Pioneer Valley Planning Commission

Pioneer Valley Environment Plan

Protecting greenways and blueways.
Growing vibrant communities in our watershed.

Produced by the Pioneer Valley Planning Commission with the support of the U.S. Department of Housing and Urban Development Sustainable Communities Initiative Regional Planning Grant Program.

February / 2014

Catalyst for Regional Progress
PVPC

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INTRODUCTION

PURPOSE

A clean and healthy environment is vital for everyone's quality of life. This includes the natural diversity of biological species and communities, and the ability of ecosystems to be resilient. The human impact on our environment often creates an imbalance in nature disrupting ecological integrity, and human enjoyment of our landscape. The Pioneer Valley Environment Plan strives to correct the imbalances created by humans to restore and or protect ecological integrity, and identify strategies for enhancing community character and quality of life.

CONNECTICUT RIVER WATERSHED

The Connecticut River is a natural and environmental resource of great regional and interstate importance, and is a key element in the bi-state area's quality of life and economic prosperity. The water quality in some sections of the Connecticut River in Massachusetts and Connecticut is not currently meeting fishable and swimmable standards due to water pollution discharges which include combined sewer overflows and urban stormwater runoff. The high cost of river clean-up is creating financial hardships for the region's three urban core communities. In addition, there are other sections which are suffering from impaired water quality due to streambank erosion and non-point source pollution. Significant federal, state and local resources have been spent on river improvements, however, limitations on access to the river and public information about river recreation are hampering the public's opportunity to enjoy these improvements. For more information about the effects of combined sewer overflows and stormwater runoff in the Connecticut River watershed, see the Pioneer Valley Green Infrastructure Plan.

The Connecticut River is New England's longest river, flowing 410 miles from the Canadian border with New Hampshire, through four states, to Long Island Sound. The 7.2 million acre watershed is home to 2.4 million people, 396 municipalities, 51 designated urban areas with half its population, many thousands of species of flora and fauna, and more than 1.5 million acres of land in public and private conservation. An additional 4.75 million acres in the watershed remain undeveloped and unprotected, affording opportunity for even greater conservation.

Designated an American Heritage River, its watershed is the focus of the Conte National Wildlife Refuge, and considered the region's most important natural asset. The river also became the first federally designated National Blueway under the National Park Service in 2012. Water quality has improved dramatically over the past two decades, but the river still faces serious water quality challenges from combined sewer overflows, urban stormwater runoff, and other nonpoint sources of water pollution. The river consistently does not meet Class B Swimmable/Fishable water quality standards during wet weather.

The two major sub-basins within the Connecticut River watershed in Hampshire and Hampden counties are the Westfield and Chicopee Rivers. The Westfield River Watershed encompasses a total of 517 square miles in Hampshire, Hampden, and Berkshire Counties of western Massachusetts and is bordered by the Deerfield, Hoosic, Housatonic, Farmington, and Connecticut River Watersheds. The Westfield River is a

major tributary to the Connecticut River made up of three branches, the East, Middle and West Branches. The watershed forms a general "L" shape, approximately 48 miles long and 20 miles wide, extending from the Berkshire Mountains in the west to the Connecticut River in the east. The river drops 2,000 feet in elevation before entering the Connecticut River. Thin soils in the hills combined with steep gradients produce extreme and rapid differences in the rate of flow, occasional flooding, and at times low water conditions. Roughly 78 miles in 10 towns of the Westfield River and its 3 branches have been designated as a National Wild and Scenic River, the first in Massachusetts. The watershed has a population density of less than half a person per acre—the second lowest density of all Massachusetts watersheds, likely a contributing factor in making it one of the state's best coldwater fisheries.

Chicopee River basin encompasses all or part of 39 cities and towns in 4 counties; it is the largest of the 27 major basins delineated for planning purposes by the state; drainage area of 721 square miles; comprised of 4 major basins: Swift River (215 square miles), Ware River (218 square miles), Quaboag River (212 square miles), and Chicopee River (76 square miles); basin contains 9 wastewater treatment plants, 6 active landfills, and 111 dams.

DESCRIPTION OF ISSUES

In a bi-state survey of stakeholders along the Connecticut River conducted in Massachusetts and Connecticut in 2011 by PVPC, the top three issues identified relative to public access, recreation and greenways were: 1. lack of protected open space for contiguous greenways and wildlife corridors; 2. lack of public access facilities, such as public parks/conservation lands, bikeways and walking paths along the river; and, 3. overuse of some river sections for water-based recreation. Informed by this feedback, PVPC developed the Pioneer Valley Regional Environment Plan to further analyze these issues in the Connecticut River watershed, and identify strategies for addressing them. The plan focuses on the following four environmental issues:

- Water Quality
- River Continuity and Habitat
- Parks and Open Space
- Vibrant Human-Riverfront Connections

PLANNING PROCESS AND METHODOLOGY

From 2009- 2012 a bi-state river management plan for the Connecticut River in Massachusetts and Connecticut was developed by the Pioneer Valley Planning Commission and its project partners—Capitol Region Council of Governments, Connecticut River Estuary Regional Planning Agency, and Franklin Regional Council of Governments— to identify key issues and goals for the Connecticut River in Massachusetts and Connecticut. This work included a detailed literature review of studies and reports spanning the past 18 years. Information from the literature was distilled to develop survey questions for stakeholders throughout the watershed in Massachusetts and Connecticut. Electronic survey responses were received from 137 of the 541 stakeholders that received an invitation, a 25.3% response rate. The municipal sector, including boards and employees made up 65% of respondents (79 people).

The survey results were used to identify five core environmental values and eight bi-state goals for the Connecticut River watershed related to improving environmental quality and public access to the lower Connecticut River in Massachusetts and Connecticut. The Connecticut River bi-state goals and values are:

1. Eliminate or reduce bacteria, pathogen, and nitrogen loading from combined sewer overflows (CSOs).
2. Eliminate toxins (including PCBs and pesticides) within the river to reduce human and wildlife exposure.
3. Reduce nutrient loading and other nonpoint sources of pollution.
4. Promote smart growth, land protection, and environmental conservation to support river health.
5. Prevent habitat loss and restore degraded habitat.
6. Promote improved flow and fish passage to ensure clean, free-flowing, and plentiful rivers for future generations.
7. Prevent erosion and sedimentation induced by human activity.
8. Promote greater public access for Connecticut River recreation and increased use of existing recreational facilities.

Core Environmental Values

- Swimmable and Fishable Rivers
- Clean Drinking Water
- Healthy Fisheries and Wildlife
- Vibrant Human-Riverfront Connections
- Sustainable Land Use and Agriculture

With these core environmental values and goals identified, PVPC conducted additional stakeholder interviews in 2012 to gather additional information in the Westfield and Chicopee River watersheds. The Westfield and Chicopee Rivers are the Connecticut River's two major tributaries in the Pioneer Valley region. Thus, it was important to include a comprehensive assessment of these sub-basins given both their significant relationship to the health of the Connecticut River watershed, and the vast geographic area and diversity of land use within each basin. A complete literature review and stakeholder interview list is included in the Appendices.

The Pioneer Valley Environment Plan was developed to more closely evaluate issues identified through the Connecticut River Bi-State Partnership project. To do this, in 2012, interviews were conducted with a wide range of stakeholders including land trusts, MA Department of Environmental Protection, UMASS, The Nature Conservancy, The Trust for Public Land, Westfield River Wild and Scenic Advisory Committee, MA Division of Ecological Resources, and MA Department of Conservation and Recreation to determine research, projects and priorities already being focused on, opportunities for collaboration, and potential gaps that needed to be addressed. Next, maps identifying open space and recreational resources were mailed to the Chief Elected Official and Conservation Commission in each of the 43 municipalities seeking input on land protection priorities and project opportunities at the local level. Local Open Space and Recreation Plans were also reviewed to identify land protection and conservation stewardship priorities at the local level.

Additionally, municipal water suppliers were contacted for the 30 public water supplies (PWS) operated in the Pioneer Valley. For each of the PWSs, a water needs forecast was conducted following the Massachusetts Water Resources Commission policy and methodology (revised May 1, 2009). However, due to the inavailability of Annual Statistics Reports for the years 2006-2008, we were only able to utilize data for the years 2009 and 2010 for use in the forecast. As such, the water forecasts do not comply with the methodology and have not been included in this report. However, the forecasts were shared with the PWSs and used as guidance in interviews to gather information about the status of public water supplies in the region.

All of this stakeholder outreach was then used in conjunction with the various levels of GIS analysis performed, depending on the section of this report, to summarize the environmental issues most pressing in the region, and develop strategies to addressing them.

INVENTORY & ASSESSMENT

WATER QUALITY

The Connecticut River is a natural and scenic resource of great regional and interstate importance, and is a key element in the bi-state area's quality of life and economic prosperity. The water quality in some sections of the Connecticut River in Massachusetts and Connecticut is not currently meeting fishable and swimmable standards due to water pollution discharges which include combined sewer overflows and urban stormwater runoff. The high cost of river clean-up is creating financial hardships for many river communities. In addition, there are other sections which are suffering from impaired water quality due to streambank erosion and non-point source pollution. Significant federal, state and local resources have been spent on river improvements however, limitations on access to the river and public information about river recreation are hampering the public's opportunity to enjoy these improvements. The Pioneer Valley Green Infrastructure Plan takes an in-depth look at these issues, and evaluates opportunities for implementation of green infrastructure systems to address them. Therefore, this section looks at water quality from the perspective of quality of life and how it affects recreational use, habitat integrity and resiliency, and greenways.

OVERVIEW OF KEY FINDINGS

BACTERIA, PATHOGENS AND NITROGEN LOADING FROM COMBINED SEWER OVERFLOWS

Water pollution from bacteria and pathogens due to combined sewer overflows (CSOs) is the primary reason the Connecticut River continues to fail to meet federal fishable-swimmable water quality standards. CSOs are a major environmental and financial problem in older urban areas, particularly Springfield, Chicopee and Holyoke, Massachusetts and Hartford, Connecticut. In Massachusetts, from South Hadley to Springfield, average bacteria concentrations at locations downstream of CSOs during wet weather events indicate impaired water quality during wet-weather events in excess of Primary (swimmable) and/or Secondary (boating) Recreational Contact Standards.[1]

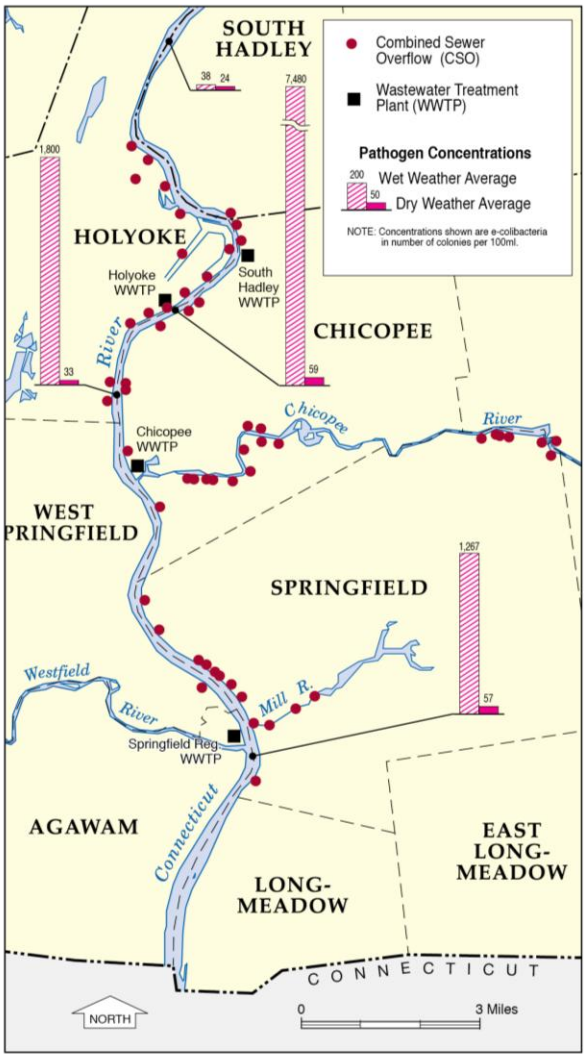
Bacteria levels in the Springfield reach are still among the highest in southern New England. The more urbanized southern Massachusetts reach frequently exceeded primary contact recreation for *E. coli* bacteria limits during wet weather and occasionally did so in dry weather at some sites.

> Efforts to clean up the Connecticut River have been coordinated on a regional basis, under an intergovernmental compact which formed the Connecticut River Clean-up Committee in 1993. The Connecticut River Clean-up Committee, under the direction of the Pioneer Valley Planning Commission, has secured over $20 million in federal funding support and matching funds to help address this regional problem.

[1] Schoen, Jerry, April 2010.*Rapid Response Water Quality Monitoring Report.*

Under Administrative Orders from the U.S. Environmental Protection Agency (EPA) to abate combined sewer overflows (CSOs) to the Connecticut River, communities in Western Massachusetts have been working for more than 20 years, eliminating 99 of the 163 CSO outfalls in the region. As of 2013, approximately 50% of the CSO problem has been eliminated on the Connecticut River in Massachusetts, with over $200 million expended to date to correct this problem.

Connecticut River Combined Sewer Overflow Locations and Bacteria Levels



Agawam, Ludlow, Palmer, South Hadley, and West Springfield no longer have any combined sewer outfalls, but Chicopee, Holyoke, and Springfield continue work to eliminate or abate overflows from remaining combined systems within their jurisdictions.

In April 2009, Chicopee completed a Final Long Term CSO Control Plan that has since been approved by EPA. The Springfield Water and Sewer Commission submitted their final plan to EPA for approval in

May 2012. Both of these documents outline the plan of work to be pursued for CSO elimination and abatement over the next decades. Holyoke completed a draft long term control plan in 2000, and must submit a final long term control plan for approval by June 2014.

There are still 64 remaining CSOs in Springfield, Chicopee, and Holyoke. The estimated cost of CSO remediation for these communities is $341million with over $200 million expended to date.

Table 1. Estimated Costs for Abating Overflows at Remaining CSOs in the Pioneer Valley

	# of CSOs	Estimated cost to eliminate/abate[2]
Chicopee	28	$173.1 million
Holyoke	12	$ 32.3 million
Springfield	24	$135.9 million
TOTALS	64	$341.4 million

Table 2. Connecticut River Combined Sewer Overflow Capital Needs

Prepared by Pioneer Valley Planning Commission and Connecticut River Clean-up Committee, April, 2013

Projects listed in order of priority for each city.

CITY/PROJECT NAME	ESTIMATED CAPITAL COST
SPRINGFIELD	
Phase 1 - Washburn CSO Control	$15,000,000
Phase 2 - York Street Pump Station and River Crossing	$49,240,000
Phase 3 – Locust Transfer Structure/Conduit and Flow Optimization in Mill System	$8,000,000
Phase 4 – York to Union Box Culvert	$30,400,000
Phase 5 – Union to Clinton Relief Conduit	$14,400,000
Phase 6 – Worthington/Clinton Targeted Sewer Separation and Stormwater Management	$18,903,000
Springfield Subtotal	*$135,943,000*
CHICOPEE	
Phase 1A – Chicopee WPCF, Sandy Hill, Montgomery St./Sheridan St., Paderewski P.S./Old Field Rd., Lower Montgomery St.	$4,140,000
Phase 1B – Jones Ferry PS, McKinstry St. Area	$15,660,000

North Fairview/Britton St. Area	
Phase 2A – Bemis Ave./Broadway St. Area, Upper Granby Road Area, McKinstry Avenue/Lorraine Street Area	$21,237,237
Phase 2B – Beauchamp Terrace/East St. Area	$15,414,763
Phase 3 – Call P.S., Chicopee, Meadow, Grattan Montgomery St. /Sheridan St., Academy St./CSO 31.1 (CELD South)	$26,162,000
Phase 4 – Robert's Pond, Riverview, Pendleton, Yelle	$14,950,500
Phase 5 – Hampden St./Front St. Area, Walnut St. and Broadway, Exchange St./South St. Area	$14,808,000
Phase 6 – James St., Jones Ferry P.S./Riverdale Road Montgomery St./Columba St. Area, Newbury, Hafey & Front Streets	$30,248,000
Phase 7 – Leslie P.S./Silvin St., Mt. Vernon St., East Main St., Linden & Maple Streets Paderewski P.S./Old Field Rd.	$16,389,000
Phase 8 – Fuller & East Streets, Hearthstone Terrace/Bray St., Bell St. and Front St., Riverview Terrace, Belcher St./Walnut St. Area, Park, Spruce & School Streets, Lower Granby Road Area	$14,165,000
Chicopee Subtotal	*$173,174,500*
HOLYOKE	
Highland Park Treatment Facility	$14,409,000
Convey Drainage Area	$5,196,000
Drainage Area 18A Separation	$2,233,000
Drainage Area 23 Separation	$3,010,000
Drainage Area 2 Separation	$773,000
Drainage Area 8 Separation	$3,818,000
Drainage Area 11 Separation	$2,934,000
Holyoke Subtotal	*$32,373,000*
TOTAL CAPITAL NEED, PIONEER VALLEY REGION	***$341,490,500***

NITROGEN LOADING

The Long Island Sound is under a Total Maximum Daily Load (TMDL) for nitrogen. Current nitrogen load delivered to Long Island Sound from the entire Connecticut River basin is approximately 28.7 million pounds per year. Of this amount, approximately 35.3% originates from point sources (primarily municipal wastewater treatment plants), with the remainder (64.7%) coming from nonpoint sources[3]. Results suggest that the point source loads in the upper part of the Connecticut River basin above Connecticut could be reduced by approximately 3.4 million pounds per year if all plants were upgraded to discharge no more than 3 mg/l of nitrogen. This would equate to a reduction of about 74.7% when

[3] Evans, Barry M. March 18, 2008. *An Evaluation of Potential Nitrogen Load Reductions to Long Island Sound from the Connecticut River Basin*.

considering the current point source load delivered by sources upstream of Connecticut (4.53 million pounds per year)[4].

STORMWATER POLLUTION

Stormwater pollution is a significant and particularly intractable problem in the Pioneer Valley region, and across the United States.

In 2006, the cities of Chicopee, Holyoke, and Springfield, together with the Pioneer Valley Planning Commission, published a study on bacteria levels in the lower part of the Connecticut River in MA during dry and wet weather. Consistent with the Swimming Hole Project, water quality during dry weather generally met Class B standards (swimmable, fishable). During wet weather, the single upstream sample site, near Northampton, met standards, but downstream all of the combined sewer overflows (CSOs), water quality was significantly impaired. The report determined that during rain storms, 50% of the bacteria in the river in that area came from CSOs, 25% came from stormwater, and 25% came from upstream sources.

CONNECTICUT RIVER BACTERIA MONITORING PROJECT

The Connecticut River Bacteria Monitoring Project was initiated in 2009 as part of the U. S. Environmental Protection Agency funded Targeted Watershed Initiative (TWI) in collaboration between the Pioneer Valley Planning Commission (PVPC), the University of Massachusetts Water Resources Research Center (WRRC), Franklin Region Council of Governments (FRCOG), and the Connecticut River Joint Commissions (CRJC). The purpose of the project is to assess health-related use of the river for recreational purposes (i.e. primary and secondary contact recreation). At its inception, the project involved sampling 16 sites twice a week in two urbanized reaches of the river in Massachusetts, Chicopee to Holyoke and Turners Falls to Greenfield; and one mixed urban/suburban/rural reach in New Hampshire and Vermont, from Lebanon and Wilder to Cornish and Weathersfield, during the high-use summer recreation months of 2008 and 2009. In total, 26 sites were sampled throughout the summer on an alternating schedule. All sample sites were considered to receive a high degree of use for swimming, boating, fishing and other river recreation.

Between 2010-2012, the Connecticut River Bacteria Monitoring Project has continued in partnership with the Connecticut River Watershed Council (CRWC). Water samples are collected weekly (Thursdays) at up to 30 sites on the main stem of the Connecticut River and several tributaries in Massachusetts and Vermont and analyzed for *E. coli* bacteria. Results are posted on the internet at www.ConnecticutRiver.us on Friday of each week to inform recreational users of water quality conditions. Major findings of the project over the past five years have been:

- Water quality appears to be worse on wet days than on dry days, specifically *E. coli* levels are elevated in reaches with CSOs.
- Vermont and New Hampshire sites generally support contact recreation in both wet and dry weather conditions.

[4] Evans, 2008

- With the exception of site Barton Cove (MAG4), the northern Massachusetts sites were supportive of contact recreation during dry weather, and partially supportive during wet weather. Site MAG4 exhibited high bacteria levels on several occasions, during both wet and dry weather in 2009. This trend did not continue in 2010-2012 monitoring at Barton's Cove. Continued monitoring of the Cove is warranted.
- The more urbanized southern Massachusetts reach frequently exceeded primary contact recreation limits during wet weather and occasionally did so in dry weather at some sites. Site North End/Bassett Marina (MAC1) is of particular concern, as this site usually exceeded the contact limit, regardless of weather conditions. [In 2012, The City of Springfield completed design of a sewer connection for the Bassett Marina facility. Sewer connection is anticipated to be completed in 2013.]

