

Some of the best places to fish in the area include Cold Harbour, Howard and Stirrup Brooks in Northborough; North Brook in Berlin; and Danforth and Hog Brooks in Hudson.

In the spring, fishing enthusiasts can land trout in the upper Assabet River, thanks to a Department of Fisheries and Wildlife (DFWELE) fish stocking program. During the past three years, DFWELE has stocked brown trout and rainbows in the Assabet at the Yellick Recreation Area in Northborough. Although the river's warm temperature, impoundments, and water quality problems prevent the trout from occurring naturally in the river (or reproducing), this is a popular program for the area's sport fishermen.

The Massachusetts Departments of Environmental Protection (DEP), Public Health (MDPH), and Fisheries Wildlife and Environmental Law Enforcement (MDFWELE) began fish toxics monitoring in 1993/1994. One test site was located on the Assabet River at the Route 85 impoundment in Hudson.

Mercury concentrations fell below MDPH trigger levels (0.5 mg/kg), though large mouth bass should probably be avoided (because larger fish are most likely accumulating mercury to concentrations above the trigger level). The testing also found low concentrations of PCBs, most likely due to discharges from industrial uses.

Balancing recreation with biodiversity

In order to protect the biodiversity of the upper Assabet, it is important to consider the impacts of recreational activities on water quality, fish, plants, and wildlife.

Areas where the river narrows and is overgrown with shrubs and trees provide excellent habitat for a variety of birds. Opening up these narrow corridors to boat travel could eliminate this habitat and in turn harm bird populations. When planning any trails within the river or along its edges, it is important to gather baseline data to establish a check point for long-term examination of water quality, animal habitat, and flora and fauna along the river corridor.

It is recommended that the boat access location on the Assabet River should be encouraged downstream from Route 20 in Northborough and that no formal maintenance of the stream corridor upstream of this location be provided.

Biodiversity Introduction

Geology of the Assabet watershed

The landscape of the Assabet River valley is the result of glacial action during the last Ice Age, which lasted for 100,000 years. During the beginning of the Ice Age, when the glaciers grew and moved south, they picked up loose soil and rock and carried it for many miles. Thousands of years later, when the glaciers began their retreat to the north, they redeposited the soil material over bedrock in new patterns. Most of this material was placed directly over bedrock, and some was washed out of the melting glaciers by meltwater streams and deposited in glacial lakes in various formations.

One of those glacial lakes was Glacial Lake Assabet, which flooded an area roughly approximate to the Assabet River watershed. As the meltwater streams flowed into the lake they created layers of sand and gravel deposits on the floor of the lake. When the lake drained, formations known as kame deltas and kame terraces were exposed. Kame terraces are flat sand and gravel formations that have built up on the floor of the lake. When the ice melted, the surface facing the ice collapsed into steep slopes.

These kame terraces—flat formations with steep slopes at their edges—are common along the Assabet River. The Algonquin Regional High School in Northborough and Hudson's High School are built on them. The flat topography of kame terraces is ideal for large one-story buildings and multiple athletic fields.

Because of their outwash characteristics, kame terraces have historically been used for mining sand and gravel. The remnants of existing and abandoned gravel pits are visible along the river, especially in South Berlin and in Marlborough along Donald Lynch Boulevard, where thick high-stage kame terraces exist.

Kame terraces also surround another interesting formation left by the glaciers, kettle holes. Kettle holes were formed when isolated ice blocks broke off the main glacier and remained in the glacial lake as the lake filled with outwash sand and gravel. When the lake drained and the isolated ice block melted, it left a water-filled depression surrounded by a flat kame terrace with steep ice-contact slopes. Perhaps the most renowned kettle hole is Walden Pond in Concord, formed in Glacial Lake Concord.

The larger kettle holes formed in Glacial Lake Assabet include Lake Chauncy in Westborough; Little Chauncy Pond and Solomon Pond in Northborough; and Muddy Pond in Marlborough.

Still another interesting and rarer glacial outwash formation found in the Assabet River watershed are eskers. Eskers are elongated hills about 35 feet in height that can be as long as a few hundred feet to miles long. They were formed when fissures occurred within the glaciers, allowing underground streams to course through the glacier, depositing gravel and boulders as it rushed through the ice block. When the glaciers melted, these subterranean gravel deposits were exposed as eskers.

Eskers are somewhat rare formations; however, they have become endangered because of their value as gravel pits. Among the few eskers known in the Assabet River watershed, a few exist north of the Woodside section of Northborough, and one is located along the Millham Reservoir in Marlborough.

Another interesting glacial formation that was formed by the direct action of glaciers are drumlins. These are large elongated or rounded hills with smooth steep sides on their eastern and western sides. The long axis of drumlins typically face in a north/south direction, reflecting the northerly direction of glacial movement. Drumlins are typically formed of fine clay material with stones. Among the many drumlins in the Assabet River watershed are Edmund Hill, Mount Assabet and Fay Hill in Northborough and Pope Hill, Potash Hill and Phillips Hill in Hudson.

Native American settlement in the Assabet River watershed

Following the receding of the glaciers and the revegetation of Southern New England, bands of hunter-gatherers began populating the area about 12,000 years ago in search of game. With the introduction of agriculture into the area from the south approximately 1,000 years ago, settlement patterns became more stable and organized around productive agricultural soils left as a result of the low stage of glacial lakes.