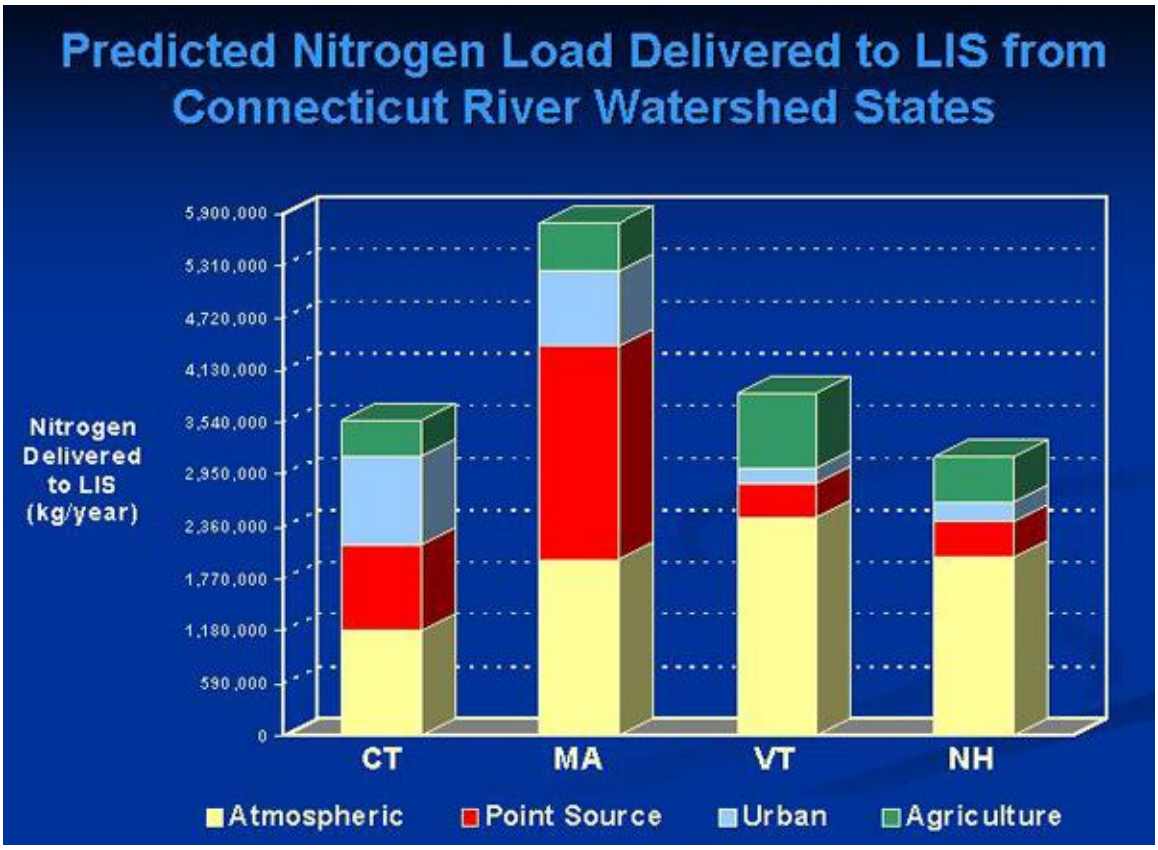
NUTRIENT LOADING AND OTHER SOURCES OF NONPOINT SOURCE POLLUTION

Nitrogen loading from the Connecticut River to the Long Island Sound continues to be a source of impairment. Nonpoint source pollution is the greatest source of nitrogen pollution (64.7%), of that, 15.5% derives from agricultural sources and 10.6% from urban sources. Best Management Practices (BMP) implementation or agricultural and other non-urban BMPs may be the most cost effective approach for improving water quality. Stormwater continues to be major contributor of NPS pollution as evidenced by water quality data collected on dry versus wet days.

Connecticut River nitrogen loading to Long Island Sound causes low dissolved oxygen (hypoxia), the major water quality problem affecting the Sound. Current nitrogen load delivered to Long Island Sound via the entire Connecticut River Basin (CRB) is about 28.7 million pounds per year. Of this amount, approximately 35.3% originates from point sources (primarily municipal wastewater treatment plants), with the remainder (64.7%) coming from non point sources. (Evans, 2008)

Of the total mean annual load, approximately 13.5% (about 3.8 million pounds per year) is from agricultural sources, and about 10.6% (about 3 million pounds per year) is from urban sources. The remaining 40.6% of the non-point source load (about 11.6 million pounds per year) originates from theoretically "uncontrollable" sources such as forested areas and wetlands principally located in the upper reaches of the Connecticut River basin. (Evans, 2008) It appears that the maximum potential reductions in agricultural and urban loads (under the assumption of full BMP implementation) are about 34.1% (1.3 million pounds per year) and 34% (1 million pounds per year), respectively. (Evans 2008) Due to the much higher relative cost of implementing urban BMPs, it may be that the combined nitrogen load from these two sources can be reduced more cost-effectively via the use of much cheaper agricultural control measures. (Evans, 2008).

Table 3. State by State Share of Predicted Nitrogen Load to Long Island Sound



Source: SPARROW Nitrogen Model, USGS and Nature Conservancy

As shown in the graphic above, Massachusetts is predicted in computer modeling to have a significant share of the total estimated nitrogen loading to Long Island Sound.

CHICOPEE RIVER WATERSHED

Seven river segments within the Chicopee basin are impaired for Primary Contact Recreation Use: Sevenmile River (Segment MA36-11); Sevenmile River (Segment MA36-12) ; Quaboag River (Segment MA36-17) ; Chicopee River (Segment MA36-22); Chicopee River (Segment MA36-23); Chicopee River (Segment MA36-24); Chicopee River (Segment MA36-25). (MADEP, 2008)

Based on a water quality analysis of 44 sub-watersheds within the Basin using the Watershed Analyst tools available on MassGIS conducted by the former Chicopee Watershed Team Leader, the following sub-watersheds should be the primary focus for remedial attention and follow-up monitoring: Poor Brook, Abbey Brook, Cooley Brook, Minechoag Brook, and Fuller Brook all in the Chicopee watershed and Coys Brook and Willow Brook in the Quaboag watershed. There is a great need for more data collection, follow up sampling, and analysis to allow for more accurate and complete river segment and lake assessments.

A total phosphorous TMDL was developed for the Quaboag and Quacumquasit ponds (MADEP, 2005). The lakes are listed on the "Massachusetts Year 2004 Integrated List of Waters" for metal and exotic

species and have had a history of algal blooms. The TMDL establishes a phosphorous limit for each lake to help prevent further water quality degradation and to ensure that each lake meets state water quality standards. "The implementation of the TMDL is comprised of 4 parts: 1) Upgrades to the Spencer Wastewater Treatment Plant, to meet 0.2 mg/l (1.8 lb/day) summer limit, 2) Control of nonpoint source pollution targeting Phase II stormwater controls by Town of Spencer and MassHighway for State Route 9, Route 31 and Route 49, by requiring roadway sweeping and catchbasin inspection/cleaning twice a year or other approved BMPs, 3) modification to increase Quacumquasit flood control gate height by adding 18 inches to height, and 4) Modification to Quaboag Pond macrophyte management plan to target specific recreational zones such as boat channels and swimming areas." (MADEP, 2005). A locally organized watershed survey may also be recommended to help identify and reduce nonpoint source pollution. The successful implementation of this TMDL will require cooperative support in the form of expanded education, obtaining and/or providing funding, and possibly enforcement from local volunteers, lake and watershed associations, and local officials in municipal government (MADEP, 2005).

WESTFIELD RIVER WATERSHED

In 2010, PVPC in cooperation with Westfield State University and the Westfield River Wild and Scenic Advisory Committee conducted a watershed assessment in the Westfield River. Of 21 sites, 12 were monitored for E. coli. E. coli values at 11 of the 12 sites (92%) had one or more times exceeded primary contact standards (235 MPN/100 ml, single sample). Of the 11 sites with single sample E. coli exceedances, 7 sites (64%) also exceeded the geometric mean (126 MPN/100 ml) for primary contact during the prime recreational season (June to October). Although there appears to be a correlation between wet weather and elevated E. coli counts for some sites, other sites (Little River, Jack's Brook, Ashley Brook, and Pond Brook) also tested high during dry weather events.

Several MA DCR beaches on the East Branch of the Westfield River have been permanently closed since 2006 due to consistently elevated E. coli levels. Sampling on the East Branch upstream of the Westfield River Beach at Windsor State Forest resulted in one high E. coli value of 260 MPN/100 ml in September 2009. Although there may be a bacteria source upstream, the data collected at Windsor State Forest beach suggests the possibility for re-opening the beach for public use. However, further downstream on the East Branch at Gardner State Park, water quality continues to be poor. Results for Gardner State Park beach had high E. coli levels on 5/18/09 and 10/25/09. MA DCR suspects an upstream septic system at a local restaurant to be the source of the problem.

Additional E. coli bacteria monitoring is needed at these locations as part of a larger source tracking program. Temperature data collected at the two sites on Pond Brook (PNDB3.3 and PNDB0.01) indicated that the brook may not meet its proposed designation as a Cold Water Fishery. Daily temperature should be collected at these locations to ensure the site is suitable for such a designation.

The lower watershed is the most urbanized and the portion of the watershed where impervious surfaces are having an impact on water quality. Six watershed communities (Agawam, Holyoke, Southampton, Southwick, Westfield and West Springfield) and two State agencies (MassHighway and Mass Turnpike Authority) are regulated under the NPDES Phase II Stormwater program. Road salt contamination has been documented in private wells within the Zone II of the Barnes Aquifer, a rapidly developing section of the lower watershed in the City of Westfield and Town of Southampton.

Five ponds and lakes are considered impaired by invasive exotic aquatic weeds, known as a Category 4c Water on the Massachusetts Year 2006 Integrated List of Waters and ten ponds, lakes, streams, and river segments are listed as waters requiring a Total Maximum Daily Load (TMDL) analysis, known as Category 5 Waters. Stream bank erosion and illegal dumping are prevalent in isolated locations along the main stem and some tributaries.

Data from the MA DEP 2006 and 2012 Westfield basin water quality assessment will be released by the Spring of 2013.

HUMAN AND WILDLIFE EXPOSURE TO TOXINS (PCB AND PESTICIDES)

Historical and ongoing pollution of the Connecticut River has had impacts on fish and wildlife populations and on human health. At least four reports and studies identify key issues and findings:

- PCBs are present in fish along the entire length of the river; coal tar is present in the river in Holyoke. (*The Health of the Watershed: A Report of the Connecticut River Forum*, January 1998, New England Interstate Water Pollution Control Commission)
- EPA-New England has worked with all New England states to substantially reduce regional mercury emissions since the late 1990s. Mercury is mostly deposited in the Connecticut River watershed from the atmosphere. Much of this mercury originates from Midwest power plants and urbanized eastern seaboard emissions. (*Connecticut River Fish Tissue Contaminant Study*, May 2006, US EPA, New England Regional Lab)
- Once in the river, mercury bio-accumulates to high levels in the food chain. Saltwater and freshwater fish are the primary source of methylmercury exposure for most people and fish-eating wildlife. Older fish tend to have higher levels of mercury and other contaminants. Total mercury concentrations in all three species of fish sampled were significantly higher in upstream Reaches than in downstream Reaches. Higher levels of mercury in the upstream Reaches may, in part, be a result of water level manipulations, particularly in reservoirs. (EPA, 2006)
- Risk from dioxin-like (coplanar) PCBs was generally lower in upstream Reaches than in downstream Reaches; although this varied by fish species and was different for the humans/mammals, birds or fish that eat them. (EPA, 2006)
- There are no known current sources of PCBs or DDT to the Connecticut River so contaminants in the fish result from historical contamination in the watershed. However, dioxins are produced in nature and inadvertently by humans; often through combustion processes such as at waste incinerators. Dioxin levels in Connecticut River fish reflect historic and possibly current sources. (EPA, 2006)
- Dioxin toxicity, in the twelve fillet composites analyzed, posed a varying risk to both subsistence and recreational fishers and fish-eating wildlife, even when dioxin-like PCB TEQs (a standardized measure of dioxin toxicity) were not included in the risk calculations. (EPA, 2006)
- DDT and related breakdown products from chemical, physical, and biological weathering, pose a risk to human subsistence fishers and to fish-eating birds, but not to recreational fishers or fish-eating mammals. (EPA, 2006)

- Insecticides were more commonly detected in urban streams than in agricultural streams. In general, higher concentrations of pesticides were detected in storm runoff following spring agricultural applications than at other times. Despite its classification as a restricted-use pesticide, Atrazine was the most commonly detected pesticide. (*Pesticides in Surface Water in the CT, Housatonic, and Thames River Basins, 1992-95*, 1999, US Geological Survey, Marc Zimmerman)

- Toxic contaminants have accumulated in some Study Unit streambed sediments and fish; nutrient concentrations are a concern for surface-water quality; pesticides were frequently detected in Study Unit streams; several classes of contaminants were detected in ground water; some contaminant MCLs were exceeded in ground water, radon is present in groundwater across the study Unit. (*Water Quality in the CT, Housatonic, and Thames River Basins, 1992-1995*, 1998, U.S. Geological Survey)

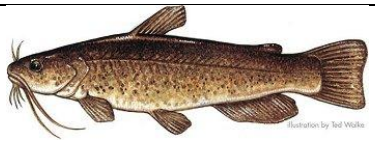
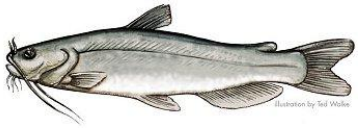
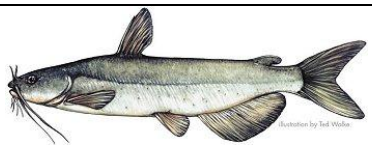
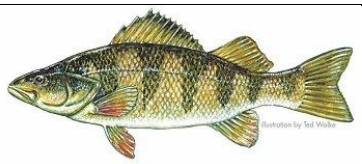
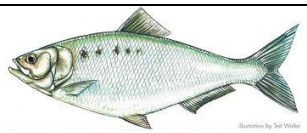
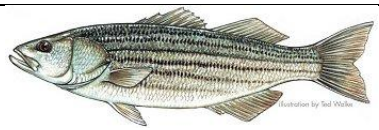
FISH CONSUMPTION ADVISORIES

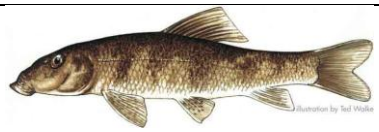
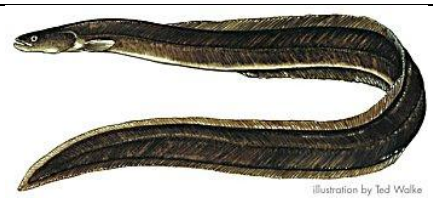
A statewide fish consumption advisory for mercury exists. In 2008, the U.S. EPA issued a TMDL for mercury load reduction to meet federal and state water quality standards. The mercury TMDL coupled with the results of the Connecticut River Fish Tissue Study in 2000 (US EPA) have resulted in expanded fish advisories for the Connecticut River as outlined in the table below for additional toxins including PCBs, DDT, and dioxin. At risk populations are children under 12, women who are pregnant or may become pregnant, women of child-bearing age, or breast-feeding women and should pay extra attention to the advisories. Potential human health risks associated with mercury, PCBs, DDT, and dioxin, *may* include the following:

- *Reproductive System* - This includes pollutant presence in breast milk; abnormal embryonic development.
- *Cancer* - The pollutants are known carcinogens.
- *Asthma* - Chronic exposure is linked to increased asthma rates and susceptibility.
- *Neurological System* - Neuro-disrupters; developmental abnormalities.
- *Cardiovascular System* - These pollutants affect tissue growth and health.
- *Development* - Chronic exposure has been linked to issues of brain and body development in children.
- *Immune System* - Exposure linked to weakened or suppressed immune responses. *Diabetes* - Chronic exposure linked to higher rates of diabetes.

Recreational fishing on the Connecticut River and its tributaries is widespread. It is unknown what percent of the fishing on the river is subsistence fishing. More information needs to be gathered about subsistence fishing levels on the river, and outreach to these communities about fish advisories needs to be conducted.

Table 4. Fish Consumption Advisories, Massachusetts Department of Fish and Game

FISH PICTURE	*COMMON NAME*	*TOXINS IN FISH TISSUE**	*POPULATIONS AT RISK FOR HEALTH PROBLEMS DUE TO FISH CONSUMPTION*
	Brown Bullhead	PCBs Mercury Dioxin DDT	Subsistence fishers Recreational fishers
	Channel Catfish	PCBs	All populations
	White Catfish	PCBs	All populations
	Yellow Perch	PCBs Mercury Dioxin DDT	All populations Subsistence Fishers Recreational Fishers
	American Shad	PCBs Mercury Dioxin DDT	Subsistence Fishers Recreational Fishers
	Striped Bass	PCBs	All populations Subsistence Fishers Recreational Fishers

	**White Sucker**	**PCBs** **Mercury** **DDT** **Dioxin**	**Subsistence Fishers** **Recreational Fishers**
	**Smallmouth Bass**	**PCBs** **Mercury** **DDT** **Dioxin**	**Subsistence Fishers** **Recreational Fishers**
	**American Eel**	**PCBs**	**All populations** **Subsistence Fishers** **Recreational Fishers**

EROSION AND SEDIMENTATION INDUCED BY HUMAN ACTIVITY

Streambank erosion along the Connecticut River main stem has been identified as a problem. This erosion poses a threat to freshwater fisheries and riparian buffer habitats, and contributes to the loss of prime agricultural lands. Erosion along the main stem and tributaries increases turbidity and diminishes water quality through sedimentation. A lack of streambank vegetation can contribute to erosion problems. (Ct River Watershed 5-Year Action Plan, Dec. 2002, UMass Grad students for Mass DEP)

Vegetated riparian buffers can play an important role in preventing erosion as well as protecting water quality, water temperature and wildlife habitat. Vegetated riparian buffers have been lost or degraded by encroaching development and agricultural practices. Currently degraded vegetated riparian buffers are most likely those that are in close proximity to high intensity land uses such as agricultural, commercial and industrial uses. (UMASS, 2002) Runoff containing sediments and nutrients can occur from agricultural fields adjacent to rivers and streams. In some instances agriculture goes clear up to the banks; in others there is a thin buffer of vegetation. (UMASS, 2002)

The Northfield Mountain Project diverts water from the Connecticut River and releases it back to the river to generate electricity. According to Simons & Associates (1999) this creates fluctuations in the water level in the Turners Falls Pool and can contribute to bank erosion. These practices are allowed under the facility's current permit. In the future, permit reviewers should consider modification of these practices in subsequent relicensing of the facility. (UMASS, 2002)

FirstLight Power Resources is licensed by the Federal Energy Regulatory Commission (FERC or the Commission) to operate the Turners Falls Hydroelectric Project (FERC No. 1889) and the Northfield Mountain Pumped Storage Project (FERC No. 2485). Both Projects utilize water from the Connecticut River to generate hydroelectric power. The current FERC licenses for both projects expire on April 30, 2018. Every 30-50 years, Licensees are required to relicense their hydroelectric facilities with FERC. By

April 30, 2016, two years prior to license expiration, FirstLight is required to file their Final License Applications for both projects. The FERC scoping process is currently underway for this relicensing.

PUBLIC WATER SUPPLIES

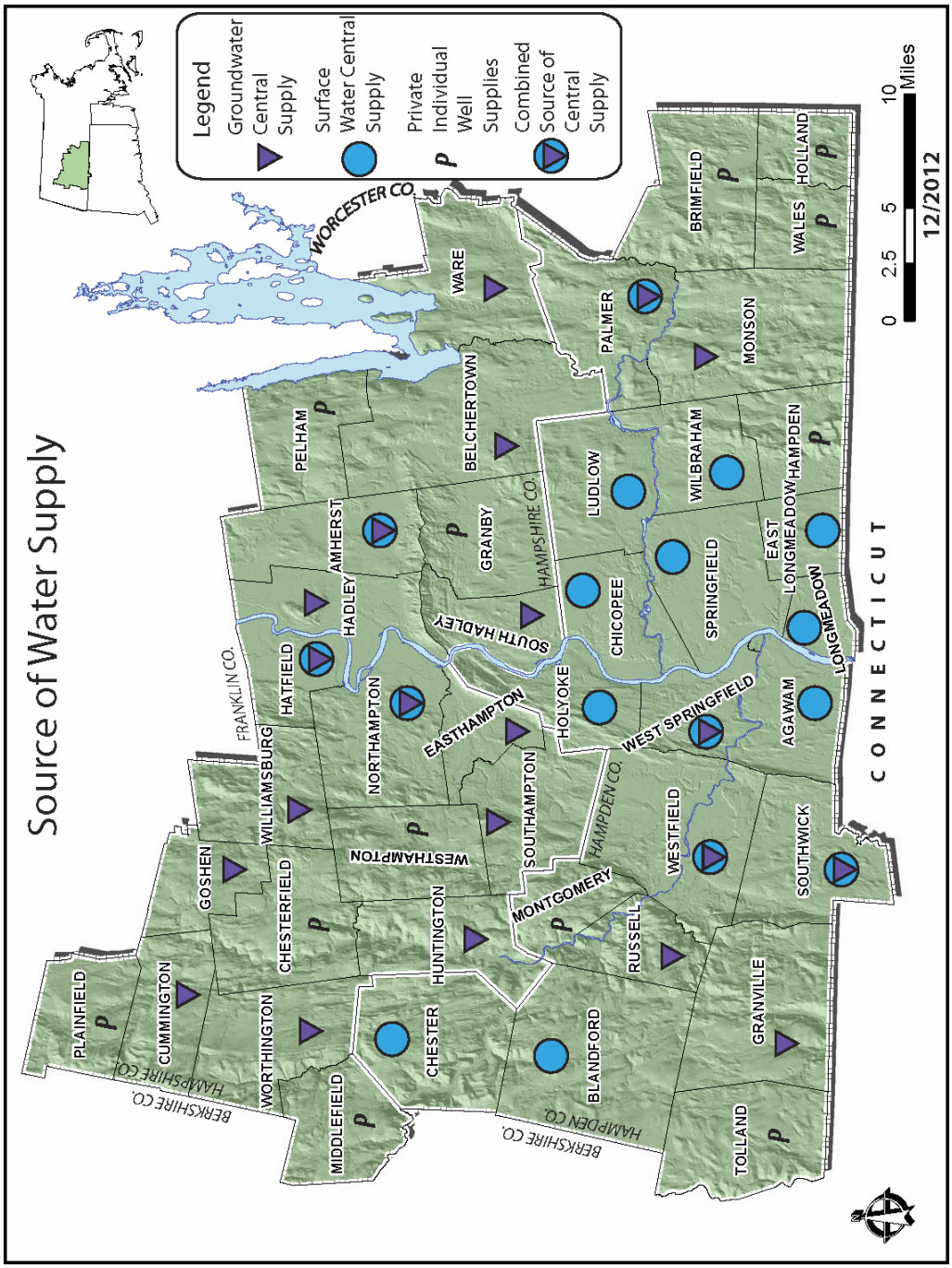
Municipal water suppliers were contacted for the 30 public water supplies (PWS) operated in the Pioneer Valley to conduct a water needs forecast following the Massachusetts Water Resources Commission policy and methodology (revised May 1, 2009). However, due to the unavailability of Annual Statistics Reports for the years 2006-2008, we were only able to utilize data for the years 2009 and 2010 for use in the forecast. As such, the water forecasts do not comply with the methodology and have not been included in this report. However, the forecasts were shared with the PWSs and used as guidance for interviews to gather information about the status of public water supplies in the region.