The area of the Assabet River valley was populated by inland Nipmuc groups, part of the larger northeast confederation of the Algonkians. Preferred settlement locations were along the Assabet River, its tributary streams and on the edge of the watershed's ponds. Longstanding settlements existed at the locations of fish weirs along tributary streams. The thousands of years of

settlement at many of the locations along the Assabet River warrant the identification of the most important sites and the initiation of an effort to protect them from disturbance.

Terrestrial biodiversity

The upper Assabet watershed is made up of a variety of habitats – from agricultural fields to upland forests to swamps. Each one provides critical value to the Assabet River, through wetland filtration of pollutants, and upland habitat for birds and other wildlife.

The Assabet watershed provides habitat for a range of common indigenous species including the white-tailed deer, coyote, red tail fox, beaver, woodchuck, raccoon, skunk, gray squirrel, chipmunk, red squirrel, bats, porcupine, fisher, and the cottontail rabbit.

The area's diverse habitats are home to a wide array of bird species including the cardinal, mourning dove, downy woodpecker, nuthatch, tufted titmouse, English sparrow, house wren, Baltimore oriole, owls, osprey, heron, barred and barn owls, chickadee, mockingbird, purple finch, robin, goldfinch, flicker blue jay, wild turkey, grouse, pheasant, woodcock, wood ducks, oven bird, cat bird and cuckoo – to name a few. Warblers migrate through the area in their spring migration north. Many hawks – including redtails and broadwings – are common.

The 2000 Biodiversity Protection and Stewardship Plan for the Sudbury, Assabet and Concord Rivers (SuAsCo) Watershed¹ identifies biodiversity areas that are significant on the watershed scale and makes recommendations for their future protection. Preserving regional biodiversity requires a variety of habitat types found in the lowlands, rocky ridgelines, streams, rivers, and riparian areas across a watershed. The upland areas of the watershed need to be connected to other areas so that over the long term, populations of wild animals can intermingle, finding mates and exchanging genetic material. One of the indications of healthy habitat is the presence of focal species. Focal species are those species that have significant effect on or indicate the quality of natural communities. Examples of focal species for this study include beaver, otters, spotted turtles and blue heron. Several of these areas fall within the upper Assabet watershed, which are outlined in each community's chapter.

The Natural Heritage and Endangered Species Program (NHESP) has identified several areas in the upper Assabet watershed that provide habitat for

species of special concern, threatened, rare and endangered species. Examples include the spotted turtle, Eastern box turtle, blue-spotted salamander, and climbing fumitory vegetation.²

All of these areas are important to the biodiversity of the river. Helping to protect these areas and any unprotected land that surrounds it and the corridor leading to the main stem of the river will be important for the future health of the river. The Regulatory and Government Programs section of the introduction and each community's chapter speak to the methods to protect these areas.

Invasive plant species

Invasive plant species can harm a region's ecological values. Many non-native plants succeed in their new environment through rapid growth, effective seed dispersal, and aggressive competition with native species. Some introduced species can alter soil chemistry, or even poison the soil for native plants, some cause erosion, and some take away from native plants' ability to be pollinated by being attractive to pollinators. Most invasive species cause loss of wildlife habitat, since native insects, birds and mammals cannot make use of the alien plants for food or shelter.

Some of the most widespread invasive plant species in the upper Assabet watershed include purple loosestrife, buckthorn, Japanese bamboo and bittersweet. A complete list of invasive species in Massachusetts can be found in the appendix.

Fish Populations

The Assabet River's native fish population once included fresh water species favored by colder and faster flowing waters, and anadromous fish, as the free-flowing waters allowed them to swim up the river from the ocean. Mainly as a result of dam impoundments, anadromous fish, such as herring and shad, are no longer found in the Assabet River. As a result, the composition of the river's fresh water fish community has also changed. While it appears that all the native species are still present, there is currently a much higher proportion of fish favored by warmer, slower-moving water than those that require colder, flowing rivers.³

In colonial times the Assabet (and Concord and Merrimack) River had a run of river herring (alewife) that were eradicated primarily due to the construction of dams along the course of the Assabet, Concord and Merrimack Rivers.

The Assabet flows downstream into the Concord, and then into the Merrimack River, which flows into the Atlantic Ocean. The Merrimack River is passable up to its confluence with the Concord River. There are three dams on the Concord River: the first (furthest downstream), the Middlesex Dam, is extensively breached and fish passage will be insured through a U.S. Fish and Wildlife Service project. The second dam, Centennial Island Dam, contains both a fish ladder and a bypass. Continuing upstream, Billerica Dam is the third dam on the Concord River; it currently has no fish passage facility.

The U.S. Fish and Wildlife Service is working to develop a run that would justify the expense of constructing a fish ladder at the Billerica Dam. USFWS began reintroducing alewives in the Concord River in 2000; this fish stocking will continue through 2002. With this passage, a self-sustaining population could be established along the entire Concord River, and parts of the Assabet and Sudbury Rivers. Eventually the USFWS hopes to restore American shad up to the Assabet as well.⁴

Restoring native anadromous species to the Assabet will require the installation of fish ladders and other forms of fish passage on all the dams along the river. The High Street (Powdermill) Dam and the Ben Smith Dam, both in Maynard, are subject to Federal Energy Regulatory Commission (FERC) regulations, which give the U.S. Fish and Wildlife the authority to require that fish runs be built by the dam owners. USFWS has imposed this requirement as a condition of Wellesley Management's (the owners of Clock Tower Place) FERC exemption for the Ben Smith Dam. However, Wellesley Management is seeking to surrender its FERC exemption. Once FERC accepts surrender of this 1986 document, the dam can no longer be used to generate hydropower, and FERC will no longer have jurisdiction over the dam. This means both the current flow requirements and fish passage requirements will no longer apply.