The table below summarizes the water supply sources for each municipality in Hampshire and Hampden counties.

Table 5. Sources of Municipal Water Supply, Pioneer Valley

Municipality	% of Public Supply from Surface Water Sources	% of Public Supply from Groundwater Sources	Private Water Supplies	Active Public Water Sources
Agawam	100%	0%		Purchase from Springfield
Amherst	60%	40%		Atkins Reservoir, Amethyst Brook Reservoir, 5 wells
Belchertown	0%	100%		6 wells
Blandford	100%	0%		Long Pond Reservoir
Brimfield			All	
Chester	100%	0%		Austin Brook Reservoir, Horn Pond
Chesterfield			All	
Chicopee	100%	0%		Purchase from MRWA (Quabbin Reservoir)
Cummington	0%	100%		3 wells
Easthampton	0%	100%		6 wells
East Longmeadow	100%	0%		Purchase from Springfield
Goshen	0%	100%		1 well
Granby			All	
Granville	0%	100%		1 wells
Hadley	0%	100%		3 wells
Hampden			All	
Hatfield	74%	26%		Running Gutter Reservoir, 2 wells
Holland			All	
Holyoke	100%	0%		Manhan, Ashley, Whiting, McLean, White Reservoirs
Huntington	0%	100%		2 wells
Ludlow	100%	0%		Purchase from MRWA

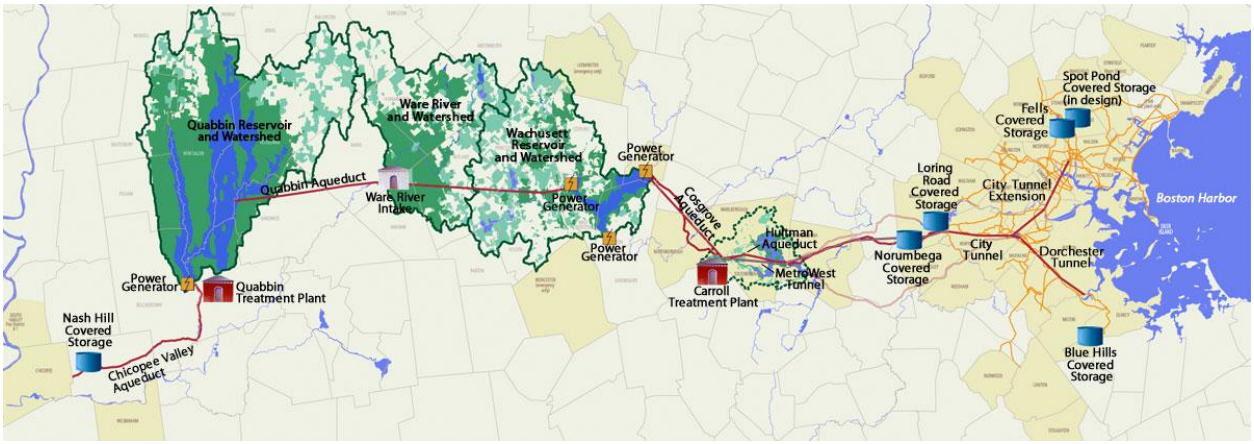
				(Quabbin Reservoir)
Longmeadow	100%	0%		Purchase from Springfield
Middlefield			All	
Monson	0%	100%		4 wells
Montgomery			All	
Northampton	99%	1%		Ryan, Mountain Street, Roberts Meadow, West Whately Reservoirs, 2 wells
Palmer - Center	52%	48%		Graves Brook Reservoirs, 2 wells
Palmer - Bondsville	0%	100%		4 wells
Palmer – 3 Rivers	0%	100%		2 wells
Pelham			All	
Plainfield			All	
Russell	0%	100%		2 wells
South Hadley	0%	100%		2 wells, purchase from MWRA
Southwick	15%	85%		2 wells, purchase from Springfield
Southampton	0%	100%		2 wells, purchase from Holyoke
Springfield	100%	0%		Cobble Mountain, Little, Intake, Borden Brook, Ludlow Reservoirs
Tolland			All	
Wales			All	
Ware	0%	100%		4 wells
West Springfield	93%	7%		4 wells, Bear Hole Reservoir, purchase from Springfield
Westhampton			All	
Westfield	50%	50%		8 wells, Granville, Montgomery Reservoirs, purchase from Springfield
Williamsburg	0%	100%		Purchase from MWRA (Quabbin Reservoir)
Wilbraham	0%	100%		2 wells
Worthington	0%	100%		7 wells, 3 springs


Source of Water Supply
Legend
Groundwater Central Supply
Surface Water Central Supply
Private Individual Well Supplies
Combined Source of Central Supply
0 2.5 5 10 Miles
12/2012
WORCESTER CO.
FRANKLIN CO.
HAMPSHIRE CO.
HAMPDEN CO.
BERKSHIRE CO.
HAMPSHIRE CO.
BERKSHIRE CO.
CONNECTICUT
PLAINFIELD
CUMMINGTON
GOSHEN
WILLIAMSBURG
WORTHINGTON
CHESTERFIELD
MIDDLEFIELD
CHESTER
HUNTINGTON
WESTHAMPTON
NORTHAMPTON
HATFIELD
HADLEY
AMHERST
PELHAM
GRANBY
SOUTH HADLEY
EASTHAMPTON
SOUTHAMPTON
BELCHERTOWN
WARE
HOLYOKE
CHICOPEE
LUDLOW
PALMER
MONTGOMERY
RUSSELL
BLANDFORD
WESTFIELD
WEST SPRINGFIELD
SPRINGFIELD
WILBRAHAM
MONSON
BRIMFIELD
WALES
HOLLAND
EAST LONGMEADOW
LONGMEADOW
AGAWAM
HAMPDEN
SOUTHWICK
GRANVILLE
TOLLAND

MWRA AND CHICOPEE VALLEY AREA COMMUNITIES

Three communities, or water supply districts, purchase water from the Massachusetts Water Resource Authority (MWRA): Ludlow, South Hadley Fire District #1, and Wilbraham. Treated water from the Quabbin Reservoir is sent through the Chicopee Valley Aqueduct to local distribution mains and smaller community pipes. Water meters log the water entering each community. MWRA also supplies wholesale water to local water departments in 42 in greater Boston and the MetroWest areas, and provides a back-up water supply in three other communities.

Figure 1 Quabbin Reservoir Distribution System



WATER QUALITY OPPORTUNITIES

NPDES MS4 STORMWATER PERMITS – WATER QUALITY MONITORING

Communities with U.S. Census designated Urbanized Areas have been regulated since 2003 under the National Pollutant Discharge Elimination System (NPDES) to implement best management practices at the municipal level to reduce stormwater pollution. Known as NPDES Stormwater Phase II, the U.S. Environmental Protection Agency (EPA) issues permits to so called MS4 communities (Municipally Small Separate Storm Sewers) requiring compliance with specific Minimum Control Measures to reduce stormwater pollution through the implementation of improved operation and maintenance at the municipal level. In 2010, EPA re-issued regionally specific draft permits which significantly increased MS4 obligations for permit compliance. The Pioneer Valley is under the Interstate Merrimack South Coastal NPDES MS4 Permit.

One of the NPDES MS4 permit requirements involves monitoring water quality with the intent of identifying and eliminating illicit connections to ultimately improve water quality. A regional in-stream monitoring approach would identify river segments and tributaries with water quality impairments, and thus guide targeted monitoring of specific outfalls in these river segments and tributaries. The in-stream monitoring approach would identify problem areas more cost effectively than monitoring every single outfall whether or not there is any indication that the contributing discharge area is causing water quality impairment. An in-stream approach is best applied regionally as most rivers and streams cross municipal boundaries and are best evaluated at the watershed scale. A monitoring program centralized at PVPC would allow for the data to be shared readily between municipalities within shared watersheds to most efficiently guide additional monitoring to either source illicit connections, or other land use activities that may be contributing pollutant laden runoff causing primary and secondary contact recreational standards not to be met during wet weather. The data could be posted on PVPC's existing Connecticut River website called www.ConnecticutRiver.us . PVPC currently operates a bacteria monitoring program on the Connecticut River at recreational access sites, with data posted to this website for public use (specifically targeting recreational river users). The website could be expanded to include data collected under this program, thus improving public access to water quality information in the region.

LONG ISLAND SOUND TMDL

The Long Island Sound TMDL, approved by the U.S. EPA in 2001 identifies actions necessary to attain water quality standards for dissolved oxygen in the Sound by 2014. These include a 25 percent reduction in point source loads of nitrogen from the upper part of the Connecticut River Basin (all areas above Connecticut), and a 10 percent reduction in non-point source nitrogen loads from urban and agricultural areas within the entire Connecticut River basin. The two agricultural controls for which potential nitrogen reductions and annual costs were estimated include the use of cover crops and riparian buffers. It was estimated that the use of such controls would result in a maximum nitrogen load reduction of 1.3 million pounds per year for the entire Connecticut River basin at an estimated annual cost of $6.48 million. (*Evans 2008*)

FISH CONSUMPTION ADVISORIES

EPA is currently reviewing its 2005 Clean Air Mercury Rule, which with the Clean Air Interstate Rule, may help to reduce emissions from Midwest power plants and urbanized eastern seaboards and ultimately may help to reduce the amount of mercury in fish. (*EPA 2006*) The entire Connecticut River is covered by state-wide advisories for mercury; however, current state fish advisories for PCBs are variable and site-specific, and there are no advisories for dioxins or organochlorine pesticides, such as DDT. Based on the information from this study, the state health agencies will evaluate existing advisories and consider the need for others to adequately protect human health. (*EPA 2006*)

Massachusetts and Connecticut have PCB advisories for some fish species for all Connecticut River waters in their states. However, Massachusetts and Connecticut provide differing fish consumption advice for sensitive "at risk" and general consumers. (*EPA 2006*)

SUSTAINABLE WATER MANAGEMENT INITIATIVE (SWMI)

The Executive Office of Energy and Environmental Affairs (EEA) and its agencies have finalized the Sustainable Water Management Initiative (SWMI) Framework in November 2012. Although best applicable relative to water quantity instead of quality, SWMI establishes a new methodology for determining maximum withdrawal volumes for major basins on an annual basis, called Safe Yield. The Department of Environmental Protection (MassDEP) has started the development of draft WMA regulations with a goal of promulgating final regulations by the end of 2013. While the SWMI Framework is final, experience gained from the SWMI Pilot Project (underway) and comments received during the regulation development process will help to inform MassDEP in its development of regulations. As a companion piece, to provide greater clarity to the permit process, the state will develop a guide or handbook to the regulations incorporating the various SWMI elements into WMA permits.

WATER QUALITY STRATEGIES

- Create/increase new state and federal funding programs to reduce and eliminate water pollution due to CSOs, possibly seeking bi-state legislative collaboration to sponsor or support new federal and/or state legislation, such as a clean water bond to clean up the Connecticut River.
- Develop cooperative, interstate plans and strategies to clean up CSOs, possibly re-establishing the bi-state partnership for Connecticut River CSO clean-up.
- Implement the HUD SKC Green Infrastructure Element Plan to reduce stormwater impacts on waterways and combined sewer systems, and reduce need for costly CSO remediation.
- Cooperatively implement pilot projects using LID techniques to remove stormwater from the sewer system, including disconnecting roof drains and using LID in redevelopment projects.
- Implement an ongoing interstate water quality monitoring and bacteria source tracking project to better understand water pollution and sources in the Connecticut River and its tributaries, dry and wet weather monitoring.

- Adopt municipal policies to correct CSOs as part of road/highway reconstruction projects
- Increase public awareness of and involvement in water quality issues and watershed protection and improvement, including an annual bi-state forum on Connecticut River water quality issues
- Explore the potential to upgrade wastewater treatment plants in the upper part of the basin (areas above Connecticut) so that each discharges no more than 3 mg/l of nitrogen. This would reduce point source loads of nitrogen by approximately 3.4 million pounds per year, which would equate to a reduction of about 74.7% when considering the current point source load delivered by sources upstream of CT (4.53 million pounds per year).
- Conduct additional monitoring to identify the sources of PCBs and mercury that are reported in the USGS study (not found in sediment, but in fish tissue)
- Review and update public health advisories and issue advisories as needed. People should not be eating these fish – especially kids and pregnant women.
- Conduct education and outreach to citizens about the quality of fish in the Connecticut River and its tributaries, especially to minority populations who fish the river to supplement their food supply.
- Investigate remediation options for areas of concern, such as heavily fished areas, and encourage use of cost-effective, innovative solutions.
- Seek interstate collaboration on funding to track and remove PCB sources.
- Expand education and outreach about use of fertilizers and pesticides and the impacts on water quality, in collaboration with the Connecticut River Stormwater Committee's Think Blue Massachusetts campaign (www.ThinkBlueMA.org)
- Make statistical comparison between land use/land cover, population demographics or other ancillary data and the contaminants found in CT River smallmouth bass, yellow perch, and white suckers. Further statistical exploration of these relationships to explain the observed patterns of contaminant loads.
- The Northeast Regional Mercury Total Maximum Daily Load (TMDL) should be successfully implemented, with a minimum of a 90 percent control on out-of-region coal fired power plant emissions and successful control of in-state/regional reductions in mercury sources.
- Continue the Connecticut River Bacteria Monitoring project to monitor *E.coli* bacteria at recreational access sites to gauge Primary and Secondary Recreational Contact.
- Expand water quality monitoring throughout the watershed to include nutrients and biological monitoring, beyond DEP's seven year watershed monitoring cycle and reference sites.
- Protect water quality through the implementation of Growth Management strategies, assisting willing communities with the implementation of such strategies.

- Assist communities in building their capacity to improve and protect water quality and reduce nonpoint source pollution, including inter-municipal collaborations in meeting NPDES MS4 permit requirements.

- Assist with the establishment of Stormwater Utilities in willing communities as funding mechanism for stormwater infrastructure capital improvements, and operation and maintenance support.

- Reduce impervious surfaces through retrofits and use of low impact development standards (where appropriate use TMDL as a mechanism to do so)

- Increase public awareness and involvement in watershed protection and water quality improvement in collaboration with the Connecticut River Stormwater Committee's Think Blue Massachusetts campaign (www.ThinkBlueMA.org)

- Coordinate the use of bi-state federal non point source grant funds.

- Implement a Riparian Corridor Educational Program for owners of land adjacent to the river and its tributaries, including farmers, and local citizens. Focus on the myriad functions of vegetated riparian buffers including erosion control, water quality protection and wildlife habitat functions. Coordinate with the local NRCS office to educate farmers about existing Farm Bill Programs that can be used to restore and/or protect vegetated buffers.

- Encourage riparian corridor restoration demonstration projects, especially during redevelopment of sites along the river. This will consist of identifying willing landowners, completing site assessments and implementation of restoration actions such as removing erosion sources and replanting vegetation.

- Continue to support the Connecticut River Watershed Councils "Sustainable Riverbanks" Project. The objective is to identify and prioritize the restoration of erosion sites along the main stem, distinguishing between sites that are naturally eroding and those eroding due to human influence. Then extend program to major tributaries.

- Emulate model erosion control strategies implemented by FRCOG and CRJC under EPA TWI grant, which included engineering log jams and sustainable riverbank restoration.

- For protection of the riparian corridor, it is important to coordinate land protection efforts between agencies such as the Massachusetts Department of Environmental Management, Department of Food and Agriculture, the Massachusetts Division of Fisheries and Wildlife, and the United States Fish and Wildlife Service and local communities and land trusts.

- Collaborations of utilities and Regional Planning Agencies to address hydro-related erosion control.

- Encourage the use of existing incentive programs as well as develop additional programs for the preservation and/or restoration of vegetated riparian buffers. Existing programs that could be promoted include the Wildlife Habitat Improvement Program (WHIP) and the Environmental Quality Incentive Program (EQIP) administered by the USDA Natural Resource Conservation Service. These programs provide funding which can be used to restore and/or protect vegetated

riparian buffers within agricultural lands. Potential additional incentives include the development of state or local tax incentives to encourage farmers to remove riparian lands from agricultural production and the encouragement of cultivating appropriate nursery plants within riparian areas through state contracted demonstration programs.

- Promote water conservation and efficient water supply delivery systems region-wide to reduce threats of Connecticut River diversion, and mitigate the effects of climate change.

RIVER CONTINUITY AND HABITAT

The natural flow regime of the Connecticut River and its tributaries has been highly altered. This altered flow regime is a primary threat to floodplain forests, estuarine communities, migratory and resident fish, and aquatic invertebrates. In an extensive, stakeholder driven planning process conducted by The Nature Conservancy, these natural communities and species assemblages were identified as key conservation targets in the watershed.

The fragmentation of dams and poorly designed culverts is one of the primary threats to aquatic species in the United States. In the Connecticut River basin in MA and CT, there are 1,422 dams, which translates to densities of one dam per 6.6 km of river. Impacts on aquatic species involve loss of access to quality habitat for one or more life stages of a species, including limiting the ability of anadromous fish species to reach preferred freshwater spawning habitats from the sea, and preventing brook trout populations from reaching thermal refuges. (*Northeast Aquatic Connectivity: An Assessment of Dams on Northeastern Rivers, 2011)*

HABITAT LOSS AND DEGRADED HABITATS

The Connecticut River connects an immense region that is home to nearly 5,000 wildlife and plant species and provides migratory pathways for both aquatic and avian species. This region is also highly attractive for human settlement and projections based on current development trends indicate that some 505 square miles will be converted from rural to exurban between 2000 and 2020. Significant problems for preservation of streams and wildlife habitat inlcude loss of riparian buffer areas and habitat along streams; introduction of non-native invasive species to riverine areas; and physical barriers that block river connectivity.

Many species are adversely affected by the spread of housing across the landscape. Exurbanization and suburbanization of the landscape will undoubtedly reduce habitat for most native species. These rapid growth rates, combined with poor development practices, could result in significant habitat loss.

There are 10 federally threatened or endangered species in the watershed. Many species have inadequate protected habitat to ensure long-term viability in their natural range. Protection of habitat priorities identified by Natural Heritage and Endangered Species Program (NHESP) must continue. Threats to habitat include extensive habitat fragmentation and loss of connectivity. Residual habitats, both aquatic and terrestrial, are often degraded. Nonnative plant species (e.g., Water Chestnut, Japanese Knotweed, Phragmites, Fanwort and Purple Loosestrife) cover areas formerly occupied by native species.

A 2001 U.S. Fish and Wildlife Service survey provides compelling evidence of the importance of wildlife habitat to economic activity. Wildlife related expenditures (on fishing and hunting, and wildlife watching) in the four watershed states totaled $2.6 billion.

HABITAT ANALYSIS

WESTFIELD BASIN

The Natural Heritage and Endangered Species Program identified 56% of the Westfield River watershed as either Biocore Habitat or Supporting Landscape Habitat. Biocore Habitat is the most viable habitat for rare species and natural communities in Massachusetts. Supporting Natural Landscape Habitat is the buffer area that connects Biocore Habitat, and identifies large, naturally vegetated blocks that are relatively free from the impacts of roads and other development.

Odanta, freshwater mussels, and fish surveys in the Westfield River watershed have been conducted in 2009 and 2010[5]. Overall, the total number of odonates encountered was lower than expected and rare species proved difficult to collect. The possible effects of two consecutive high-water years (2008 and 2009), with severe flooding during the May-August emergence periods, might have reduced odonate densities. In contrast, the high diversity of the aquatic insect community indicates excellent water quality and few stressors.

The survey documented a very high number of aquatic insect taxa that are typically found only in high-quality coldwater rivers and that are sensitive to pollution, as well as several taxa considered uncommon in the region and rarely documented in Massachusetts. These data should be combined with DEP biological monitoring data to generate more complete taxonomic lists for these streams and rivers.

Mussels were absent at nearly all stream survey sites in the Wild & Scenic portion of the watershed. The Middle Branch Westfield River below the Littleville Dam was the only river in the Wild & Scenic portion that contained mussels (five species found) although these may be relic non-reproducing populations.

Viable mussel populations were detected in the Dead Branch (one species) and most ponds (two species). The mainstem Westfield River and its larger tributaries in the lower watershed (Great Brook and Little River) supported large and viable mussel populations, especially of eastern elliptio and eastern pearlshell.

Possible explanations for the lack of mussels throughout most of the river miles in the upper watershed include a dynamic and harsh river environment, and the cumulative effects of large dams and natural barriers that impede the movement of migratory fish into the upper watershed.

Six mussel species were found, including eastern elliptio (Ellip-tio complanata), eastern pearlshell (Margaritifera margaritifera), creeper (Strophitus undulatus), triangle floater (Alasmidonta undulata), eastern floater (Pyganodon cataracta), and eastern lampmussel (Lampsilis radiata). A seventh mussel species—alewife floater (Anodonta implicata) was not found but is likely to occur in the lower mainstem Westfield River. The creeper and triangle floater are Species of Special Concern in Massachusetts. Three

[5] Biodrawversity, LLC, 2010. *Dragonfly and Damselfly (Insecta: Odonta) Survey in the Wild and Scenic Westfield River Watershed.*

crayfish species were found, including Orconectes rusticus, Orconectes virilis, and Orconectes propinquis.

The Target Fish Community (TFC) Model study conducted in 2009 identified the five most abundant species in the Westfield River are blacknose dace (36%), longnose dace (24%), common shiner (13%), slimy sculpin (8%), and smallmouth bass (5%). Both the TFC and current fish community are dominated by fluvial fish and a mix of moderate and tolerant species. Four of the top five species in the TFC are also in the top five of the current community. Corresponding similarity scores for species (80%), habitat-use categories (95%), and tolerance categories (95%) were high.

The similarity between the current and target fish communities is an indication of the relative integrity of the system. The Westfield River provides an environment suitable for native riverine species predicted by the TFC model. Assessments of water quality support the same basic conclusion. Except for the 1-mile reach of the Westfield River near the Westfield Wastewater Treatment Plant, the assessed portions of the river supports the Aquatic Life Use Standard (Dunn and Kennedy, 2005). The river does still have impairments to habitat including impoundments and hydromodification that alter temperature and flow regimes, but these impairments also affect aspects of the fish community not directly studied in this report (e.g. anadromous fish species).

Upstream and downstream fish passage is available at the DSI facility on the Eastern Main Stem for anadromous and resident fish and eel. The other three major dams on the lower main stem have systems for downstream fish passage.

CHICOPEE BASIN

The Chicopee Basin was included in the Target Fish Community Study. (Kashiwagi, 2009) While 18 fish community surveys have been conducted on the Ware, Swift and Quaboag Rivers with the study reach, only two met the criteria for inclusion in the Target Fish Community analysis. These samples do not have the geographic distribution to adequately characterize the entire main stem study reach. Full analysis of this system is currently in progress and should be completed within the next five years as part of the basin assessment cycle.

There are a wide variety of habitat types, which has resulted in substantial richness of aquatic and terrestrial wildlife species. NHESP indicates several core habitats (high priority locations for biodiversity conservation). NHESP also identified 12 key sites for preservation within the basin:

- Quabbin Reservoir and surrounding watershed lands (BM504 and LW309)
- East Branch of the Swift River and Moccasin Brook (LW290)
- Upper Ware River Watershed in Barre, Hubbardston, Rutland, and Oakham (BM518)
- Several sections of the Ware River (LW160, LW202, LW303, LW310)
- Westover Air Reserve Base and adjacent areas in Ludlow and Chicopee (BM900)
- Wine Brook wetlands in Phillipston and Templeton (BM536)
- Quaboag River and tributaries in Brookfield and West Brookfield (BM898)
- Hitchcock Mountain and Great Brook in East Brookfield and Sturbridge (BM915)
- Brookfield River and adjacent wetlands in East Brookfield (BM920)
- Kings Brook and surrounding forest in Palmer (BM936)
- Wolf Swamp – Trout Brook – Cranberry Pond complex in Brookfield and Sturbridge (BM963)

- Brimfield State Forest and surrounds in Brimfield, Wales, and Monson (BM1017)

The Upper Ware River watershed and Chicopee River watershed have been identified where dams and/or water withdrawals may have adverse impacts on downstream conditions.

FISH PASSAGE AND FLOW

Dams, culverts, and rapid changes in flow all present challenges to fish passage and are detrimental to the success of many species that must travel up and down stream[6]. Rapid changes in river flow can be difficult for many aquatic species to adjust to, though such flow can be beneficial to power generators and paddlers. There is an ongoing challenge to balance the needs of a "working river" (flood control, recreation, and power generation) with wildlife and environmental protection objectives. Strive for a balanced goal to determine if altering flows can improve aquatic species and floodplain habitats while preserving the numerous and diverse human uses of the river.

There are two major dams on the main stem: Turners Falls Dam (has upstream fish passage facilities, but downstream fish passage facilities scheduled for construction not built as of 1998); and Holyoke Dam (has fish passage facilities). Breaching of Enfield Dam has improved ability of anadromous fish to migrate upstream[7]. In addition to dams, other barriers to fish passage occur within the watershed. These barriers can include railroad crossings, culverts, livestock fences and road crossings. Additional assessment work is needed to fully identify impedances to fish migration including culverts and road crossings.

Seven out of ten rivers with high or severe potential (based on dam storage) for hydrologic alteration in the Connecticut River basin have US Army Corps flood control dams.[8] Potential hydrological alteration is highest in the Upper CT River, Deerfield River and Chicopee River. In the Chicopee River (Swift River) there are severe decreases in maximum flows and frequency of flooding.

MA and CT authorize the withdrawal of 6,676.5 MGD from the Connecticut River watershed, including 315 MGD of withdrawals in MA and 6,361.5 MGD of withdrawals and diversions in CT. Of the authorized water withdrawals in Massachusetts (in the Connecticut, Deerfield, Chicopee, Millers, and Westfield Rivers), only 5.4 percent are subject to the permitting process created by the Water Management Act (WMA). The remaining 94.5 percent are grandfathered and not subject to environmental review. In MA, non-consumptive withdrawals and withdrawals that do not exceed the threshold that triggers regulatory review under the WMA are unknown, but probably constitute a significant amount of water. As of 2007, 122 NPDES permits existed in the MA portion of the CT River watershed, authorizing the discharge of 313.5 MGD. (Zimmerman, 2008)

A major water withdrawal has been proposed for the Eastern Main Stem known as the Russell Biomass Power Plant in Russell was cancelled in 2012 due to technical issues pertaining to renewable energy credits that were not achievable for this project.

[6] TNC and USACE, Oct. 2009. *Connecticut River Watershed Project Assessment Report.*
[7] UMass Grad students for Mass DEP, December 2002. *Connecticut River Watershed 5-Year Action Plan.*

The *Spatial Distribution of Hydrologic Alteration and Fragmentation among Tributaries of the Connecticut River* (Zimmerman, 2006) provided a decent overview of flow in the Connecticut basin. Low flows only decreased on two rivers, the Swift (in the Chicopee watershed) and the Ottauquechee. The 3-day minimum flow decreased by 39% in the Swift River and by 29% in the Ottauquechee River. The 3-day minimum flow remained relatively constant in the Ashuelot, Ware (Chicopee watershed), Westfield, and Middle Branch of the Westfield, and increased in the Black, Wells, and West Rivers. Low flow duration tended to increase and the frequency of the Q90 (the flow exceeded 90% of the time) tended to decrease across tributaries, although a few tributaries did not exhibit this pattern. Changes in central tendency (monthly median flows) tended to be greatest in the winter and lowest in the summer/fall, although not all rivers followed this trend.

Tributary studies determined the spatial distribution of dams and assessed the potential for dams to alter flows in 44 major tributaries of the Connecticut River (defined as watersheds with drainage areas exceeding 30 square miles) The ratio of total dam storage to mean annual runoff in each tributary basin was computed at the confluence with the main stem Connecticut River. This yielded a flow index for each tributary; the potential for hydrologic alteration was categorized as Low (<10), Moderate (10-30), High (31-50), and Severe (>50). Flow Ratings demonstrated Chicopee River as severely impacted and Westfield River as at moderate risk on this scale. Dam Fragmentation identified Chicopee River as high and Westfield River as moderate on scale that runs from low to very high. Dams for flood control, hydroelectric power generation, and water supply have all contributed to altered flows in tributaries; however, effects of flood control dams on overbank flows seem to be the most prevalent threats to natural communities among tributaries in this analysis.

The *2006 Westfield River Continuity Project* determined 85 dams and 328 crossings to pose significant barriers to animals and river processes; another 200 structures (7 dams and 193 crossings) were classified as moderate or partial barriers. 16 of the dam sites visited were found to be entirely or substantially free-flowing. The MA River and Stream Crossings Standards were met by 141 of the road-stream crossing structures surveyed. All crossings with watershed greater than 30 sq. miles met the standards. 31 barriers categorized as Priority 1 for restoration 128 as Priority 2, 172 as Priority 3, and 275 as Priority 4.

The US Army Corps Programmatic General permits that have been implemented since this research was done, requires all new and replaced culverts to follow river friendly standards. TNC is also nearing completion of a study in Vermont showing how these improved standards (implemented in the Green Mountains), resulted in fewer culvert failures during Tropical Storm Irene than with culvert that did not follow these standards.

There are a number of FERC licensed hydroelectric plants on the Western Main Stem, used by industrial operations still located on the river. Low flows have been observed downstream of the Cobble Mountain Reservoir Dam on the Little River and no flow release requirements for this dam. The West Branch, East Branch and lower Middle Branch, below the Littleville Reservoir Dam, have been classified as Medium Stressed Basins due to periodic low flows. More data is needed to better understand flow regimes in each of these locations.

DAMS

Most dams in the Connecticut River watershed create shallow impoundments and release water from the surface; thus the primary effect is to elevate downstream water temperatures in the summer. Even small

surface-release impoundments may warm waters enough to affect species that were already near the upper limit of their thermal range, such as Atlantic Salmon in many tributaries to the CT River.

Rivers draining the eastern and western highlands of the CT River valley tend to have non alluvial channels that are underlain by bedrock and sediments that resist erosion. The rivers often have more variable flows and may be particularly sensitive to low flows. In contrast, larger rivers and low gradient rivers in the Valley lowlands tend to have alluvial channels and are more dynamic, with frequent changes in channel morphology through erosion and sedimentation.

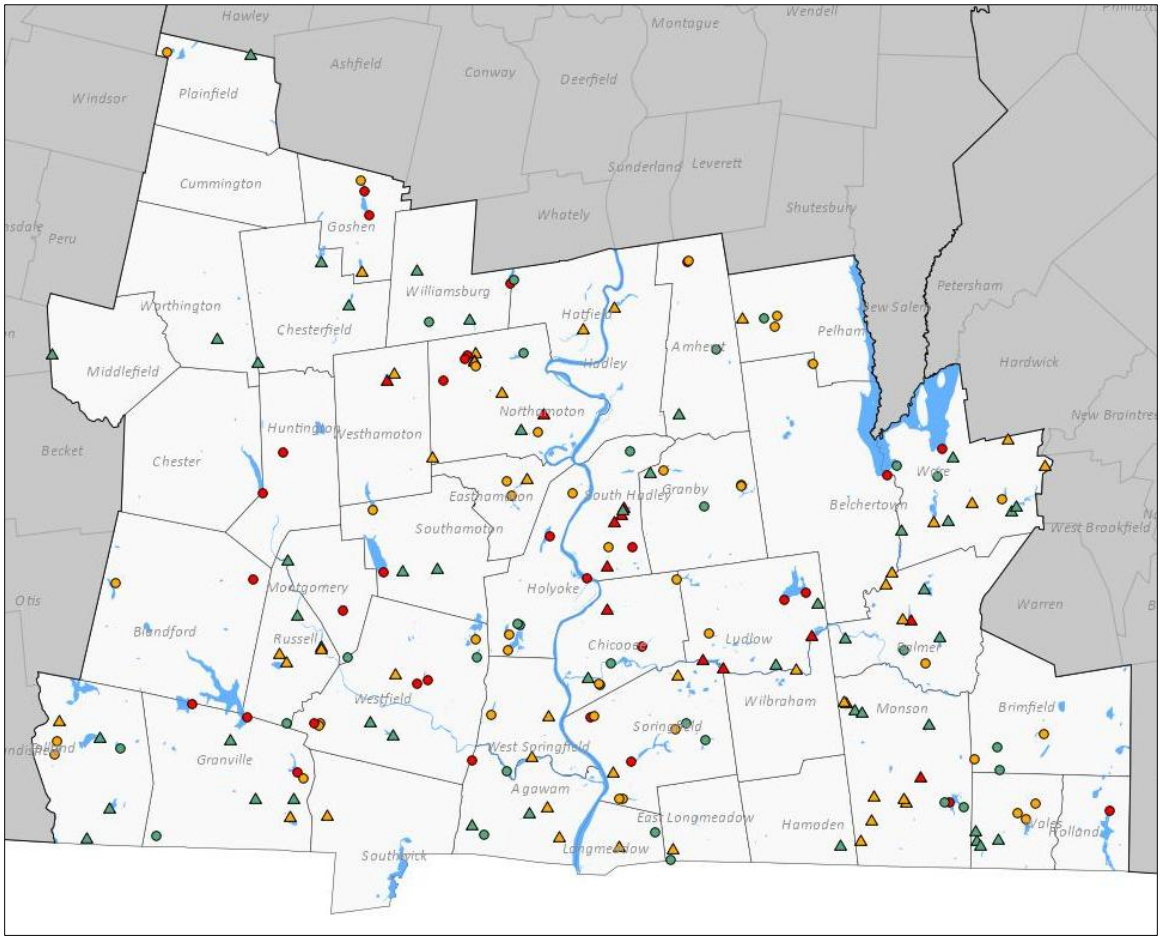
The Upper CT, Deerfield, and Chicopee River have dam storage capacity greater than 50% of mean annual runoff and were considered to be severely impacted with respect to flow. Low flows only decreased on two rivers (the Swift River in the Chicopee watershed and the Ottauquechee River) Dams for flood control, hydroelectric power generation, and water supply have all contributed to altered flows in tributaries; however, effects of flood control dams on overbank flows seem to be the most prevalent threats to natural communities among tributaries in this analysis. (Zimmerman, 2006)

There are 224 dams regulated by the Office of Dam Safety in the Pioneer Valley region. To be regulated, these dams are in excess of 6 feet in height (regardless of storage capacity) and have more than 15 acre feet of storage capacity (regardless of height). There are also many dams in the region that because they fall below these parameters are known as non-jurisdictional dams. Of the regulated dams in the region, 42 have a hazard index rating of high, 90 are rated significant hazard, and 92 are rated low hazard.[9] Hazard index rating is a level of risk determined by the likelihood that a dam failure (an uncontrolled release of impounded water) would result in loss of life or substantial property damage.[10]

[9] These numbers are estimates based on PVPC's work with information from the Office of Dam Safety.

[10] Dams that are "likely" to cause such damage are classified as "high hazard"; dams that "may" cause such damage are classified as "significant" hazard; dams that "may cause minimal property damage to others" where "loss of life is not expected" are classified as "low" hazard. Dams that fall into these classifications are regulated by the Office of Dam Safety.

Location of Public and Private Dams in the Pioneer Valley, by Hazard Level



Public	Private	
●	▲	Low hazard
●	▲	Significant hazard
●	▲	High hazard

This map shows the location of all dams in the Pioneer Valley for which there is information on the hazard level. High hazard dams are located near the highest population areas, near the Connecticut River. Source: MassGIS

Dam safety regulations enacted in 2005 transferred significant responsibilities for dams from the State of Massachusetts to dam owners. Financial burdens of these new responsibilities can vary greatly, depending on the number of dams for which an owner is responsible, and the dam's condition and hazard index rating. A dam in poor or unsafe condition can entail very costly repairs, and a hazard index rating brings with it different requirements related to frequency of inspections and the need for emergency action plans (currently only required for high hazard dams).

A 2011 report focused on municipal dams from the State Auditor found that the cost of complying with the new regulations presents serious financial challenges.[11] The Auditor's report identified 100 critical high and significant hazard dams owned by municipalities across the state in poor or unsafe condition where the average per dam cost for remediation is $600,000. Six of these dams are located in the Pioneer Valley region and are shown in gray highlight in Table 3 below. There are another 9 high and significant hazard dams, either privately or state-owned, known to be in poor condition, and a total of 9 low hazard dams in poor or unsafe condition in the region.[12]

Unless a dam is providing a specific beneficial function, such as water supply or power generation, dam owners facing financial difficulties with the costs of ongoing inspections, repairs, maintenance, and liability, can opt for dam removal. Removing a dilapidated dam can save money when compared to repair and maintenance over the long term, and protect public safety by avoiding continued neglect and the possibility of partial or catastrophic failure of the structure.

With the more frequent larger storm events predicted for the Northeastern United States, dam failure may increase in likelihood.[13] The extreme storm flows produced by Tropical Storm Irene on August 28th, for example, led to the failure of at least two dams in the Pioneer Valley Region. In Blandford an unnamed private dam failed sending a surge of water downstream to inundate and damage nearby roads. At the Granville Reservoir Dam owned by the City of Westfield, the spillway failed when waters rose to such a level as to overwhelm the structure.

These events raise several questions about dams and their capacity to pass these more frequent extreme flows. Poor condition dams in the region—as may have been the case in Blandford—will certainly be tested and it may make sense to focus resources on removal to avoid what could be the larger costs of damages in the wake of a failure. Are spillways adequately designed for other dams like the Granville Reservoir Dam that are kept in relatively good repair? These recent dam failures combined with the more frequent larger storm events predicted for the Northeastern United States suggest that the experiences of Blandford and Westfield may occur with more frequency in other places as our climate changes. If this is the case, then the $5 million estimate for repair and improvement of the spillway at the Granville Reservoir Dam could be but an early indication of the infrastructure investments that could be required down the road.[14]

Two dam removal projects in the watershed have been completed on the West Branch. The Silk Mill Dam on Yokum Brook was removed in February 2003 and the Ballou Dam was removed in 2006.

[11] Local Financial Impact Review: Massachusetts Dam Safety Law, Auditor of the Commonwealth, January 2011.

[12] This table is based on 2006 data from the Office of Dam Safety with which PVPC has been working with and updating for various projects since. Obtaining current data from the Massachusetts Office of Dam Safety is difficult given the reported lack of staffing and funding within that office.

[13] See: Climate Change in the U.S. Northeast, Union of Concerned Scientists, October 2006, which notes that regardless of whether our society pursues a higher or lower emissions scenario, the Northeast will be a tangibly different place. Modeling indicates increases in the likelihood and severity of heavy rainfall events, including more than a 10 percent increase in the number of annual extreme rainfall events and a 20 percent increase in the maximum amount of rain that falls in a five-day period each year.

[14] While there may be funding help from FEMA and the Natural Resources Conservation Service for this particular project, the City of Westfield must produce monies to cover 25 percent of the cost.

Table 6. Dams in the Pioneer Valley in Poor or Unsafe Condition

Dams in gray listed in 2011 Massachusetts State Auditor's Report, which lists 100 municipally owned critical dams

Dam name	Location	Hazard index rating	Physical condition	Notes
UPPER HIGHLAND LAKES DAM	GOSHEN	H	Poor*	
LOWER HIGHLAND LAKE DAM	GOSHEN	H	Poor	
ROBERT'S MEADOW UPPER RESERVOIR DAM	*NORTHAMPTON*	*H*	*Poor*	*MEPA filing for dam removal is expected by January 2013. An expanded environmental notification form will detail the impacts of the dam removal and restoration work.*
HATHAWAY & STEANE POND DAM #2	SOUTHWICK	H	Poor	
VAN HORN PARK LOWER DAM	*SPRINGFIELD*	*H*	*Poor*	
BONDSVILLE UPPER DAM	BELCHERTOWN	S	Poor	Repair cost has been estimated twice ($359,000 and $548,500 respectively). Governor Patrick has included $350,000 for repairs in the 5-year capital plan.
KNIGHTS POND DAM	*BELCHERTOWN*	*S*	*Poor*	
D.F. RILEY GRIST MILL DAM/ADVOCATE DAM	HATFIELD	S	Poor	
WHITE RESERVOIR DAM	*HOLYOKE*	*S*	*Poor*	*Impoundment drained in 1982. Acts as retention basin currently and City has an agreement with the Office of Dam Safety to continue operating as such. Dam carries a poor condition rating based on several improvements required by ODS.*
PULPIT ROCK POND NEW DAM	MONSON	S	Poor	
FOREST PARK UPPER POND DAM	*SPRINGFIELD*	*S*	*Poor*	
MONSANTO CHEMICAL CO. UPPER DAM	SPRINGFIELD	S	Poor	
VAN HORN PARK UPPER DAM	*SPRINGFIELD*	*S*	*Poor*	

Dam name	Location	Hazard index rating	Physical condition	Notes
FOREST PARK UPPER POND DAM	SPRINGFIELD	S	Poor	
STRATHMORE PAPER DAM	WEST SPRINGFIELD	S	Poor	
NINE LOT DAM	AGAWAM	L	Poor	
QUENNEVILLE DAM	GRANBY	L	Unsafe**	Impoundment has reportedly been drained
BAHRE POND DAM	GRANVILLE	L	Poor	
CLEAR POND DAM	HOLYOKE	L	Poor	
VIRGINIA LAKE SHORE DAM	MIDDLEFIELD	L	Poor	
ROCKY HILL POND DAM	NORTHAMPTON	L	Poor	
PUTNAM'S PUDDLE DAM	SPRINGFIELD	L	Poor	
VINICA POND DAM	WALES	L	Poor	
NORCROSS POND DAM #2	WALES	L	Poor	

**POOR* - Dams with major structural, operational, maintenance and flood routing capability deficiencies. Also unsafe, non-emergency dams.

** *UNSAFE* – Unsafe Dam means a dam whose condition, as determined by the Commissioner, is such that a high risk of failure exists. Among the deficiencies which would result in this determination are: excessive seepage or piping, significant erosion problems, inadequate spillway capacity and/or condition of outlet(s), and serious structural deficiencies, including movement of the structure or major cracking.

Pending dam safety legislation, approved by the Massachusetts Senate in late July of 2011 and currently in the House, would provide some important support for better managing dams. The bill proposes a Dam Repair and Removal Revolving Loan Fund that would provide low interest long-term loans and it proposes greater flexibility for municipalities to assess betterments to remove, repair, or improve dams. At the same time, however, the legislation proposes requiring emergency action plans at dams with significant hazard ratings. Currently, emergency action plans are only required at high hazard dams. According to the State Auditor's report, costs for such plans at high hazard dams have ranged from $5,000 to $25,000. While the proposed requirement for significant hazard dams is a result of public safety concerns, there will be significant costs involved in drafting such plans for the 31 significant hazard dams in the Pioneer Valley region of Hampden and Hampshire counties.