Other dams further upstream are not subject to FERC regulations; the decision to install fish ladders rests with the generosity of individual owners.

The U.S. Fish and Wildlife Service has published Habitat Suitability Index Models for species of anadromous fish including alewife, blueback herring, and american shad. The models outline habitat needs for the species including water temperature, food and dissolved oxygen levels. Since the Assabet River has been altered by high nutrient loads and river impoundments, the studies will help guide the restoration of anadromous species through analysis of the herrings' specific needs.⁵

The U.S. Geological Survey (USGS) is performing a target fish community analysis on the Assabet River, slated for completion in 2003.⁶ The analysis determines what the fish community in the Assabet River should look like, based on studies in other rivers and historic information. This “target” community becomes the benchmark for comparison with the current fish community. As such, it will help guide management of the river so that the “target” fish community is achieved in the future. The study looks at the relations among stream habitat, fish communities, and hydrologic conditions. Impoundments along the river, for example, have slowed flow and increased water temperatures. This decreases habitat for cold-water fish or flow-dependent species, instead supporting warm-water species. Native species have therefore become a smaller percentage of the river’s fish population. For example, fluvial specialists, such as brook trout, are almost always found in streams or rivers, and require flowing habitats throughout life. Fluvial dependents, such as white suckers, require access to streams or flowing water habitats for a specific life stage, but are otherwise commonly found in lakes and reservoirs. As dams impede the Assabet River’s flow, fewer numbers of flow dependent fish are found in the river (as compared to warm-water species). Over the long term, it would be desirable for the Assabet River to shift back to higher numbers of native and flow-dependent species. This would indicate a healthier and more naturally flowing Assabet River.

In 2002-2003, OAR’s Streamwatch project will monitor and evaluate tributaries of the Assabet River for fish habitat. The purpose of the project is to establish minimum flow and water quality requirements for native populations of fish in each of the tributaries. The information collected will be used for a public education campaign through weekly updates to signboards, newspapers, and websites to educate the public on water quality, flow volume and other environmental issues that impact fish habitat.

¹ Clark, Frances. Biodiversity Protection and Stewardship Plan for the SuAsCo Watershed. Massachusetts Riverways Program, Massachusetts Watershed Initiative. August 2000.

² *ibid.*

³ Beede, Susan. Organization for the Assabet River. Personal Communication. January 2002.

⁴ Smithwood, Douglas A. Proposed Alewife Stocking Program for the Concord River, Massachusetts. Years 2000-2002. Office of Fishery Assistance, U.S. Fish and Wildlife Service. Laconia, NH.

⁵ Habitat Suitability Index Models and Instream Flow Suitability Curves: American Shad. U.S. Fish and Wildlife Service. U.S. Department of the Interior. June 1985.

⁶ Richards, Todd, Fisheries Biologist, MA Division of Fisheries and Wildlife. Westborough, MA.

Water Quality and Quantity

Over its 31-mile run, the Assabet drops about 200 feet and encounters seven dams, seven wastewater treatment plants, and five town centers. The watershed drainage area is 178 square miles; it receives an average of between 45 and 47 inches of rainfall each year. The Assabet watershed has varying degrees of development; most of the urban town centers and dense suburban residential areas are near the river. The municipal wastewater treatment plants are placed near the downstream edge of town.

History

Since ancient times, the Assabet has been a “working river;” working to turn mills; to provide transport, food, and drinking water; and to carry away wastes for the people that settled along its banks. Dozens of small mills and enterprises were built on the Assabet during the 17th and 18th centuries. Serving a primarily agricultural economy, stream-powered mills ground corn and oyster shells, pressed apples, fulled wool, sawed lumber, and provided water for tanning leathers. Although little is known about what impact these small industries had on the quality of the river’s water, the existence of at least two tanning operations, notorious for voluminous use of water and the odiferous results of the oxygen-depleting tanning process, suggests that pollution was present even during colonial times¹. As early as 1663, the Town of Marlborough issued a proclamation condemning the practice of retting flax in the Assabet, because it endangered cattle drinking in the river. As far as we know, that was the last official action against water pollution for over 200 years².

Large manufacturing mills built in the late 19th century dumped significant quantities of industrial and domestic wastes into the river³. By 1900, industrial pollution on the Assabet was severe enough to attract the attention of the Massachusetts State Board of Health, which issued a comprehensive report recommending immediate action to remove pollutants from the river. No action was taken in response to the report, but, in fact, the river did begin to run cleaner due to the collapse of New England’s woolen mill industry⁴. The presence of a public swimming area at Apsley Park in Hudson during the 1930s suggests that some improvement in water quality was achieved during the early part of this century.

By the early 1960s, the population in the watershed began to increase. At that time, wastewater treatment technology usually involved only primary treatment

of wastes, that is, removing solids and treating the effluent with chlorine. All of the Assabet was classified by the state as “suitable for transportation of sewage and industrial wastes without nuisance; for power, navigation and certain industrial uses.”⁵ In 1969, the George H. Nichols Multiple Purpose Dam was constructed at the headwaters of the Assabet, in part to create the ability to manipulate flow to dilute the outflow from the sewage treatment facilities and to control flooding.

With flow manipulation and the installation of secondary treatment facilities at a number of the plants, water quality improved somewhat during the early 1970s. Larry Roy of Marlborough remembers pleasant days fishing for (stocked) brown trout on the Assabet about 1970. Unfortunately, this improvement was short-lived, as increased sewage volume began to tax the capacity of the newly installed plants. By 1975, the Division of Fisheries and Wildlife stopped stocking the Assabet with trout, not only to protect the health of the fishing public but also to call attention to the growing pollution problem.