CULVERTS AND STREAM CROSSINGS

There are 2,885 culverts in the region, which are shown below. The top 5% deemed most vulnerable to extreme weather and heavy rainfall are shown in red.

Figure 7-11: Culverts for Roadway Crossings in the Pioneer Valley

OPPORTUNITIES FOR RIVER CONTINUITY AND HABITAT

Despite 44 inches of precipitation in an average year, rivers and streams have shown flow impacts from water withdrawals, impervious cover and other factors. These impacts affect human use and enjoyment of rivers as well as species habitat. Climate change including more variable precipitation may be our future. The need to manage water resources responsibly for the long term is more essential now than ever. Disputes between stakeholders over how the state allocated water have led to costly litigation, long delays and lack of certainty in water withdrawal permit decisions. In response to this, by court order, the MassDEP Water Management Act Program's "safe yield" issue was remanded back to MassDEP for a redetermination of safe yield. As a result, the Executive Office of Energy and Environmental Affairs (EEA) and its agencies finalized the Sustainable Water Management Initiative (SWMI) Framework in November 2012. The Department of Environmental Protection (MassDEP) has started the development of draft WMA regulations with a goal of promulgating final regulations by the end of 2013. While the SWMI Framework is final, experience gained from the SWMI Pilot Project (recently completed) and comments received during the regulation development process will help to inform MassDEP in its development of

regulations. As a companion piece, to provide greater clarity to the permit process, the state will develop a guide or handbook to the regulations incorporating the various SWMI elements into WMA permits.

The states of Massachusetts and Connecticut have developed stream crossing standards that include performance standards for culverts and other stream crossings to promote river health, and fish and wildlife passage. There are several on-going stream continuity restoration projects in the Pioneer Valley seeking to implement successful demonstration projects utilizing the Massachusetts Stream Crossing Standards, including:

- Bartlett Fish and Rod Company Dam Removal on Amythest Brook, Amherst, October 2012
- Bronson Brook, Worthington – culvert replacement, culvert retrofit, bank bioengineering, and woody habitat installation.
- Tower Brook, Chesterfield – culvert retrofit
- Upper Roberts Meadow Dam Removal, Northampton

Additionally, assessment monitoring by MA DEP for the Connecticut and Chicopee Rivers is scheduled for 2014. DEP may include habitat considerations in assessments.

The Conservation Assessment and Prioritization System (CAPS) computer program developed at the University of Massachusetts Amherst has mapped an Index of Ecological Integrity (IEI) for all communities in Massachusetts. The IEI delineates the relative wildlife habitat and biodiversity value of any point on the landscape based on landscape ecology principles and expert opinion. Mapped areas represent 50% of the landscape with the highest IEI values. IEI maps are available for Massachusetts towns at http://www.umass.edu/landeco/research/caps/data/iei/iei.html. CAPS is an important resource for assessing wildlife habitat relative to stream continuity.

The North Atlantic Landscape Conservation Cooperative (NALCC) provides a partnership in which private, state, tribal and federal conservation community works together to address increasing land use pressures and widespread resource threats and uncertainties amplified by rapidly changing climate. The modeling and mapping work of the NALCC was born out of the UMASS CAPS project, and will provide valuable information for prioritizing areas for conservation relative to wildlife habitat.

The Compact for Pioneer Valley Conservation is a regional collaboration between the Pioneer Valley Planning Commission, towns, and land trusts working together to more effectively conserve and steward land, and offer wetland permitting assistance to municipal Conservation Commissions. The Compact has the potential to increase the capacity of the entities involved for improved conservation and stewardship within the region.

Westfield River Invasive Species Partnership has been active since 2011 conducting inventories, assessments, removal, and education about invasive species.

STRATEGIES FOR RIVER CONTINUITY AND HABITAT

- Seek interstate funding for dam removal and increased stream connectivity.

- Implement the recommendations of the University of Massachusetts Stream Continuity Project (which include removal of non operational dams and a protocol to improve fish passage at road crossings). These are critical to developing a watershed-wide strategy for the removal of barriers to fish and wildlife movement in and along river and stream corridors.

- Identify habitat areas, wetlands, environmentally sensitive areas and geologic features, and develop plans to protect these areas through acquisition or management (priority can be given to acquiring parcels that complement existing protected lands). Data sources should include, at a minimum, BioMap 2 Core Habitat, Critical Natural Landscapes, Priority Habitat, and Living Waters; and CAPS Index of Ecological Integrity (IEI) data layers.

- Initiate watershed-wide public awareness campaign on recognition and protection of rare and endangered species and important habitat in river areas.

- Reclassify eligible headwater streams as "Outstanding Resource Waters" or "Cold Water Fisheries".

- Promote the protection of important wildlife habitats during the development of Growth Management Strategies for communities.

- Establish river protection zoning bylaws and buffer areas to better manage riverfront land and protect environmentally sensitive areas.

- Restore degraded areas of the natural environment such as the Mill River (Springfield), Bondi's Island, Chicopee River confluence and other riverfront areas

- Effect changes in hydro facilities, modifying impoundment management practices to make releases more natural toward run of river hydrographs, including by-pass reaches

- Work with willing dam owners and communities to remove non operational dams; continue to support and expand education on the value of removing dam.

- Provide assistance to local communities, as well as non-profit and volunteer groups that are interested in improving fish passage at specific locations. This could include acting as liaison between local interest groups and federal and state agencies.

- Identify, inventory, and assess barriers to fish passage, including railroad crossings, culverts, livestock fences and road crossings.

- Focus fish passage improvements in the tributaries on improving river continuity for resident and stocked fish populations.

- Encourage fish passage at hydropower plants and other dams. Evaluate the need for increased upstream and downstream fish passage for diadromous fish species (particularly on the Dwight Dam on the lower Chicopee River).

- Work with dam owners to improve flow strategies to address: 1)loss of bankfull and overbank flows in the CT River and tributaries, especially downstream of flood control dams to restore timing and magnitude of high flow events to increase floodplain inundation and restore channel processes where possible; 2) high within-day flow variability downstream of hydropower dams

(i.e. hydropeaking) to reduce within-day flow variability to improve the quality and quantity of aquatic habitat; 3) larger water withdrawals with goal of ameliorating the effects of large water withdrawals and maintaining healthy ecosystems in rivers with human induced chronic low flows.

PARKS AND OPEN SPACE

OVERVIEW OF KEY FINDINGS

Urban sprawl over the past 40 years in the Connecticut River Valley has resulted in the loss of significant amounts of farmland, forestland, and riverine habitat, while commercial and residential land uses have expanded dramatically. The region is positioned for increased growth in the future due to its prime location at the crossroads of New England and its highly developable land base. Affordability and accessibility of the Connecticut River valley give it a high potential for economic develop and rapid growth. In their 2006 report *Conserving the Heart of New England: The CT River Watershed,* The Trust for Public Land projected under current trends, 323,000 acres will be converted from rural to exurban between 2000 and 2020.

Only 11% of prime farmed soils and 16% of other farmland are currently protected. More than a quarter of the farmland in the Connecticut River watershed was lost between 1982 and 2002. Although only 11% of the landscape is developed for commercial or residential purposes, this number increased by 31 percent from 1982 to 1997. Nearly 80% of the Connecticut River watershed is forested, with roughly 31% permanently protected from development. The U.S. Forest Service ranked portions of the watershed among the top 20 areas in nation with high development threats.

Given the state of the open space in the Connecticut River watershed, we evaluated the accessibility of open space and parks to residents. The plan also reviewed on-going regional landscape scale conservation initiatives in the region and how their conservation priorities overlapped in support of developing a regional greenway network. Additionally, accessibility to parks and open space was evaluated relative to the Environmental Justice areas in the Pioneer Valley and found that only 5.8% of protected open space and parks in Hampshire and Hampden counties are within Environmental Justice areas.

PARKS AND OPEN SPACE ACCESSIBILITY ANALYSIS

PVPC developed an inventory of publicly accessible parks and open space in the Pioneer Valley region utilizing the MassGIS Protected Recreation and Open Space datalayer, and incorporated community feedback. Schools were superimposed on this layer due to the fact that most schools have playgrounds and/or open fields available for community use during after school hours. Parks are classified based on size (acreage) following standards developed by the National Recreation and Parks Association (NRPA):

- Pocket Park – Less than 1 acre
- Neighborhood Park – 1-5 acres
- Community Park – 6-100 acres
- Regional Park – 100+ acres

A designated "service area" for each park based on walking distance, also following NRPA standards, was mapped. The service areas for each type of park are as follows:

- Pocket Park Service Area – 5-10 minute walk (.25 miles)
- Neighborhood Park Service Area – 10-15 minute walk (.5 miles)
- Community Park Service Area – 15-20 minute walk (1 mile)
- Regional Park Service Area – 20+ minute walk (2 miles)

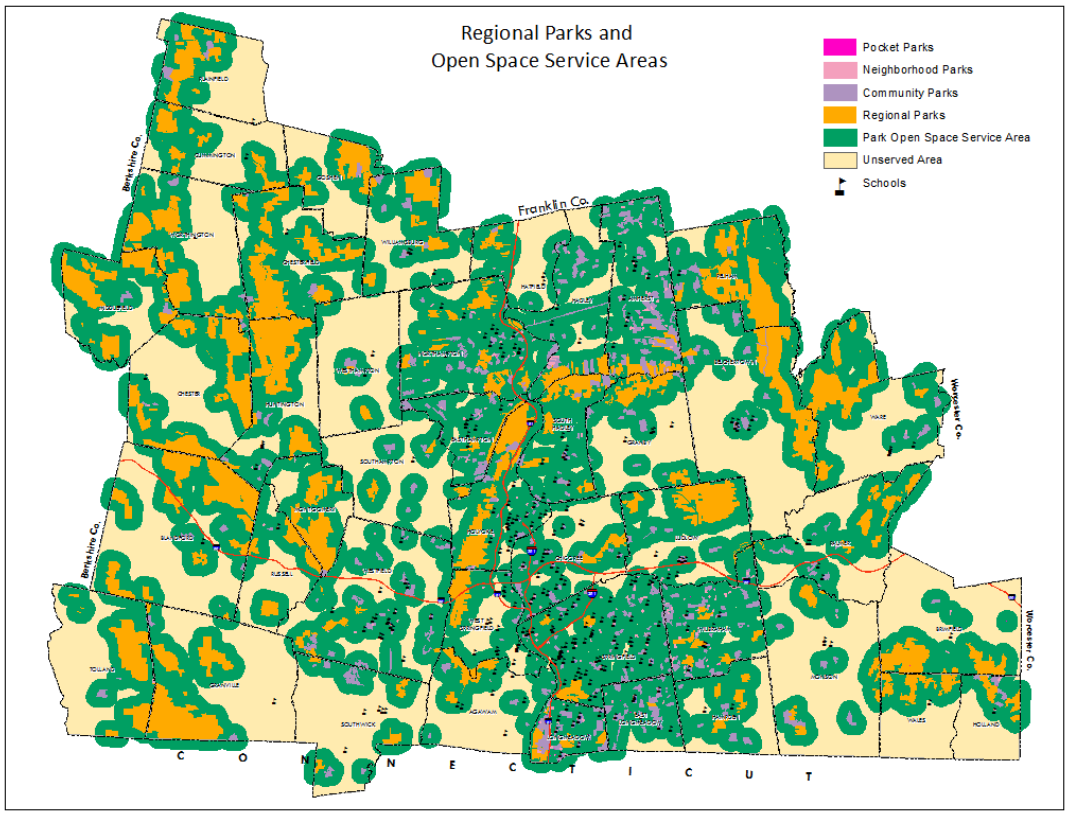


Table 7. Park and Open Space Analysis (Hampshire and Hampden Counties)

	Park/Open Space Acreage	% of Total Acreage
Pocket Parks	50	0.006%
Neighborhood Parks	640	0.08%
Community Parks	14,229	1.9%
Regional Parks	99,763.0	13.2%
Total Protected Park/Open Space Acres	114,682	15.2%
Environmental Justice	43,743.6	5.8%
Total Region Acres	754,769.4	100%

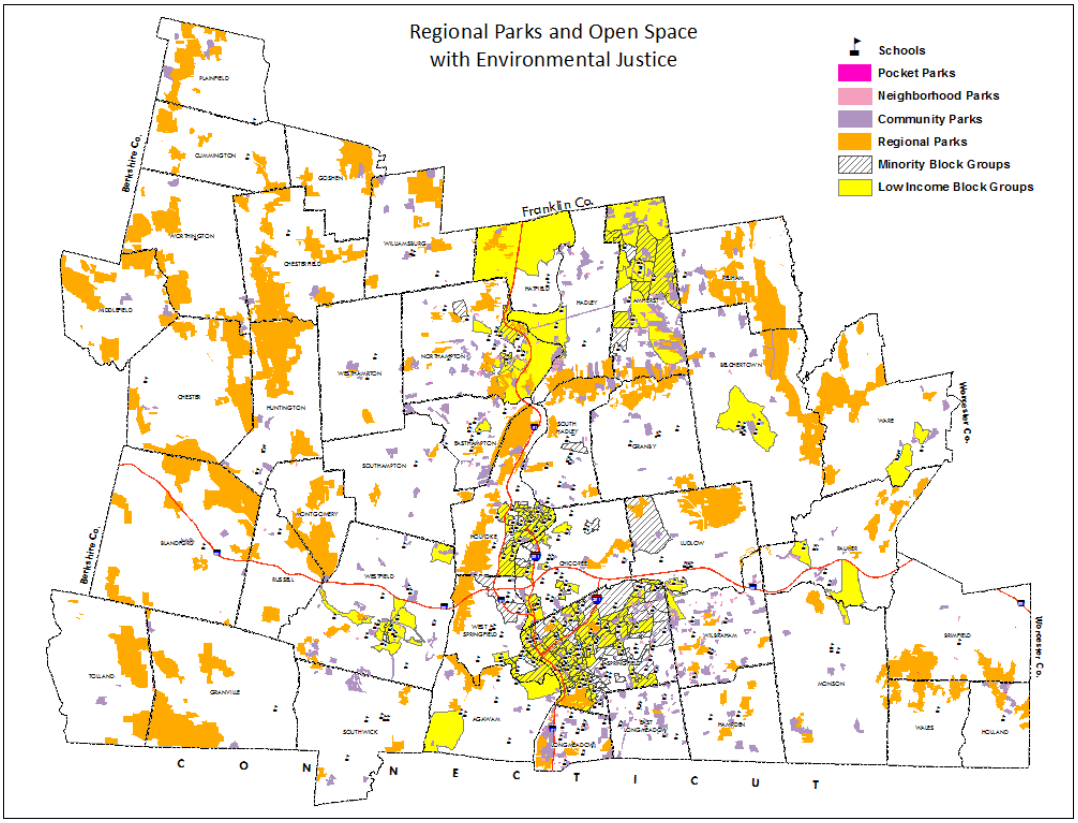
PARK AND OPEN SPACE ACCESSIBILITY RELATIVE TO ENVIRONMENTAL JUSTICE COMMUNITIES

PVPC has accepted the definitions of "minority" and "low-income" geographic areas developed by the Pioneer Valley Metropolitan Planning Organization (PVMPO) and approved by FHWA as the Pioneer Valley regional definition of Environmental Justice (EJ). The full method and application is described in the PVMPO Regional Transportation Plan 2011 (http://www.pvpc.org/activities/transportation-rtp.shtml).

The PVMPO method defines "minority" as "the population that is not identified by the census as White-Non-Hispanic" in the 2010 US Census. The racial or ethnic groups included are:

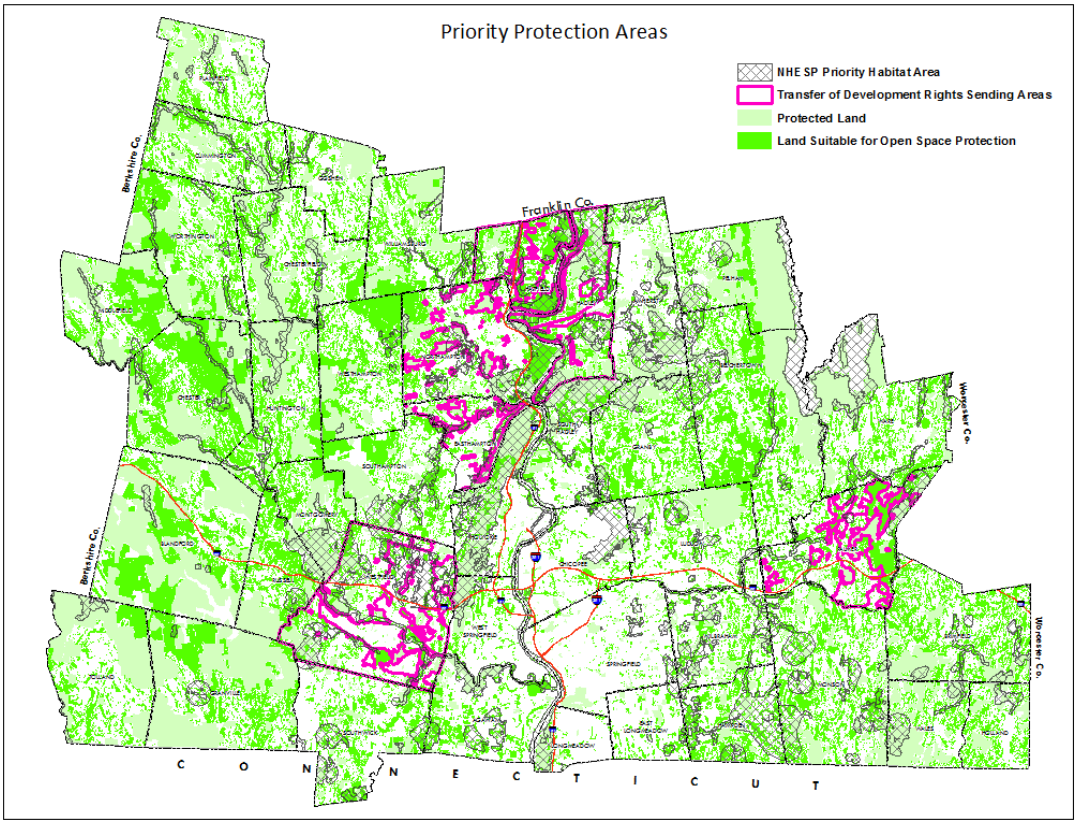
- White Non-Hispanic
- African-American or Black
- Hispanic or Latino (of any race)
- Asian (including Native Hawaiian, & other)
- American Indian (& Alaska Native)
- Some other race
- Two or More Races.

Of the PVMPO region's 621,570 residents (US Census 2010), 23.48 percent meet this definition of minority. Applied to the census block groups in the region, there are 163 block groups with a minority population greater than the regional average (23.48), or 4.5% of regional acreage.

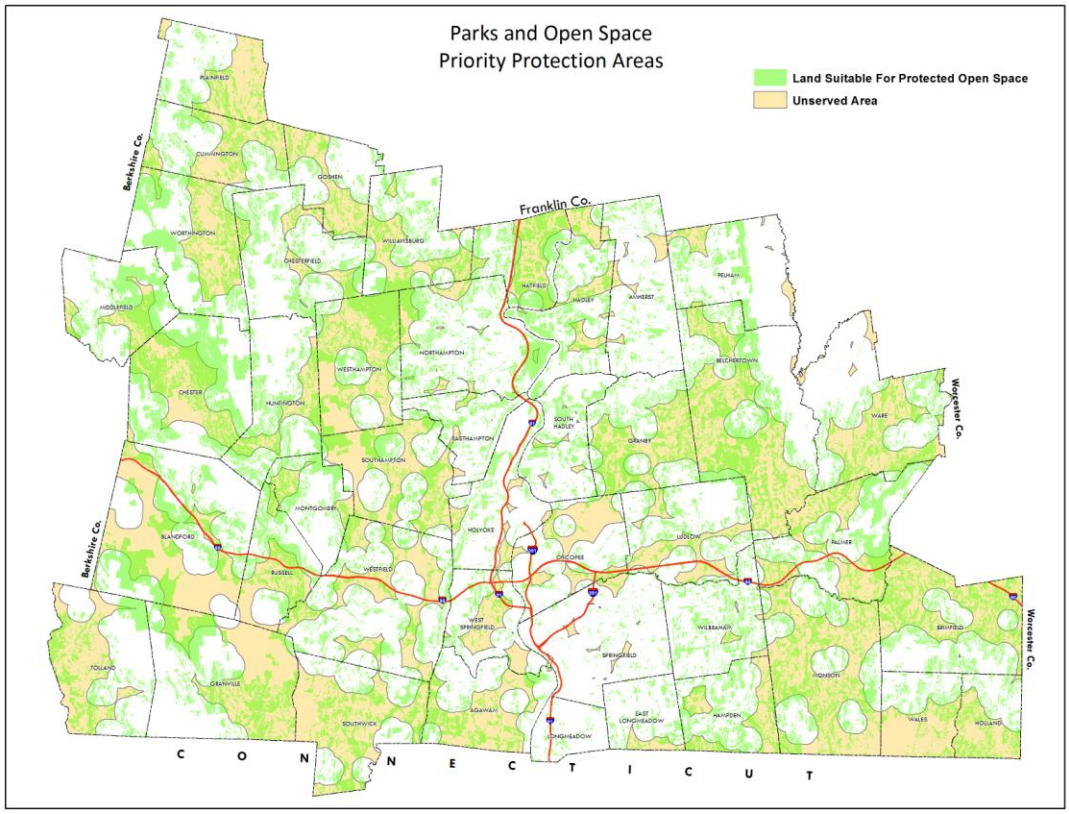


PRIOTITY PROTECTION AREAS

The Pioneer Valley Regional Land Use Plan Valley Vision identifies Priority Protection Areas for the region as Land Suitable for Open Space Protection. MassGIS natural resource datalayers used to map this layer include: watersheds for public water supplies reservoirs and Zone II aquifer recharge areas, 100-year flood plains, wetlands and 100' buffer zones, steep slopes over 15%, and active farmland. Existing developed land and permanently protected land were then extracted from the natural resource datalayer. The remaining land is identified as "land suitable for open space protection" totaling 235,908 acres in the Pioneer Valley.