The Assabet’s condition improved when a new wastewater treatment plant went on line in the late 1980s but then deteriorated, especially in the upper segments where its volume of flow is low and sewage from a swelling population continued to increase.

Current conditions

As a part of its effort to comply with the federal Clean Water Act, the state adopted a water quality classification system for inland waterbodies⁶ that is intended to be used to determine the quality of discharges allowed to enter a river. Under this classification system, the goal for the Assabet River is to meet Class B standards, that is, safe for fishing, boating and swimming.

The Organization for the Assabet River (OAR) has monitored water quality in the river between June and October from 1992 to the present. Nutrient measurements collected during the 1999 and 2000 surveys indicate that the Assabet River system is nutrient saturated in terms of both

Massachusetts Inland Waters Water Quality Classes

Class A: waters designated for use as a source of public water supply

Class B: waters designated for the uses of protection and propagation of fish, other aquatic life, and wildlife; and for primary (swimming) and secondary (boating and fishing) contact recreation.

Class C: waters designated for the uses of protection and propagation of fish, other aquatic life, and wildlife; and for secondary (boating and fishing) recreation.

Class D: waters suitable for transportation of sewage and industrial wastes without nuisance, for power, navigation and certain industrial uses.

phosphorous and nitrogen.¹ Flows in 1999 were extremely low, contributing to severe nutrient concentrations, low levels of dissolved oxygen, and drastic swings in dissolved oxygen. The year 2000 brought higher water flows, yet while the nutrient concentrations were lower, they still indicate that the Assabet River fails to meet the applicable state water quality standards for dissolved oxygen, fecal coliform bacteria, pH, and nuisance aquatic vegetation.

The majority of water quality concerns associated with the Assabet River are directly related to a severe ecological condition known as eutrophication. Eutrophication occurs when high nutrient levels fuel the growth of nuisance aquatic vegetation, such as duckweed. This "biotic growth" impacts dissolved oxygen levels, thereby threatening fish and other aquatic life. Dense plant growth can also impede recreational uses of the river, such as canoeing and swimming. When the duckweed mats die, they decay and create a foul odor.

There are three major contributing factors to eutrophication in the Assabet River. First, there are excessive nutrient loads of phosphorous and nitrogen. Second, the river impoundments impede water flow and retain nutrients, supporting biological activity. Third, shallow water in the river impoundments is easily penetrated by sunlight. This raises water temperatures, encouraging biotic growth.

To improve the water quality of the Assabet River, it will be necessary to decrease the nutrient loads that contribute to the excessive aquatic plant growth and to restore natural flow. Remediation is recommended on several fronts: reduce point and non-point nutrient inputs, protect baseflow, and assess sediment conditions.

¹ A nutrient saturated system may be defined as a system in which biotic growth is not limited by the levels of available phosphorous or nitrogen. Dissolved oxygen is the presence of oxygen gas molecules in the water. The concentration of dissolved oxygen in the water column provides a direct indication of the water's ability to support aquatic life. Aquatic plants and bacteria remove dissolved oxygen from the water when they respire (plants respire mainly at night). Therefore, the lowest dissolved oxygen concentrations of the day occur in the early morning. During the day plants add oxygen to the water column through photosynthesis. Both extreme (low or high) dissolved oxygen concentrations and large changes in dissolved oxygen concentrations over the day (diurnal variation) are damaging to the habitat.¹

Phosphorous is measured as total phosphorous and ortho-phosphate. Ortho-phosphate is the form required by plants, as it is a soluble inorganic nutrient. In natural (unaltered) water bodies, the available concentration of phosphorous is low enough to limit biotic growth. The Assabet River's high levels of available phosphorous allow a much greater growth of aquatic plants.¹

Nitrogen is also a major nutrient supporting plant growth. It is measured in three forms; nitrate, ammonia, and total Kjeldahl nitrogen (TKN). Total nitrogen is a sum of TKN and nitrates. Available nitrogen is the sum of nitrate and ammonia, and measures the readily available nitrogen for absorption by plants. Although most aquatic plant growth in rivers is limited by the availability of phosphorous, increased nitrogen availability can also lead to algal blooms

Other significant factors

TMDL study

A Total Maximum Daily Loading (TMDL) study, mandated by the Clean Water Act, is being prepared by the U.S. Army Corps of Engineers, Massachusetts Department of Environmental Protection (DEP) and ENSR International. The objective of the TMDL study is to document the river's eutrophication problem and determine what reductions in nutrient loadings and other actions are necessary to restore the river.

The assessment phase was completed in 2001. To no one's surprise, the TMDL found excessive eutrophication in the Assabet. Observations from the TMDL study recorded phosphorous and nitrogen concentrations indicative of nutrient saturation, extensive volumes of plant growth, large diurnal variations in dissolved oxygen, effluent accounting for 80% of river streamflows, and very low streamflows. The eutrophic conditions of the Assabet River are most extreme at the impoundments above dams, such as the Allen Street dam in Northborough and the Route 85 dam in Hudson. The next step in the TMDL process is modeling nutrient loads from wastewater treatment plants and other sources to establish loading guidelines.

Comprehensive Wastewater Management Planning

In response to Department of Environmental Protection (DEP) requirements to undertake comprehensive wastewater management planning, the communities of Shrewsbury, Westborough, Northborough, Marlborough, Hudson, and Maynard formed the Assabet Consortium. The Consortium organized to consider regional wastewater solutions and opportunities and ultimately to have more political clout when seeking funding for wastewater treatment plant upgrades.

The CWMP addresses water supply and non-point source pollution, but focuses primarily on wastewater treatment plants. The Consortium is assessing current and future wastewater needs of each community and will evaluate regional management alternatives for phosphorous removal, infiltration and inflow reduction, water conservation, and for potential areas that will need sewer in the future. Each community also addresses specific water issues.

The Comprehensive Wastewater Management Plans must satisfy the requirements of the federal Clean Water Act and the state Water Management Act by improving the eutrophic conditions in the Assabet. This can only be achieved by decreasing nutrient loads and reforming the region's water use.

Stormwater regulations

Stormwater runoff carries several contaminants that affect water quality: nutrients (nitrogen, phosphorous), soil sediments, bacteria and viruses from pet and other animal waste or failing septic systems, hydrocarbons and metals from automobiles or industrial waste, lawn and agricultural pesticides, and salt from road salting operations.⁷

Under the Clean Water Act, the U.S. Environmental Protection Agency's (EPA) National Pollutant Discharge Elimination System (NPDES) Program includes an effort to reduce pollution from stormwater runoff. Under this program, municipalities in urbanized areas must obtain NPDES permits. In 1990, Phase I regulations were implemented, covering municipal storm sewer systems serving populations over 100,000, construction sites above 5 acres, and industrial activities.

The Stormwater Phase II NPDES regulations, to be implemented in 2003, affect communities with a population over 10,000 (this includes Hudson, Marlborough, Northborough and Westborough, but not Berlin). The regulations take a best management practice approach using six minimum control measures: public education and outreach, public involvement and participation, illicit discharge detection and elimination, construction site stormwater runoff control, post-construction stormwater management, and pollution prevention for municipal operations.⁸ The regulations will require communities to map storm drain systems and locate all storm drain discharges to waterways. Some of the Upper Assabet communities have begun this effort.

Water balance: aquifers, groundwater recharge, and stream flow

The Assabet River and its watershed are affected by water withdrawal practices. As communities grow, demand for water rises and the impacts of water use increase. Depleted stream flows, particularly during low flow periods, contribute to degradation of habitat, water quality and wetlands.

The six Assabet Consortium communities receive about 61 percent of their water from outside the watershed on a yearly basis, and over 68 percent during the summer. As a result, more water is discharged into the Assabet by wastewater treatment plants than is removed from the watershed.⁹ However, much of the water that is withdrawn from the Assabet Basin is lost because it is not returned as groundwater recharge. For example, the Consortium's Phase 2 CWMP water balance shows that in 1999, approximately 79 percent (1.22 mgd)

of the water withdrawn by the Town of Westborough from Assabet subbasins was exported as effluent down the Assabet River. In addition, Westborough piped an estimated 2.03 mgd of stormwater runoff directly to the river and its tributaries.¹⁰ Altogether, an estimated 3.25 mgd was lost from the Assabet subbasins in Westborough in 1999 because of water withdrawals and the piping of stormwater runoff directly to the river and its tributaries. According to the Consortium's Phase 2 water balance, the Assabet subbasins in the upper Assabet that are most stressed because of watershed water withdrawals are the Mill Pond subbasin in Westborough and Shrewsbury, and Stirrup Brook in Westborough and Northborough.

Communities are considering discharging treated effluent into the groundwater instead of the Assabet River. Some believe this may be more cost-effective than constructing new packaged wastewater treatment plants. This system would reduce the load of effluents into the river and recharge groundwater in the watershed. Recharging groundwater is critical to maintaining both a sustainable water supply and healthy watershed over time.

The U.S. Geological Survey (USGS) has begun to evaluate groundwater management alternatives in areas of the Assabet River basin. The goals of the research are: to define water resource conditions for aquifers and associated streams within the basin, to assess the impacts of existing and proposed water supply withdrawals on the low flows of the Assabet River and its tributaries, and to evaluate water resource management alternatives for the basin. The study should be completed by spring 2004.

In addition to groundwater recharge, communities and private landowners can benefit from the use of graywater. Reclaiming water for irrigation and other water-intensive uses can greatly reduce the impacts of development or industry on a community's hydrology and infrastructure.

Infiltration and inflow are also a major concern along the sewer lines of all four sewer communities in the upper Assabet (Hudson, Marlborough, Northborough and Westborough, but not Berlin). During times of high groundwater if sewer pipes and structures are not properly sealed, groundwater enters the system, draining water out of the groundwater table and sending it to the sewage treatment plants. Not only does this problem add clean water into the sewage treatment plant taking up sewage treatment capacity, it also drains critical groundwater from the watershed. Efforts to reduce infiltration and inflow are being investigated through the comprehensive wastewater management planning process in each community.

Dam removal

Dam removal has been touted as a panacea for the Assabet River. The removal of certain dams could have a beneficial effect on stream flow, eliminating impoundments with their shallow, slow-moving water that contributes to eutrophication. The improved flow could have a positive impact on in-stream habitat, as fish could move more easily along the river. Finally, recreational users would benefit from the increased access to longer sections of the river. The evaluation of dams should include determining whether they are serving a useful purpose, whether removing them would have any detrimental effects, and cost.

¹ Zwinger, Ann and Edwin Way Teale. *A Conscious Stillness. Two Naturalists on Thoreau's Rivers*. University of Massachusetts Press, Amherst, Massachusetts. 1984.