Land suitable for open space protection was overlaid with the parks and open space underserved areas mapped in yellow in the Regional Park and Open Space map above. The combination of these two layers illustrates a prioritization for protection of important natural resource areas with those areas underserved by public accessible parks and open space.



HAMPDEN COUNTY FARMLAND MAPPING ANALYSIS

PVPC in partnership with New Entry Sustainable Farming Project, a Lowell based non-profit farm support organization, and Agricultural Commissions in Hampden County, Massachusetts, are working to identify and help increase the productive use of available farmland throughout the County. Using GIS aerial photography mapping, New Entry has identified vacant or underutilized farmland parcels in each community that may be of interest to farmers looking for land. Community maps have been distributed to Agricultural Commissions for review and comment to develop a detailed agricultural land inventory for each town. PVPC will continue to be involved in this project to facilitate productive use of active farmland in Hampden County.

Hampden County Totals

	Town ID	Total # of parcels of agricultural land NOT in Ag land use	Total acres of potential agricultural land NOT in Ag land use	Total # of Agricultural parcels (potential and existing)	Total acres of agricultural land (potential and existing)
Agawam	5	61	263.27609	172	1600.4044
Blandford	33	11	39.32454	72	561.82679
Brimfield	43	27	98.65645	121	763.73065
Chester	59	20	64.31363	58	388.74263
Chicopee	61	3	68.5377	8	86.0829
East Longmeadow	85	31	109.29278	77	440.41281
Granville	112	32	123.98707	116	721.3867
Hampden	120	36	122.31308	95	612.80564
Holland	159	5	13.12221	17	106.27711
Holyoke					
Longmeadow	159	3	7.00534	16	170.15975
Ludlow	161	39	115.12013	113	658.25491
Monson	191	41	157.72567	134	1011.86003
Montgomery	194	9	26.79687	36	203.59423
Palmer	227	51	253.75498	106	768.1547
Russell	256	4	10.22266	13	67.46571
Southwick	279	72	328.87607	292	2799.15944
Springfield					
tolland	297	4	20.52887	6	34.11151
Wales	306	4	21.21363	17	156.29803
West Springfield	325	19	79.64446	33	162.62092
Westfield	329	128	514.29336	330	2941.92096
Wilbraham	339	55	192.51307	101	659.98644

REGIONAL LANDSCAPE CONSERVATION INITIATIVES

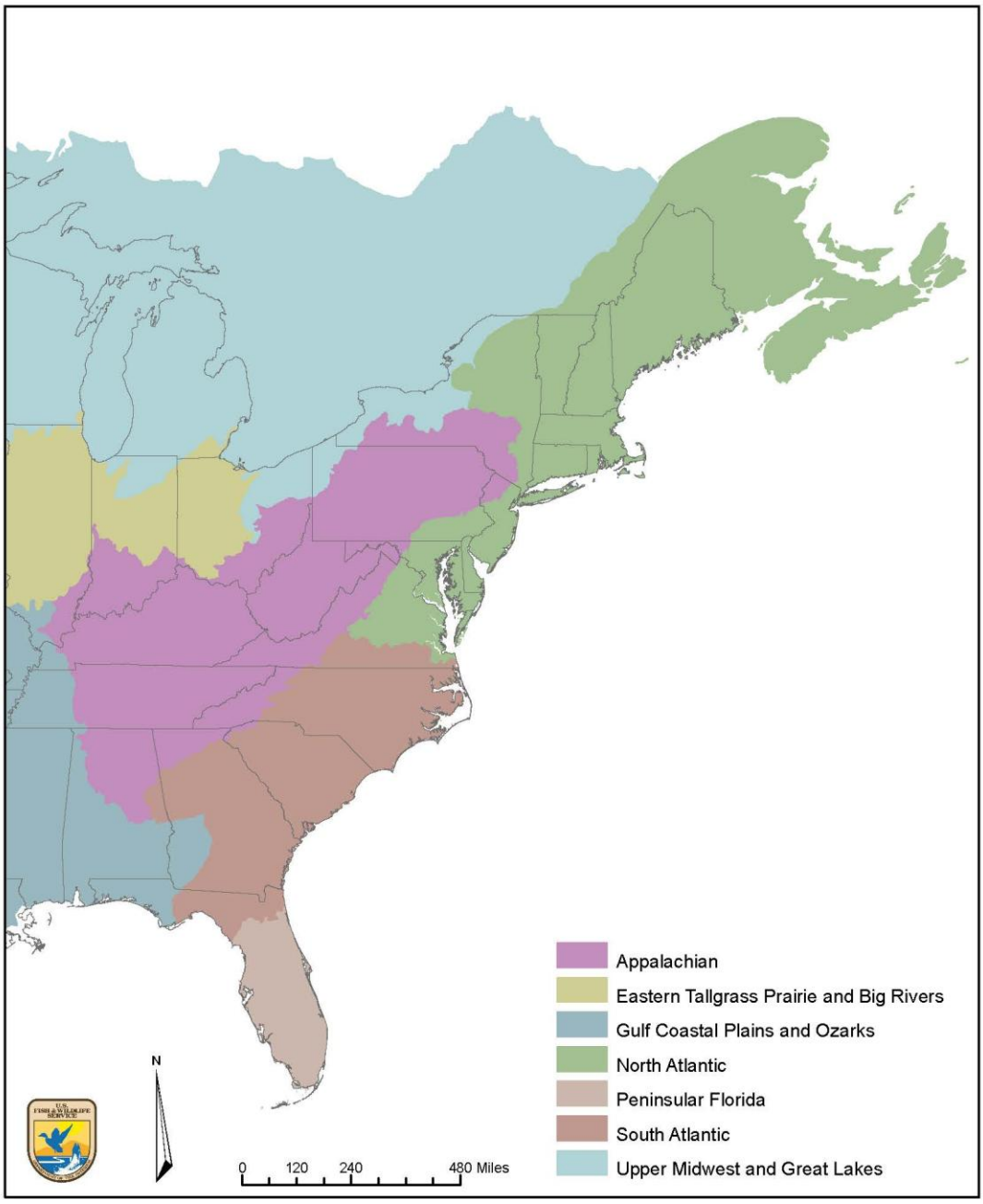
There are several sub-regional landscape scale conservation initiatives underway in the Pioneer Valley. An understanding of these initiatives is important as it serves to identify overlapping landscape priorities and potential partners for land conservation and park and recreation projects. The target areas of these partnerships are indentified herein as key resources for advancing landscape scale conservation in our region. Political boundaries are irrelevant to plant and animal communities, and to ecosystem processes. Ecologists increasingly understand the importance of landscape connectivity -- contiguous and connected forested areas that allow species to migrate, interbreed, and shift their ranges in response to changes in the environment -- to the health and sustainability of our ecosystems, and ultimately our planet. It is increasingly important that conservation groups work together to conserve land in a way that is meaningful on a larger, regional scale, and to tap into resources that are not available to organizations working alone.

THE NORTH ATLANTIC LANDSCAPE CONSERVATION COOPERATIVE (NALCC)

The North Atlantic Landscape Conservation Cooperative (LCC) provides a partnership in which private, state, tribal and federal conservation community works together to address increasing land use pressures and widespread resource threats and uncertainties amplified by rapidly changing climate.

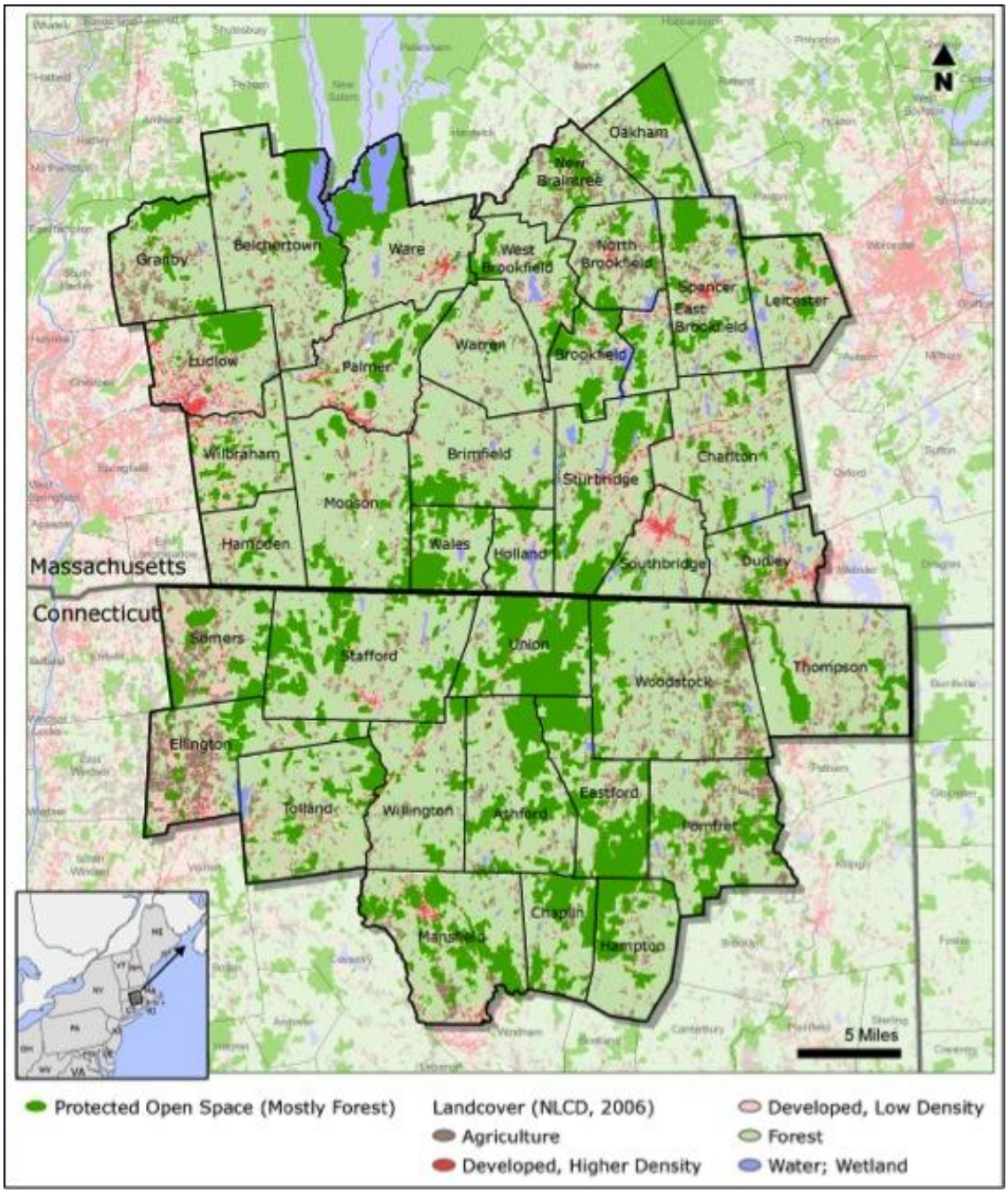
The Conservation Assessment and Prioritization System (CAPS) computer program developed at the University of Massachusetts Amherst has mapped an Index of Ecological Integrity (IEI) for all communities in Massachusetts. The IEI delineates the relative wildlife habitat and biodiversity value of any point on the landscape based on landscape ecology principles and expert opinion. Mapped areas represent 50% of the landscape with the highest IEI values. IEI maps are available for Massachusetts towns at http://www.umass.edu/landeco/research/caps/data/iei/iei.html CAPS was the first coarse data filter used in building the NALCC models.

Landscape Conservation Cooperatives in the Eastern U.S. & Canada



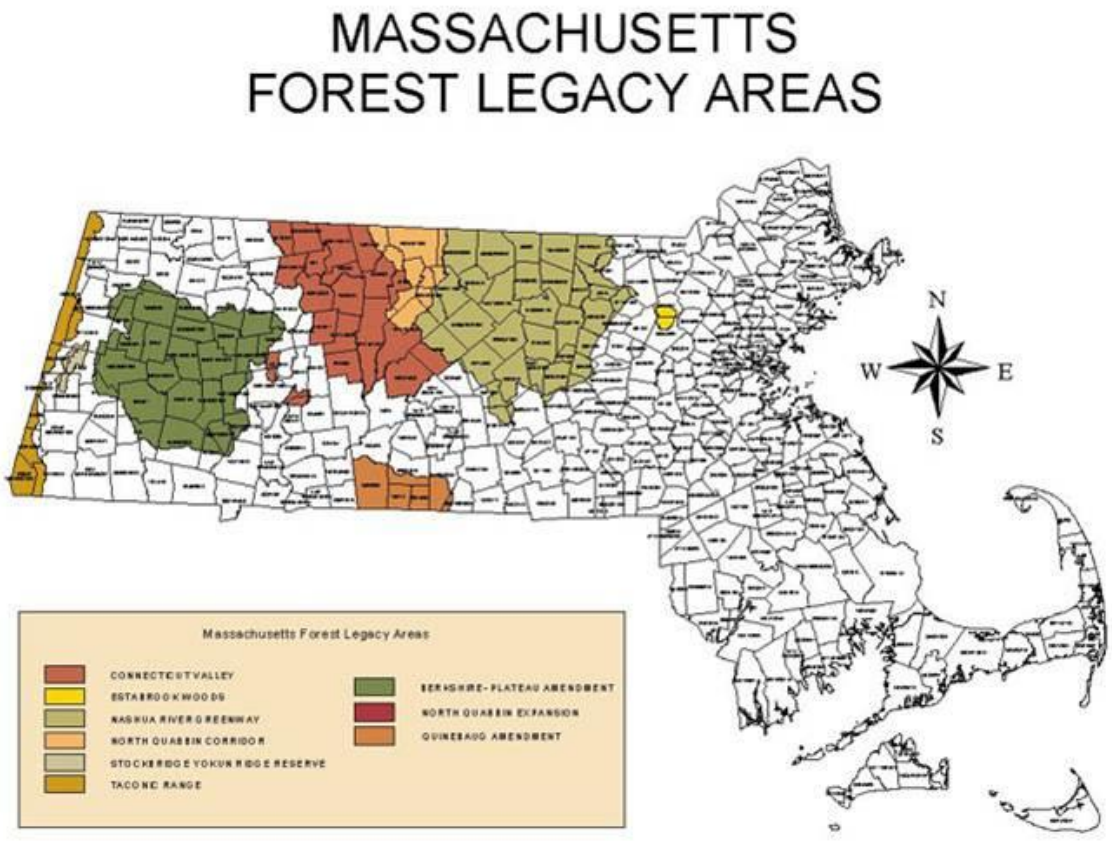
MASSCONN SUSTAINABLE FOREST PARTNERSHIP

The MassConn Sustainable Forest Partnership is a voluntary association of land trusts, conservation organizations, state agencies, and foresters serving a region of 35 towns spanning the border of South-Central Massachusetts and Northeastern Connecticut. Member groups identify key areas of the region for conservation, collaborate on land protection efforts, promote sustainable forestry practices, and organize public outreach and education efforts in order to increase the pace and efficacy of conservation in the MassConn area.



The MassConn Sustainable Forest Partnership is seeking to designate a new Forest Legacy Area in Massachusetts called the Heritage Corridor Forest Legacy Area totaling 421,100 acres. If the designation is successful, it would connect the following already designated Forest Legacy areas enabling the opportunity for greater funding resources for land protection in these areas: North Quabbin Corridor, Nashua River Greenway, Connecticut Valley Western Valley, Connecticut Valley Holyoke Range; and the Eastern Mainland Forest Legacy Areas in central Connecticut.

The Forest Legacy Program (FLP) is a Federal program in partnership with States to support State efforts to protect environmentally sensitive forest lands. Designed to encourage the protection of privately owned forest lands, FLP is an entirely voluntary program. To maximize the public benefits it achieves, the program focuses on the acquisition of partial interests in privately owned forest lands. FLP helps the States develop and carry out their forest conservation plans. It encourages and supports acquisition of conservation easements, legally binding agreements transferring a negotiated set of property rights from one party to another, without removing the property from private ownership. Most FLP conservation easements restrict development, require sustainable forestry practices, and protect other values.



SILVIO O. CONTE NATIONAL FISH AND WILDLIFE REFUGE

Silvio O. Conte National Fish and Wildlife Refuge was established to conserve the abundance and diversity of native plants and animals and their habitats in the 7.2 million acre Connecticut River watershed in Connecticut, Massachusetts, New Hampshire and Vermont. A Comprehensive Conservation Plan and Environmental Impact Statement is currently under development that will include management alternatives, proposed vision and management goals.

COMPACT FOR PIONEER VALLEY CONSERVATION

The Compact for Pioneer Valley Conservation has been established as a non-profit service bureau to assist local land trusts and municipal Conservation Commissions and Open Space Committees in the Pioneer Valley region for the following purposes:

- To conserve land in the Pioneer Valley region, including important natural resource areas, farmlands, scenic areas, and water resource areas;

- Provide technical assistance in land conservation work, including but not limited to conducting baseline studies, holding and monitoring Conservation Restrictions, grant writing and mapping; and,
- To provide technical assistance to municipal Conservation Commissions, and other municipal boards/departments, in wetlands protection and land conservation work, including but not limited to wetland permitting and plan review, and site inspections.

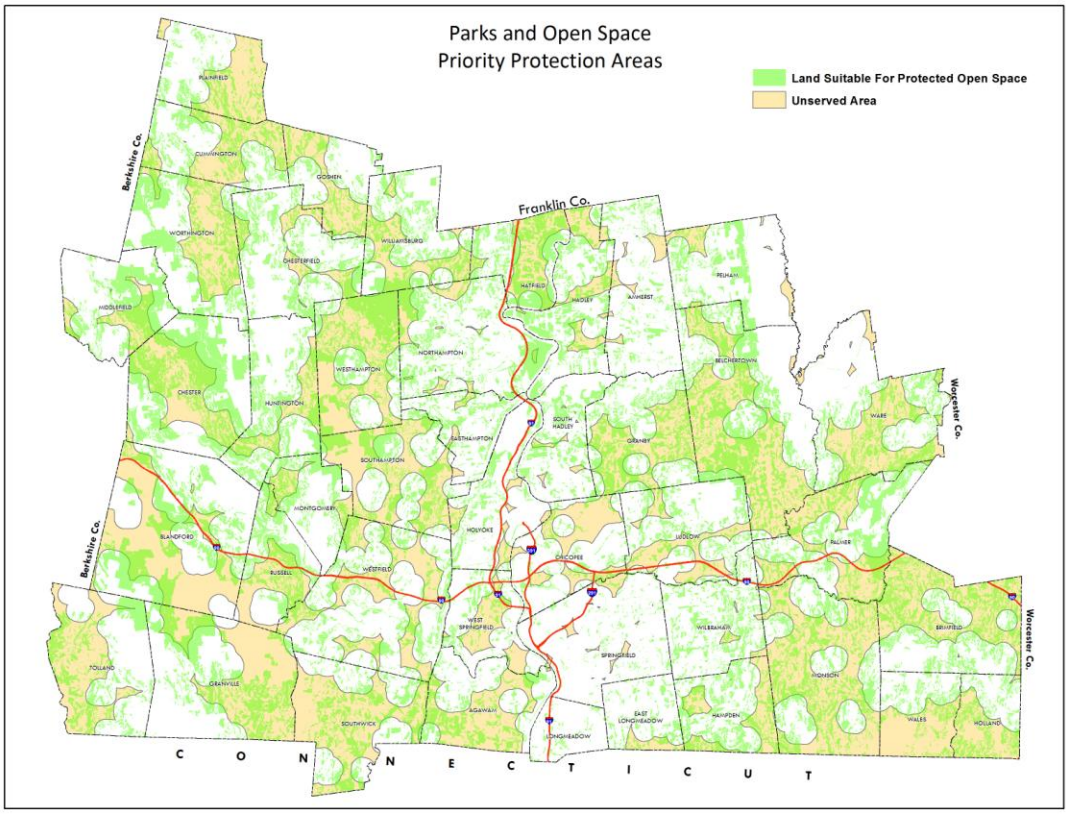
The Compact was formed through a Memorandum of Agreement (MOA) between Land Trusts and Municipalities of the Pioneer Valley region, and the Pioneer Valley Regional Ventures Center, Inc., (PVRVC) the 501C3 non-profit arm of the Pioneer Valley Planning Commission. The following entities have signed on to the Compact: PVRVC, Minnechaug Land Trust, Opacum Land Trust, Winding River Land Conservancy, and the Towns of Hatfield and Southampton.

Per the MOA, members will pay annual dues of $1,500 which will entitle them to 20 hours of service. Beyond the 20 hours of service, an hourly rate for additional service will be set annually based on the amount of grant funds leveraged for the fiscal year to offset the hourly rate. Annual dues will not be assessed until FY14. For FY13, PVPC has received a Community Innovation Challenge (CIC) Grant from the MA Department of Finance and Administration to enable the startup of this program and provide service to each Compact member in FY13. The Pioneer Valley Regional Conservation Agent Program currently has room for additional members.

PARKS AND OPEN SPACE OPPORTUNITIES

PRIORITY PROTECTION AREAS

The map below illustrates the relationship between land Suitable for Open Space Protection and areas identified as Underserved for accessibility to parks and open space. Areas overlapping in these two criteria are identified as Priority Protection Areas.