² Massachusetts Division of Water Pollution Control. *The Assabet River – 1974 Water Quality Data*. MDWPC, MDEQE, Westborough, Massachusetts. 1974.

³ *ibid.*

⁴ League of Women Voters, SuAsCo River Basin Group. *Sudbury-Assabet-Concord River Basin Study*. League of Women Voters Education Fund, Washington, District of Columbia. 1963.

⁵ *ibid.*

⁶ Massachusetts Division of Water Pollution Control. *The Sudbury-Assabet-Concord Basin Water Quality Management Plan*. MDEQE, MDWPC, Westborough, Massachusetts. 1982.

⁷ *Comprehensive Wastewater Management Plan and Environmental Impact Report, Phase I - Needs Analysis*, Assabet Consortium, 2001, prepared by Earth Tech, Inc.

⁸ *ibid.*

⁹ *ibid.*

¹⁰ Consortium Technical Memorandum to Phase 1 Needs Survey, October 2001, Earth Tech.

Regulatory and Government Programs

While upper Assabet communities have made a good start at using regulatory tools to protect the watershed, other opportunities are available to them, including state laws, local zoning, town bylaws and board of health regulations. The upper Assabet communities use a variety of techniques to protect the area's natural resources, as seen in the chart below. Communities should look to neighboring cities and towns for input on regulations and their implementation.

	Westborough	Northborough	Berlin	Marlborough	Hudson
Cluster Zoning	✓	*		✓	
Comm. Preservation Act					
Scenic Roads	✓	✓	✓	✓	✓
Wetlands bylaw		✓			
Site Plan Review	*	*	*	*	*
Poop-scooper bylaw		✓		✓	✓

✓ Community has adopted

* Community has adopted but should revise (see community's regulatory section for details)

There are grant opportunities available for communities and organizations to fund local projects. A complete listing of funding is in the appendix.

Clean Water Act

Growing public awareness and concern for controlling water pollution led to enactment of the Federal Water Pollution Control Act Amendments of 1972. As amended in 1977, this law became commonly known as the Clean Water Act. The Act established the basic structure for regulating discharges of pollutants into the waters of the United States. It gave EPA the authority to implement pollution control programs such as setting wastewater standards for industry. The Clean Water Act also continued requirements to set water quality standards for all contaminants in surface waters. The Act made it unlawful for any person to discharge any pollutant from a point source into navigable waters, unless a permit was obtained under its provisions. It also funded the construction of sewage treatment plants under the construction grants program and recognized the need for planning to address the critical problems posed by non-point source pollution.

Sudbury, Assabet and Concord Wild and Scenic Rivers

The federal government designated 29 miles of the Sudbury, Assabet and Concord Rivers “Wild and Scenic” in 1999. This designation recognizes their outstandingly remarkable resources of historic, literary, scenic, recreational and biodiversity values, and provides the riverways added protection. While the designated segment of the Assabet is in Concord (in the lower watershed), federal activities upstream that could affect the designated segment could fall under the regulatory jurisdiction of the Wild and Scenic Rivers Act. The National Park Service administers this designation on the Sudbury, Assabet and Concord Rivers. The Wild and Scenic River Stewardship Council coordinates the rivers’ protection and also serves as an advisory committee to the National Park Service.

Massachusetts Water Management Act

The Massachusetts Water Management Act became effective in March 1986. The Act authorizes the Massachusetts Department of Environmental Protection (DEP) to regulate the quantity of water withdrawn from both surface and groundwater supplies. The purpose of these regulations is to ensure adequate water supplies for current and future water needs and to balance the water withdrawals with the need to sustain the ecological integrity of the river. The Act consists of a few key components, including a registration program and a permit program.

Interbasin Transfer Act

The Massachusetts Interbasin Transfer Act was passed in 1984 with the purpose of governing the transfer of water and wastewater between river basins within the Commonwealth. The Act is administered by several state agencies including; the Water Resources Commission, the Metropolitan District Commission, and the Departments of Housing and Community Development, Environmental Management, Environmental Protection, Fisheries, Wildlife and Environmental Law Enforcement, and Food and Agriculture.

Massachusetts Riverways Program

The Massachusetts Riverways Program was established in 1987 as part of the Department of Fisheries, Wildlife and Environmental Law Enforcement. Recognizing that protection of watershed resources cannot be accomplished through land acquisition alone, the mission of Riverways is to promote the

restoration and protection of the ecological integrity of the Commonwealth's watersheds: rivers, streams and adjacent lands. The Riverways program primarily provides technical assistance to communities, citizen groups and others on river, stream and watershed protection, restoration and stewardship.

Stream Teams/Adopt-A-Stream Program

Part of Riverways, the Adopt-A-Stream Program supports groups who want to "adopt" a river or stream by working to improve water quality and protect lands adjacent to rivers. Stream teams work to document the water quality of their local rivers and streams to assess strategies for improving water quality and land protection.

Community Preservation Act

The state's Community Preservation Act, adopted in September 2000, allows Massachusetts communities to increase their taxes by up to 3% and dedicate the revenue to open space preservation, historic preservation, and affordable housing. The state will also match each city or town's money raised, creating substantial funds with which communities can preserve their valuable resources or create diversified housing opportunities. To adopt the Community Preservation Act, communities must pass a referendum at Town Meeting or City Council, and gain approval in a general election.

Scenic roads

Communities may designate "Scenic Roads" under the provisions of G.L. Chapter 40, Section 15C in order to preserve their natural character and physical appearance. Any repair or maintenance of a designated Scenic Road cannot involve cutting of trees or destruction of stone walls without a public hearing and consent of the planning board.

Wetlands bylaws/ordinances

Municipalities may write local wetland bylaws and ordinances that are stronger than the state's Wetlands Protection Act. These bylaws can assist communities by giving larger jurisdictions and better controls over river corridors, buffer zones and wildlife habitats, providing better enforcement tools and allowing Conservation Commissions to require performance bonds and payment of consultants' fees. To be effective, wetlands bylaws need to be accompanied by local wetlands regulations, and good enforcement.

Cluster Zoning Bylaws

One of the best ways to lessen the impacts of residential development on biodiversity is for communities to adopt cluster subdivision zoning bylaws. A cluster bylaw allows, or even encourages, a developer to concentrate development in one section (preferably the site most suitable for development) of a large parcel, rather than spreading out each lot to cover the entire parcel. In order for a cluster subdivision zoning bylaw to be effective, it needs to provide incentives to the developer to cluster lots, rather than create a traditional subdivision plan. The Town of Westborough and the City of Marlborough have good cluster subdivision bylaws. Berlin, Hudson and Northborough are all encouraged to adopt similar bylaws.

Site Plan Review

Site plan review provides an opportunity for the community to review development projects for conformance with the community's regulations. Departments that should participate in site plan review are: Fire, Police, Building, Health, Conservation, Planning, and Town/City Engineer. Site plan review can be established through its own committee or as part of the Planning Board requirements. Communities should include additional regulations to improve site plan review, including automatic sprinkler bans, limitations on water-consumptive landscaping, reductions of impervious surfaces, and tree-cutting regulations (see recommendations for more detail).

Pooper Scooper Bylaws

Pooper Scooper bylaws insure that dog waste is not left on the ground in public places where rainfall causes it to wash off into surface water (or where people can step on it). The dog feces can contain pathogens that are potentially harmful to other species, including humans, attract insects (flies), and contain nutrients that add to the proliferation of vegetation in water bodies. In areas close to rivers and wetlands, this contamination eventually reaches the river. Removal of this material from the ground surface can reduce the nutrient levels in all situations. In addition, unwanted waste is also removed.

Land protection strategies

There are many ways to protect land from development and other degradation. Acquiring land in fee (full ownership) is straightforward, but with the rising cost of real estate in the upper Assabet Valley, more creative techniques are

usually necessary. A conservation restriction allows a landowner to retain ownership, but place a permanent restriction on the land limiting development and other uses, depending on the terms of the agreement. Enrolling land in the state's Chapter 61 program provides a landowner with a lower tax burden in exchange for keeping land in agriculture, recreational or forestry use. Under this program, the municipality has the right of first refusal to purchase the land if the landowner withdraws it from the program.

Technical assistance is available from land conservation organizations such as Sudbury Valley Trustees for landowners and municipalities. "Land Conservation Options: A Guide for Massachusetts Landowners" is a great resource for landowners considering protecting their land (see resource list).

General recommendations

The following recommendations apply to all of the upper Assabet communities. Please also refer to the recommendations specific to each community at the end of that community's chapter. The recommendations are not prioritized in any order of importance.

Goal: preserve biodiversity

1. **Perform a baseline study** of species found in the Assabet River's mainstem and tributaries to define the habitat and protection needs, building on the 2000 Biodiversity Protection and Stewardship Plan for the SuAsCo Watershed.
2. **Restore native fish and aquatic life.** In order to restore and preserve native species, the river's habitat (water flow and water quality) needs to be improved for fluvial specialists (flow-dependent species) and anadromous species (for example, alewife and shad). Most native species can be found in the river, but a better balance of populations is desirable.
3. For the long-term goal of river health, **consider dam removal** to restore river's natural hydrology. Evaluate dams for possible removal; determine whether the dams are serving a useful purpose, whether removing them would have any detrimental effects, and evaluate the cost of dam removal.
4. **Install fish runs** on dams that can't be removed to provide upstream access for anadromous fish.
5. **Eradicate invasive plant species.** The Massachusetts Division of Fisheries and Wildlife provides a list of current invasives in the state (see appendix), and the New England Wildflower Society also holds workshops on the subject.
6. **Restore native plant species.** When landscaping or carrying out restoration projects along the river, property owners should plant native species. The New England Wildflower Society has great resources available, both publications and trainings. Landowners should protect and/or restore vegetated buffers along the river. Landowners should be encouraged not to pile leaves or compost near the river, as these materials, carried into the stream by stormwater, worsen the river's nutrient problem. (However, landowners should be encouraged to compost and reuse the compost in their gardens to enrich their garden soil and provide slow release nutrients).
7. **Identify vernal pools.** Each municipality should perform a survey of vernal pools in its city or town. The Massachusetts Natural Heritage and