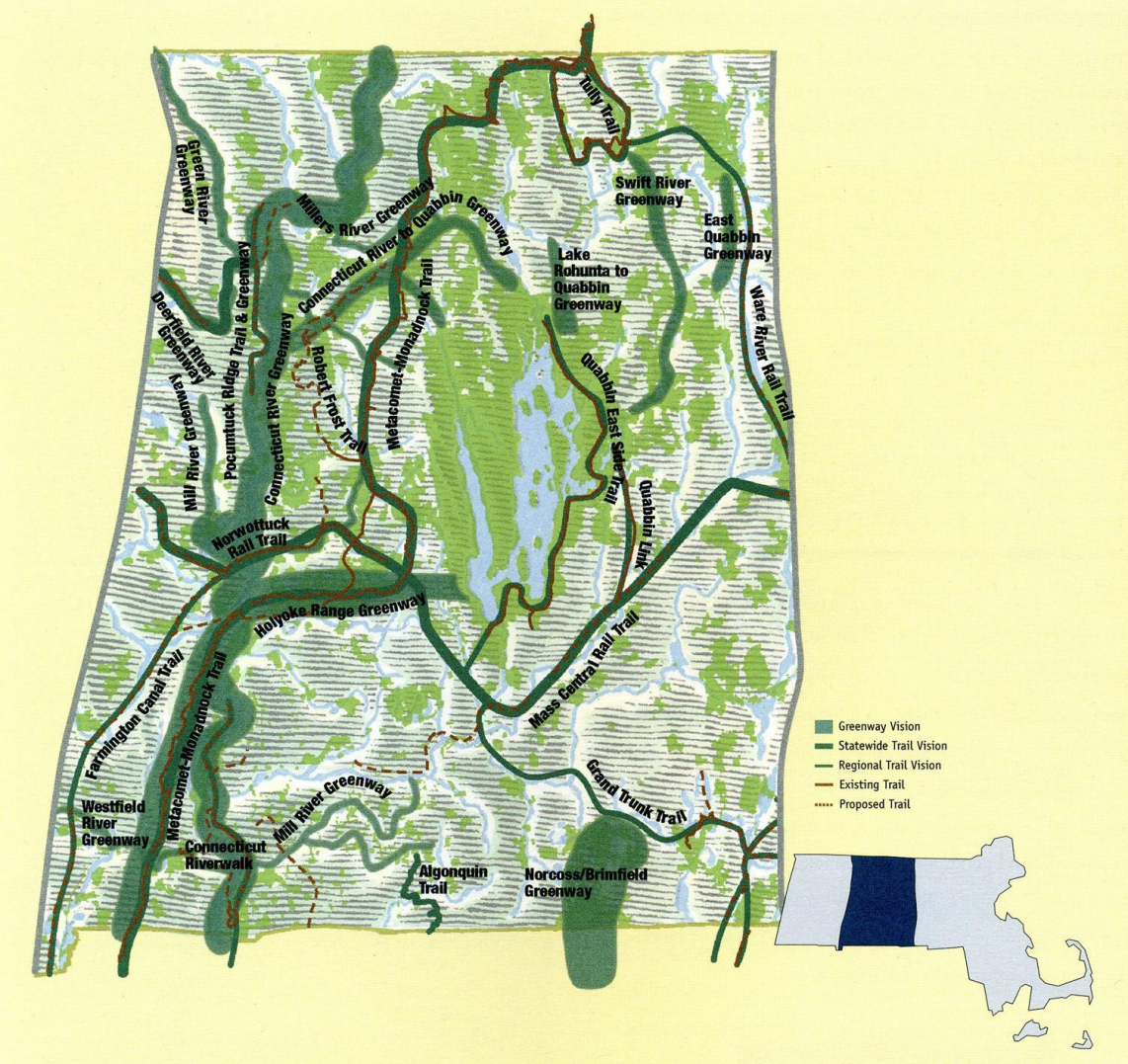
REGIONAL TRAILS AND GREENWAYS

Major regional trail initiatives provide critically important opportunities for recreation and alternative forms of transportation. These initiatives also help to galvanize local and regional land protection efforts toward a common purpose. There are two types of regional trail initiatives: long-distance unpaved trails that pass through scenic protected lands and paved trails located on abandoned railroad beds and utility corridors. As part of a greenways visioning effort in 2002, the Massachusetts Department of Environmental Management, Appalachian Mountain Club, and National Park Service, in consultation with many individuals and organizations across the state in 2002, identified several priorities for the region, including two specifically related to trails:[15]

- Protect and secure long-distance trails as spines of a regional trails network
- Support the creation of a regional rail-trail network as part of the cross-state trail

The map below illustrates DCR's (formerly DEM) Greenway vision for the Connecticut River valley region of Massachusetts.

[15] See: "Commonwealth Connections: A Greenway Vision for Massachusetts," Department of Environmental Management, 2002.



PROTECT AND SECURE LONG-DISTANCE TRAILS AS SPINES OF A REGIONAL TRAILS NETWORK

THE NEW ENGLAND NATIONAL SCENIC TRAIL/ METACOMET-MONADNOCK (M&M) TRAIL

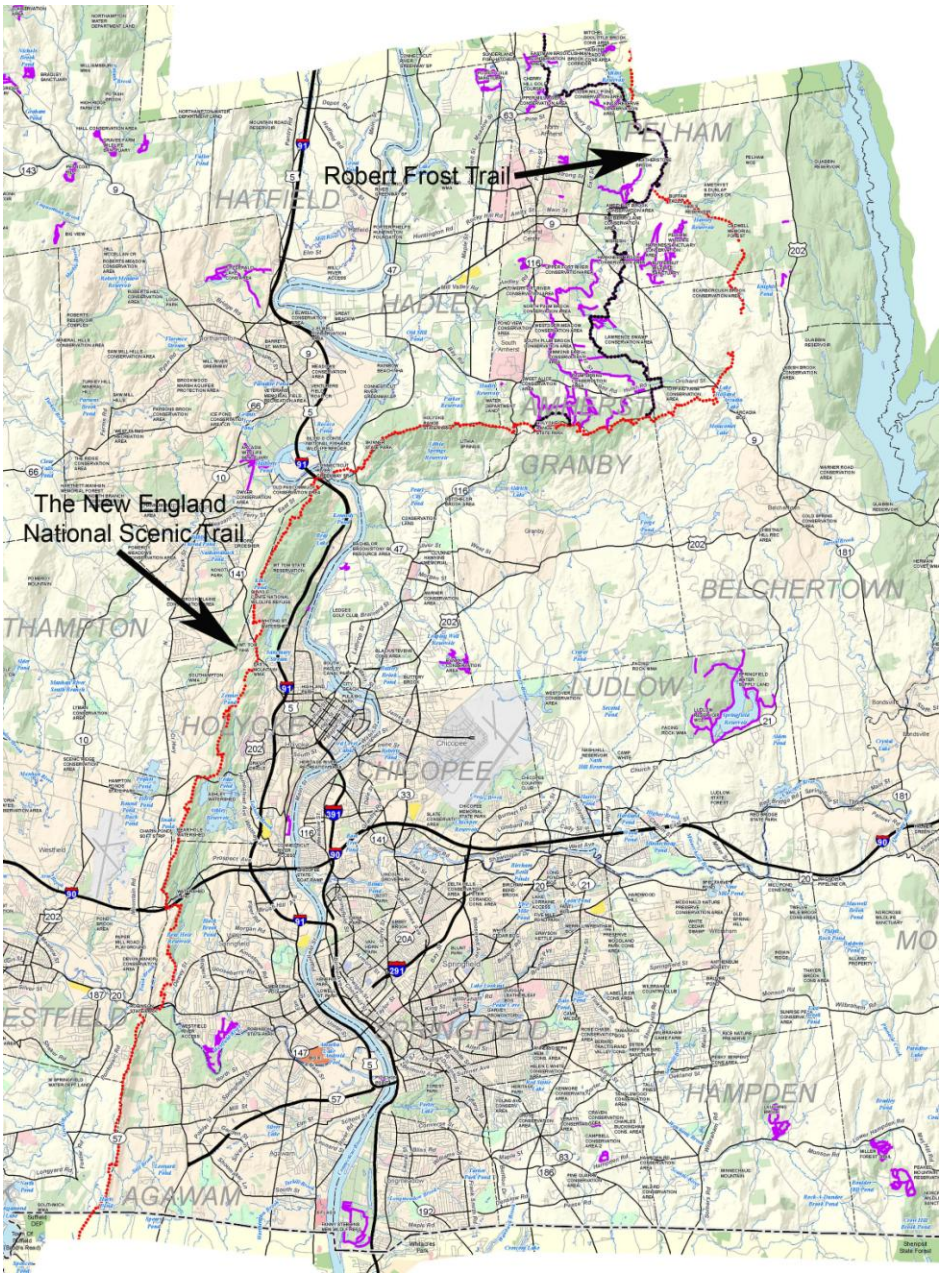
In 2009, the historic Metacomet-Monadnock (M&M) Trail received a tremendous boost in public profile when it was joined with the Mattabesett Trail in Connecticut and officially designated by the National Park Service as The New England National Scenic Trail. Stretching 215 miles now from Long Island Sound in Guilford, Connecticut, to Mount Monadnock in New Hampshire, the trail showcases classic New England landscapes…long distance vistas with rural towns as a backdrop, agrarian lands, un-fragmented forests, and large river valleys."[16] Since the designation, the Appalachian Mountain Club and Massachusetts DCR have been at work to reroute parts of the trail in Massachusetts from privately

[16] http://www.newenglandnst.org/

owned lands to public lands at the Quabbin Reservoir. Advocates continue to work on land protection and easements to fully connect this trail system and to establish campsites for hikers.

ROBERT FROST TRAIL

The 47-mile Robert Frost Trail is another important resource for the region. Completed in 2004, the trail winds east from its start near Route 47 at the Hadley/South Hadley town line and then north to the Wendell State Forest. While the trail passes through some 10 towns, the Amherst Conservation Department and the Amherst Area Trails Committee have spearheaded much of the land protection and trial maintenance work to date.



SUPPORT THE CREATION OF A REGIONAL RAIL-TRAIL NETWORK AS PART OF THE CROSS-STATE TRAIL

In support of development of a stronger regional network of trails in the Pioneer Valley, the Pioneer Valley Regional Trails Coalition formed in late 2012. The group is currently identifying specific goals and strategies for the coalition to focus on to address gaps in resources, technical assistance, and stewardship not currently met by existing state, federal, non-profit, and local trail advocacy organizations.

There are three significant ongoing rail-trail efforts in the region that involve many years of work from regional partners and many local champions doing on-the-ground work. These three corridors are among seven identified as state-wide priorities within MassDOT's "Baystate Greenway Plan."

MASS CENTRAL RAIL TRAIL

Involving the work of 24 communities, the Mass Central Rail Trail will stretch from Boston to Northampton. Ultimately the vision is for the trail to extend all the way to the New York state line. Locally known as the Norwottuck Rail Trail, the trail occupies the rail route built in 1887 by the Central Massachusetts Railroad Company to connect Boston and Northampton. In the Pioneer Valley Region, the trail is currently in place from Northampton, through Hadley and Amherst, and into Belchertown. The oldest segments constructed in 1993 through Northampton, Hadley and Amherst, will be undergoing reconstruction in 2013 at a cost of $4.5 million. In Belchertown, easements in the northern section need to be renegotiated (or alternative route identified) and the Town and Belchertown Land Trust have secured ownership of the trail along one segment of the southern section. In Palmer segments of the rail corridor are still actively used by the MassCentral Railroad to store rail cars. In Ware the project faces several challenges that involve the right of way, environmental constraints, and structural design issues. While 25 percent design plans have been completed for the northern trail segment to Hardwick, right of way issues remain unresolved. Meanwhile the Town of Ware is moving forward with work on the southern segment thanks to support from the private sector. Officials are working to identify funding to install two bridges that would complete the first segment of the Ware River Rail Trail.

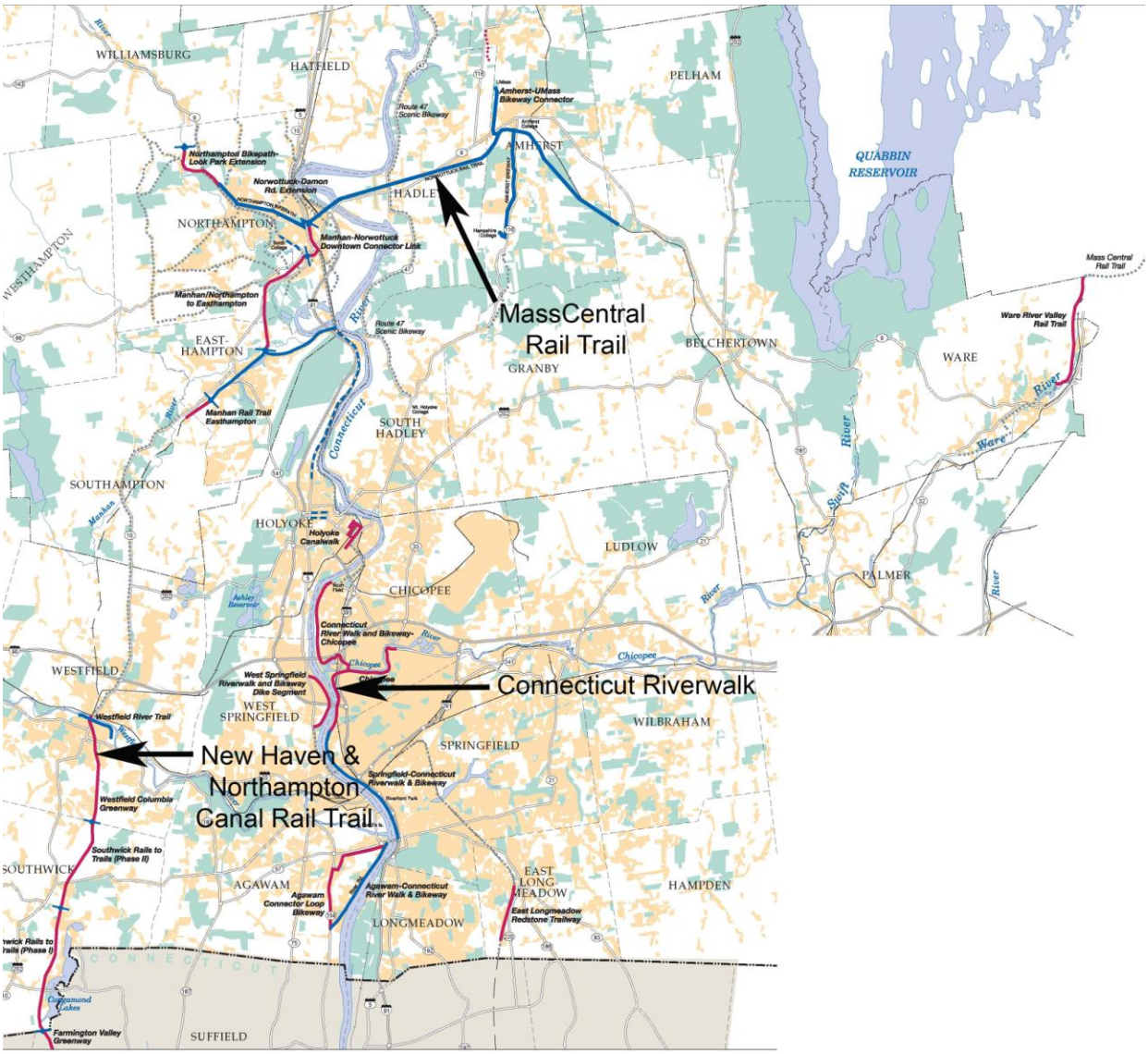
NEW HAVEN & NORTHAMPTON CANAL RAIL TRAIL

Known locally by many names locally—including the Manhan Rail Trail in Northampton and Easthampton, Westfield Columbia Greenway in Westfield, Southwick Rail Trail in Southwick, and Farmington Canal Trail in much of Connecticut—this rail trail will extend 84 miles from New Haven to Northampton when completed. Sections in Southwick, Easthampton, and Northampton have been completed. Westfield has completed the most southern section that connects to Southwick and is making progress toward constructing sections that will connect to Southampton. In Southampton, a small section near the Easthampton line has been completed, and the next 3 mile section to the south will be secured through a grant just awarded through the state's LAND grant program.

CONNECTICUT RIVERWALK AND BIKEWAY

The Connecticut Riverwalk and Bikeway is a series of paved multi-use recreational pathways along the Connecticut River in Agawam, Chicopee, and Springfield. There are proposed Riverwalk segments with design plans completed or ongoing designs including:

- Agawam – Agawam Bikeway Loop
- West Springfield – Connecticut Riverwalk
- Chicopee – Chicopee Riverwalk
- Chicopee – Connecticut Riverwalk


MassCentral Rail Trail
Connecticut Riverwalk
New Haven & Northampton Canal Rail Trail
WILLIAMSBURG
HATFIELD
PELHAM
AMHERST
QUABBIN RESERVOIR
NORTHAMPTON
HADLEY
EAST-HAMPTON
GRANBY
BELCHERTOWN
WARE
SOUTH HADLEY
SOUTHAMPTON
HOLYOKE
LUDLOW
PALMER
CHICOPEE
WESTFIELD
WEST SPRINGFIELD
WILBRAHAM
SPRINGFIELD
SOUTHWICK
AGAWAM
EAST LONGMEADOW
HAMPDEN
LONGMEADOW
SUFFIELD
Connecticut
Chicopee
Ware River
Swift River
Manhan
Westfield River
Mass Central Rail Trail
Ware River Valley Rail Trail
Amherst-UMass Bikeway Connector
Route 47 Scenic Bikeway
Northampton Bikepath-Look Park Extension
Norwottuck-Damon Rd. Extension
Manhan-Norwottuck Downtown Connector Link
Manhan/Northampton to Easthampton
Manhan Rail Trail Easthampton
Holyoke Canalwalk
Ashley Reservoir
Connecticut River Walk and Bikeway-Chicopee
West Springfield Riverwalk and Bikeway Dike Segment
Springfield-Connecticut Riverwalk & Bikeway
Agawam-Connecticut River Walk & Bikeway
Agawam Connector Loop Bikeway
East Longmeadow Redstone Trailway
Westfield River Trail
Westfield Columbia Greenway
Southwick Rails to Trails (Phase II)
Congamond Lakes
Farmington Valley Greenway

PARKS AND OPEN SPACE STRATEGIES

- Seek targeted state, federal, and local funding for protection of working lands, water resource lands, wildlife habitat and farmlands in the watershed through new legislation and existing programs such as the Forest Legacy Program, and the Land and Water Conservation Fund.
- Collaborate to seek large federal grants on bi-state basis for land protection (i.e., scenic byways), and for smart growth/sustainability (i.e., HUD/DOT Sustainable Communities)
- Create a Connecticut River greenway system of trails and parks throughout the region and between Hartford and Springfield.
- Expand the Compact for Pioneer Valley Conservation, and seek funding to support the program's land protection and stewardship mission.
- Promote a strong agricultural economy in the four-state valley and the state of Connecticut.
- Develop a bi-state "river corridor management plan" to preserve natural, scenic and historic resources, using GIS analysis to assess natural resources and land use impacts. Review zoning, open space plans, and master plans to assess if they are in conflict with river protection goals, and to ensure that growth is directed to existing urban and growth centers.
- Identify and promote selected riverfront sites as tourist destination points and locations for water-oriented commercial and recreational development that will attract people to the riverfront (restaurants, crafts center, recreational business, and housing). Ensure that public access to riverfront walkways and green space is integral to all of these plans.
- Employ screening and other tools to improve aesthetics of existing unattractive riverfront uses, such as power plants, landfills, wastewater treatment plants, railroad storage, and highways.

VIBRANT HUMAN-RIVEFRONT CONNECTIONS

OVERVIEW OF KEY FINDINGS

The Connecticut River has been cleaned up considerably over the past two decades and is now far more attractive for recreation. In many areas, however, the river has been fenced by highways, railroads and incompatible commercial development, which has reduced opportunities for public access. Some areas of the river are heavily used for recreation, while other areas are neglected. Communities need to reconnect with the river, and find ways to bring people back to the river. To reverse the longstanding cycle of riverfront neglect and abandonment, and to bring urban riverfront areas to life, it is critical to invest in riverfronts, and find ways to bring people back to the river. Flood control dikes, highways and railroad track along the Connecticut River have been imposing barriers to public access and recreation. However, these barriers have also kept open large sections of riverfront land which otherwise would have been developed.

The River is heavily used for recreational activities. Recreational use on upper Connecticut River in MA (above the Holyoke Dam)was estimated to be 130,000 recreation days in 1996. Most popular uses include motor boating (39%); boat fishing (26%); fish viewing (11%); camping (9%); picnicking and sightseeing (7%); non-motorized boating (1.7%). The majority of recreational use occurs on weekends. (Recreational use of CT River in MA above the Holyoke Dam, 2000, Louis Berger Group, Inc)

In addition to the abundant recreational use of the river, it also provides important habitat for over thirty state or federally listed endangered species including the Dwarf Wedge Mussel and the Puritan Tiger Beetle. The need to balance recreational use with the protection of wildlife and sensitive habitats is critical. High use can result in the introduction of invasive species from improperly cleaned boats. Boat wakes can contribute to streambank erosion as well as have impacts on wildlife, such as rare dragonflies and other insects that emerge from the riverbank. (UMASS, 2002)

LAND USE AND DEVELOPMENT PATTERNS

The watershed is home to nearly 100,000 people with land use characterized by 7% agricultural, 12% developed and 82% undeveloped with roughly 27% of all land permanently protected as open space. The watershed is divided into distinctly rural and urban communities. The upper reaches of the watershed are primarily rural communities distinguished by unfragmented forests and scattered with agricultural, seasonal, and home-based businesses. The communities of Westfield, Agawam, West Springfield, and Holyoke in the lower (southeastern) basin are urbanized with the greatest job opportunities. The rural and suburban communities surrounding the region's job center are experiencing the most significant growth. Population growth in the top seven fastest growing watershed communities from 1990 to 2004 ranged from just under 40% in Middlefield to 20% in Becket.