- Endangered Species Program provides an Aerial Survey of Potential Vernal Pools in Massachusetts (see appendix). This is a good starting point, but it should be augmented for local accuracy.
8. **Recreational opportunities should be balanced with sensitivity to the biodiversity of the area.** Avoid certain areas on the Assabet River for recreation to protect biodiversity. Between the SuAsCo Reservoir and Route 20 in Northborough the river is narrow. Opening this area to canoeing has been determined not to be good for habitat. Therefore, we recommend canoeing beginning below Route 20 in Northborough.
 9. **Preserve open space of the Assabet watershed.** Wildlife corridors and large, connected pieces of land should be preserved. Land along the Assabet River and its tributaries should be protected. When previously developed sites are redeveloped, communities should work for reclamation and restoration of the riverfront and tributary shores. The Rivers Act should be strictly enforced, and communities should push for reclamation of at least 200 feet of river buffer.
 10. **Improve municipal operations for conservation.** Encourage conservation and planning staff from Upper Assabet towns to meet at least once a year and discuss common issues.
 11. **Develop management plans for protected lands.** Conservation lands should be managed for biodiversity. An inventory and analysis should be done on stewardship and other needs. Sudbury Valley Trustees can be a resource, and the Massachusetts Department of Environmental Management has grants for creating management plans. The Nature Conservancy has a great template for Site Conservation Plans, found at: <http://www.consci.org/scp/5s-V2.pdf>.
 12. **Educate the general public on biodiversity,** including school children, landowners and developers. Host walks on or near target properties for protection. Work with nurseries to stock more native plants and eliminate invasive plant products.

Goal: improve water quality and water quantity

1. **Minimize phosphorous and nitrogen loadings from wastewater treatment plants in order to eliminate domination of aquatic plant species favored by eutrophication;** including duckweed, watermeal and algal mats. The U.S. Environmental Protection Agency's current guidance to states in this region suggests that in order to avoid eutrophic conditions, phosphorous levels should be in the range of approximately 0.031 mg/l to 0.24 mg/l. (This is the ambient level above which you get eutrophication). Municipalities should support efforts to achieve this by

the Department of Environmental Protection, the Environmental Protection Agency (EPA), OAR, and other organizations. Local stores should be asked to carry phosphate-free detergents, and political pressure should be applied to meet these objectives.

2. **OAR should continue its water quality monitoring program.**
3. **Encourage water conservation** through education and public policy.
4. **Property owners or managers should be encouraged to reduce water use in their lawn design and maintenance.** They should be encouraged to plant smaller lawns, choose appropriate grasses for soil type through soil testing, plant diverse lawn cover and drought-tolerant species, water less often, mow high, and reduce fertilizer use. Cisterns can be used to collect rainwater for lawn maintenance (and other uses) for both private citizens and public facilities. The Massachusetts Water Resources Commission's "Guide to Lawn and Landscape Water Conservation" has some great suggestions.
5. **Educate landowners on lawn maintenance.** Create a brochure each community can use, and send it out with tax bills or the town census.
6. **Manage recreational fields and turf for reduction of pesticide and water use.** The Massachusetts Department of Food and Agriculture's Turf Management for Municipal Athletic Fields is a good reference. Some of the best practices suggested include choosing the right grass, efficient irrigation, and mowing high.
7. **Encourage golf courses to take on environmentally friendly management practices,** such as the Audubon Cooperative Sanctuary System. This program provides comprehensive environmental education and conservation assistance to golf course developers and managers (see resource list for contact information). For example, Audubon's program includes suggestions such as integrated pest management, vegetated buffers around waterways, non-mow areas and blue bird box installation.
8. Municipalities can **institute lawn-watering bans,** which should include private wells, to encourage water conservation. The bans should be coupled with public education about lawn maintenance. Some communities have found that every-other-day allowances encourage citizens to water their lawns every other day, which is unnecessary.
9. **Ban automatic sprinklers** in new developments. Automatic rain shutoff devices should be installed on current systems.
10. Municipalities should **regulate all water use,** including private and irrigation wells. The first step would be to figure out who would monitor use. Tiered water rates (higher rates for outdoor use or high volume use) are proven to reduce water use in some communities.

11. Municipalities (particularly the Boards of Health) should **encourage the use of graywater** for private citizens, businesses, and municipal services. Clivus Multrum, Inc. has good information available on their web site at www.clivusmultrum.com, including a good explanation of graywater use. The State of Massachusetts currently lacks a graywater policy, but supports and encourages the development of pilot systems, from which the Commonwealth will develop guidelines. The Department of Environmental Protection's Bureau of Resource Protection Title 5 Program staff welcomes the opportunity to meet and discuss options available for communities with Boards of Health and other interested parties. Communities need to send a letter to the Director of Watershed Permitting to request such a meeting (see resource list for contact information).
12. **Involve volunteers** in OAR's annual river cleanups, stream teams, and water quality monitoring.
13. Perform **public information campaigns** on the Assabet River and water issues including; minimizing phosphorous loads, drought information, water conservation, not throwing trash in the river, or poop-scooping (for dog owners). Organize storm drain stenciling program to inform public about storm drain connections into the Assabet River.
14. **Educate municipal water providers on water conservation** issues (encourage or pay staff to attend training). Cities or towns should promote a water conservation ethic.
15. **Work with nurseries to carry and promote drought-tolerant turf**, stock more native plants and eliminate invasive plant products.
16. **Encourage collaboration across towns**. For example, neighboring stream teams could collaborate with one another.

Goal: enhance recreational opportunities

1. **Recreational Opportunities** should be balanced with sensitivity to the biodiversity of the area.
2. Improve existing and create new **walking & biking trails that provide access to the Assabet River**.
3. Improve existing and create new **canoe access to the Assabet River**. This includes improving portages (by getting easements or improving trails), improving canoe landings, or creating new canoe landings.
4. **Host events and tours**. This includes organizing a River Festival, guided walking and biking tours, armchair (video or slide) tours, or bus tours.

5. Launch **public information campaigns**; use the Assabet River Rail Trail as an educational tool, post interpretive signs (historic, environmental) along the river and roads that cross the river, create a signboard or interpretive facility on the river.
6. **Educate** outdoor/canoeing outfitters and stores on recreational opportunities and conservation issues.