Population of watershed not increasing in proportion to pace of development. Land is being used often without reference to any plan. Over the past 30 years, sprawl has become the dominant force affecting land use change. From 1971 to 1999, the communities of Westfield and Agawam have experienced the greatest loss of cropland in the entire Pioneer Valley, losing nearly 2,400 acres. In that same time period, the communities with the greatest increase in commercial development were: Holyoke, Westfield, West Springfield, and Agawam.

In an attempt to create passable roadway in areas where road closely follows river corridor, town highway departments often resort to clearing vegetation to open the roadway to sunlight and to allow space for snow removal. One result of clearing is reduction of shade to the watercourse, downgrading the wildlife habitat quality and increasing water temperatures. Another result is a reduction of natural erosion control the vegetation offers protecting the waterway from sediments and contaminants flowing from the roadway.

Winter maintenance also usually results in the heavy use of salt and sand which is applied to keep road surface clear and/or passable. Road surface condition and shape is a major influence on the ease of maintenance of the surface year round. Poor road drainage and subgrade drainage can result in uneven road surfaces. These types of conditions result in increased maintenance efforts and the likelihood of generating some type of negative contamination to the Riverfront area.

Most stormwater on roads is handled by culverts or culverts with drop inlet structures. Drop inlet structures are typically concrete structures with little to no sumps for sediment containment located within roadside drainage swales or channels. Many culverts discharge directly or in very close proximity to the River. Most structures provide no pretreatment of stormwater prior to discharge. The majority of roads reviewed had minimal drainage structures resulting in a greater concentration of flow and contaminant transport.

Many roads have sheet flow or channelized (curbed) stormwater discharge to the river embankments. Some roads that discharge direct to embankments by sheet flow and by structures are introducing temperature pollution in the form of heated water off the road to coldwater fisheries. Many roads are in difficult areas to provide areas for pretreatment, being squeezed between side slopes and the river bank.

The 2010 *Town Drainage and Nonpoint Assessment* for the Westfield River Wild and Scenic Advisory Committee found many of the Hilltown highway departments lack the equipment, training and/or budget to address the proper maintenance of drainage structures although this has improved in recent years.

VIBRANT HUMAN-RIVERFRONT CONNECTIONS OPPORTUNITIES

Enhancing recreational opportunities on the Connecticut River, and its tributaries, will help connect urban and rural communities to the river and to one another, safeguard its water quality from the headwaters to Long Island Sound, and promote healthier life styles, recreation, and economic development. Outdoor recreation often serves as an interface between people and the environment. The existence of quality outdoor recreational opportunities has the potential to develop environmental knowledge and to promote environmental stewardship. Enhancement of recreational opportunities should be coordinated with the protection of aquatic resources and open space planning to ensure that recreational endeavors coincide with the needs to protect biodiversity, unique or regionally significant habitats, water supply areas, aesthetics, other recreational opportunities, and to improve quality of life.

The river and other lakes and ponds in the Westfield River watershed are widely used for fishing, swimming, kayaking and canoeing. Sections of the West, Middle and East Branches are noted in the Appalachian Mountain Club's River guide for Massachusetts Connecticut and Rhode Island .The East Branch provides one of the longest whitewater runs in Massachusetts. The winter pool release at the Knightville Dam triggers the annual Westfield River Whitewater Canoe Races, the longest continuing

running race in the country, now in its 53rd year. The Appalachian Trail crosses October Mountain State Forest in Becket. The West Branch also contains 10 beautiful stone arch railroad bridges known as the Keystone Arches. Listed in the National Register of Historic Places, the arches are a popular trail destination point.

CONNECTICUT RIVER BI-STATE PARTNERSHIP

The Connecticut River Bi-State Partnership was formed in 2012 as an intergovernmental compact between the four regional planning agencies (RPA) located along the main stem of the Connecticut River in Massachusetts and Connecticut for purposes of collaborating more effectively to improve the environment, water quality, recreation and public access on the Connecticut River. Participating RPAs include Pioneer Valley Planning Commission, the Capitol Region Council of Governments, the Franklin Regional Council of Governments, and the Lower Connecticut River Valley Council of Governments.

The Partnership has been established as an innovative, bi-state and intergovernmental approach to improving the environment, recreation and water quality on the Connecticut River to benefit riverfront communities. The Connecticut River Bi-state Partnership provides a framework to:

- Improve the water quality in the Connecticut River, and more effectively address water pollution problems affecting the river and its environment;
- Enhance the overall environmental quality of the Connecticut River, including protecting and restoring natural communities and biodiversity along the river;
- Promote recreational use of the Connecticut River and bring people back to the river; and
- Seek opportunities to improve or expand recreational access to the Connecticut River.

The Connecticut River Bi-state Partnership has defined its mission as follows:

- Identify and prioritize critical challenges to the health of the Connecticut River, and seek bi-state solutions to those challenges;
- Seek opportunities to utilize bi-state cooperation to secure additional federal and state resources to improve the Connecticut River;
- Address the bi-state water quality problems of combined sewer overflows, nitrogen loading to Long Island Sound, urban stormwater runoff, streambank erosion, and non-point source pollution in a cooperative and coordinated manner;
- Protect, enhance and restore open space, wildlife habitat, greenspace, parkland and recreational areas along the Connecticut River, seeking to make regional greenbelt linkages between these areas;
- Make information available to the public on Connecticut River recreation opportunities, access areas and water quality, in order to promote enhanced public use of the river; and,
- Collaborate to create new river-oriented recreational access areas, including regional bikeway-walkway projects, regional water trails, fishing and boating access areas and other river access facilities.

The Bi-State Partnership work plan for 2013-2014 is as follows:

- Seek grant funds to develop a bi-state River Corridor Management Plan to preserve natural, scenic and historic resources, using GIS analysis to assess natural resources and land use impacts

and reviewing zoning, open space plans, and master plans to assess if they are in conflict with river protection goals, and to ensure that growth is directed to existing urban and growth centers

- Encourage adoption of Green Development practices, including Green Development Performance Standards or other green development initiatives by watershed communities to promote good development practices that do not adversely affect water quality, habitat, and stream functions
- Create a bi-state Connecticut River watershed greenway system of trails and parks throughout the region. Continue the partnership's small grants program to municipalities and non-profits to support this effort.
- Create new and expand existing funding programs to reduce and eliminate pollution due to CSOs, possibly seeking interstate collaboration to sponsor new federal and/or state legislation. Develop a green infrastructure plan and explore other cost saving innovative solutions to reduce the cost of CSO correction, including research and demonstration projects

CONNECTICUT RIVER BLUEWAY

In 2012, the Connecticut River was designated the first federal National Blueway. This initiative was born out of the 2011 report to the National Park Service, U.S. Environmental Protection Agency, and Commission of Land Conservation of the New England Governor's Conference, Inc. entitled "Connect People to the Outdoors". The report cites five specific objectives for the regional Connect People to the Outdoors Initiative including: conservation corps and employment opportunities, livability, recreational opportunity, environmental education, and healthy outcomes.

The report heavily cited the public health crisis as the most pressing reason for connecting people to the outdoors. Health conditions related to obesity and overweight cost Americans an estimated $117 billion each year. The CDC lists the percent of overweight and obese youth in 2009 by state. For the Connecticut River watershed states it reports: New Hampshire, 25.7; Vermont, 25.8; Massachusetts, 27.6 and Connecticut, 24.9. A 2001 JAMA report on health risk factors states that "overweight and obesity, influenced by inactivity and poor diet, are significantly associated with an increased risk of diabetes, high blood pressure, high cholesterol, asthma, arthritis, and poor health status."

CONNECTICUT RIVER SCENIC FARM BYWAY

In 2000, the Massachusetts Legislature approved legislation under Chapter 235 of the Acts of 2000 to formally designate the Connecticut River Scenic Farm Byway along Routes 47 and 63/10 in Franklin County. Since the Massachusetts Scenic Byway Program is currently under development, designation of scenic byways in the Commonwealth is accomplished through an act of the State Legislature at the request of participating communities. In 2003, the Legislature amended the Act to include Route 47 in the Towns of Hadley and South Hadley.

The Massachusetts segment of the Connecticut River Byway was designated as a National Scenic Byway in 2009, adding to the segment already designated along the entire length of the Connecticut River in Vermont and New Hampshire.

ROUTE 112 / JACOBS LADDER SCENIC BYWAY

The Jacob's Ladder Scenic Byway is a pleasant alternative to the Massachusetts Turnpike, which it roughly parallels. It winds its way through five towns in the Berkshire Foothills, beginning in Lee, Massachusetts and continuing through Becket, Chester, Huntington and Russell. Also known as the "Jacob's Ladder Trail," the 35-mile stretch of U.S. Route 20 was designated as a scenic byway by the state of Massachusetts in 1992.

The Westfield River, a nationally designated Wild and Scenic River, flows through much of the Jacob's Ladder Trail region. With headwaters in the Berkshire Hills, the Westfield River traverses some of the wildest areas in Massachusetts, as well as cultivated landscapes of maple-shaded farms and historic villages. In the spring, the river attracts hundreds of paddlers from the eastern United States for the excellent whitewater canoeing and kayaking at the annual river races (Hill and Dale Rapids).

The Appalachian Trail, America's longest walking trail – 2,175 miles long, 90 miles of which pass through Massachusetts, intersects the Jacob's Ladder Trail in Becket. The Appalachian Trail (AT) was established during the 1920s partly as a reaction to the burgeoning of auto-tourism. To the north of Jacob's Ladder Trail, the AT passes through October Mountain State Forest, Massachusetts' largest state forest. To the south, the AT travels past scenic Upper Goose Pond.

The Keystone Arch Bridges, located in Chester, Becket and Middlefield, Massachusetts, the series was the first system of bridges of their kind built for railroad use in the United States. These 70-foot high stone bridges, built without mortar or steel reinforcements, were built between 1833 and 1841, extending the Western Railroad across the deep gorges of the Westfield River on its route to New York. Major George Washington Whistler, father of the artist James Whistler, and William Gibbs McNeill were the chief engineers responsible for designing the bridges. The five remaining Keystone Arch Bridges are in the Middlefield-Becket Stone Arch Railroad Bridge District on the National Register of Historic Places. The Keystone Arch Bridges Trail extends for 2.5 miles and provides the only public access to two of the bridges. The trail also provides beautiful views of the West Branch Gorge of the Westfield River, the first National Wild and Scenic River designated in Massachusetts. The hiking trail to the Arches originates off of Middlefield Road in Chester.

Chester-Blandford State Forest - Created by the Civilian Conservation Corps during the Depression, this forest contains Sanderson Brook Falls and Goldmine Brook Falls, a semi-primitive campground and numerous hiking trails, including the Newman Marsh Trail which offers spectacular views of the Westfield River Valley.

The Littleville flood control dam and recreational facility was built in 1963 in response to the devastating 1955 Westfield River flood. The two-and-a-half mile long impoundment created by the dam is popular for fishing and canoeing.

Gardner State Park - Named for the former national president of the Grange Association, Charles M. Gardner, this park is popular for picnicking, and for swimming and fishing in the nationally designated Wild and Scenic Westfield River.

Knightville Dam and Wildlife Management Area - This flood control dam, built in 1941, has a 1,200 foot long earthen embankment which stores water during flood conditions in a six-mile long reservoir. The basin contains second growth forest that is habitat to native New England fish and wildlife. Among the

many recreational opportunities are catch-and-release trout fishing and hiking trails. Located at the northern end of the basin is Chesterfield Gorge, a Trustees of Reservations property that is open to the public.

Blandford Ski Area - This ski area has been owned and operated by the Springfield Ski Club since 1936 and is the oldest continuously operating club-owned ski area in North America. Located just ½ hour from Springfield, the ski area offers exciting downhill skiing, ski sales, and ski instruction.

Tekoa Mountain Wildlife Management Area and Rattlesnake Sanctuary -This rugged, steep-sided mountain marks both the mouth of the Westfield River canyon and the eastern end of the Jacob's Ladder Trail. The canyon was formed by the erosion of the highlands by the river over the millenia following the last Ice Age. Purchased in 2000 by the Massachusetts Department of Environmental Management, Mt. Tekoa has been designated as a rattlesnake preserve.

VIBRANT HUMAN-RIVERFRONT CONNECTIONS STRATEGIES

- Purchase riverfront lands for parks and recreation, using funding sources such as federal open space grants, state Public Access Board, Connecticut River Greenway State Park, and Community Preservation Act.
- Establish coordinated Riverfront Overlay Zones in all Connecticut River communities with incentives for appropriate riverfront land uses, disincentives to protect riverbank areas from inappropriate uses, provisions for riverfront easements to accommodate public river access, and a coordinated design theme for riverfront development.
- Improve and expand public access areas, including access for fisherman and formal picnicking areas along the river for use by the boating public.
- Provide public information to increase knowledge and use of public access sites, and environmentally sensitive river use, including preventing riverbank erosion and the spread of invasive species by properly cleaning boats (this could consist of establishing a Connecticut River recreation website with maps of recreation access sites, posting signs, distributing informational brochures and information with fishing licenses).
- Establish a bi-state network of Connecticut River greenway corridors and trails, including expanding and promoting the Connecticut River Walk and Bikeway and riverfront parks.
- Develop a bi-state Connecticut River Recreation and Access Plan to improve and enhance recreation opportunities by improving environmental maintenance, providing additional biking and walking paths, providing interpretive signage that highlights the area's history and wildlife.
- Create linkages between the river and adjacent neighborhoods and businesses.
- Pursue National Heritage Corridor Designation and explore ways to capitalize on the river's assets for tourism.
- Reclaim the urban riverfront as the center of city life.

- Minimize conflicts between users and relieve congestion by regulating areas for non-motorized boaters, a required course for power boaters, and additional environmental police.

- Support program to create a four-state water trail that would extend "from the source to the sea" (a water trail currently exists in NH and VT and has more than a dozen primitive camping sites along the river)

- Promote trail linkages along the Jacob's Ladder Trail and Route 112 (Hampshire County) Scenic Byways. These byways occupy a region where small villages lie in close proximity to large tracts of public lands.

- Ferry Road Canoe/Kayak Access Area (Connecticut River Byway) – Design and construction for a car-top boat access point for canoes and kayaks, with fishing access, to the Connecticut River at Ferry Road in North Hadley, MA. Ferry Road is shown at the Hampshire County Registry of Deeds as both a county road and a town road. Hadley controls a right-of-way along Ferry Road from the Byway directly to the Connecticut River. Design plans and specifications will be developed for improvement of the road access, creation of a parking area, gates and rock barriers to prevent access to adjacent private lands, construction of a trail to the river for canoe/kayak access. Design work will include survey and purchase of recreational easements as needed. There is very little access to the Connecticut River in Hadley, and this work will lead to improved access to a very attractive portion of the river for canoes and kayaks and fishing, and to the Connecticut River Water Trail, allowing canoes and kayaks to make day trips from Montague or Sunderland put-in areas to Hadley. Estimated budget: $88,000

- New England National Scenic Trail Access (Connecticut River Byway) - Visitors to the Connecticut River Byway have the opportunity to experience both a National Scenic Byway and a National Scenic Trail, which intersect in the Town of Hadley, MA. This task includes construction of design plans for a new trailhead, including improved trailhead signage, interpretive information and safe, attractive parking for the New England National Scenic Trail (NENST) near its crossing of the Connecticut River Byway. The preferred location for this trailhead is on land owned by Mount Holyoke College. Recreational easements will be negotiated and secured on the trail route. Currently this trailhead is poorly marked and difficult to find, and without adequate off-road parking. This area will become an attractive gateway to the NENST with gravel parking, an interpretive exhibit describing the two-state NENST, and timber and stone fencing. Estimated budget: $93,000

- Red Rocks River Trail – Work with the Massachusetts Department of Conservation and Recreation and a consultant to construct a trail layout plan for a Connecticut River hiking trail segment along the riverbank in North Hadley, MA, focusing on state-owned land under the Department of Conservation and Recreation, and working in concert with willing private property owners to secure needed permissions and access agreements. This trail will provide access to a particularly beautiful and unspoiled section of the Connecticut River and enhanced visitor experience. Estimated budget: $90,000

- Connecticut Riverwalk and Bikeway Construction Projects

There are proposed Riverwalk segments that have completed design or are currently in design and will be seeking construction funding:

- Agawam – Agawam Bikeway Loop
- West Springfield – Connecticut Riverwalk
- Chicopee – Chicopee Riverwalk
- Chicopee – Connecticut Riverwalk

RECOMMENDED STRATEGIES

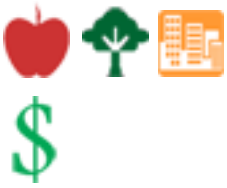
CROSS CUTTING STRATEGIES ICONS

The following icons are used in reference to issues and strategies also identified in the other nine Sustainable Knowledge Corridor Element Plans, called "cross cutting strategies". To learn more about the cross cutting strategy as it may pertain to the topics and analysis in the cross cutting Element Plan, visit www.SustainableKnowledgeCorridor.org .

FOOD SECURITY	LAND USE	CLIMATE ACTION
GREEN INFRASTRUCTURE	TRANSPORTATION	ECONOMIC DEVELOPMENT
HOUSING	BROWNFIELDS	ENVIRONMENT

STRATEGY	DESCRIPTION	LEAD ROLE	CROSS CUTTING STRATEGIES
Protect and Promote Swimmable and Fishable Rivers			
Maintain current Connecticut River website www.ConnecticutRiver.us	Maintain website broadly used by the public for information about recreational access to the river, water quality for swimming and boating, fish consumption advisories, and other recreational news and information.	PVPC	
Bi-state CT River Corridor Management Plan	Develop "report card" on indicators of CT River watershed health, including pollution (nitrogen, bacteria), percent impervious, number of CSOs, acres of land protected, miles of bike paths, etc.; host annual event to release report card.	PVPC; CRCOG; FRCOG	
Continue Connecticut River Bacteria Monitoring Program	Seek funding for 2013 monitoring season; continue collaboration with local watershed organizations to monitor sites in Franklin County, MA, VT and NH.	PVPC; Connecticut River Watershed Council	
Continue to Address Combined Sewer Overflows,	Seek bi-state collaboration in seeking federal funding for CSO remediation including establishment of bi-state legislative coalition to direct funding to CT River; sponsor Environmental Bond Bill for CT River in MA and CT; and, create	PVPC; CRCOG	

	Green Infrastructure Small Grants funding program.		
Conduct a Pilot for Zero Net Energy Wastewater Treatment Plant on Connecticut River	Identify Connecticut River community to serve as pilot study for implementing Zero Net Energy Wastewater Treatment Plant. Consider Integrated Resource Management of water, wastewater, and energy as part of pilot study.	PVPC, Municipalities	
Adopt Stormwater Utilities	A local Stormwater Utility can generate revenue for stormwater infrastructure operation and maintenance.	Public Works Departments, Planning Boards, CEO	
Implement Local Stormwater and Erosion Control Standards	Implement or amend local stormwater bylaw/ordinance to comply with NPDES MS4 Permit requirements including Stormwater Pollution Prevention Plans, best management practices for on-site control and treatment of stormwater, and post-construction operation and maintenance requirements and enforcement.	Planning Boards	
Implement Green Infrastructure Zoning Incentives	Create zoning incentives for green roofs, permeable parking lots, on-site stormwater recharge and other green infrastructure.	Planning Boards	
Support Sustainable Land Use and Agriculture			
Compact for Pioneer Valley Conservation	Continue land conservation, stewardship and wetland permitting assistance offered through the Compact. Seek funding to capitalize a Revolving Loan Fund for land conservation bridge funds.	PVPC, Conservation Commissions, Open Space Committees	
Implement Priority Protection Areas / Critical Lands Acquisition Program	Build on Hampden County Farmland Mapping Project and protect prioritized farmland through fee acquisition, transfer of development rights, APR/CR, and zoning mechanisms mentioned herein.	PVPC, Agricultural Commissions, Open Space Committees	
Improve Access to Parks and Open Space in Environmental Justice Areas	Expand healthy recreational opportunities by creating and/or expanding opportunities for access to open space and parks in EJ Areas.	PVPC, Municipalities	
Adopt Community Preservation Act (CPA)	The CPA provides dedicated funding for historic preservation,	Conservation Commissions,	

	low and moderate income housing, and open space protection including recreational development.	Open Space Committees, Planning Boards, Historic Commissions	
Use CPA funds to leverage state and federal funds for land conservation projects	Use CPA funds as match to leverage state and federal land acquisition funding and/or Conservation Restrictions, and Agricultural Preservation Restrictions.	Municipalities, PVPC	
Establish Local Conservation Funds	Establish local Conservation Funds to accept donations, town meeting appropriations, and other funding sources for land conservation and stewardship projects.	Conservation Commissions	
Create and Maintain Active Agricultural Commissions	Active Agricultural Commissions can sponsor Right-to-Farm Bylaws, inventory and identify local agricultural properties, create marketing programs and materials, and host community events.	Planning Boards, Conservation Commissions, Open Space Committees	
Adopt Right to Farm Bylaws	A local bylaw encourages the pursuit of agriculture, promotes ag-based economic opportunities, and helps protect farmland by reducing conflict with abutters.	Agricultural Commissions, Planning Boards, Conservation Commissions, Open Space Committees	
River Protection Standards and Bylaws	Seek to implement coordinated bi-state model bylaws: Green Development Performance Standards, Low Impact Development, and Floodplain Regulations, including addressing climate change impacts	Planning Boards, Conservation Commissions	
Create Transfer of Development Rights Zoning (TDR)	Implement TDR Bylaws that allow development rights to be purchased in designated Sending Areas and transferred to Receiving Areas for use in more compact residential or commercial development projects.	Planning Boards, Agricultural Commissions, Conservation Commissions, Open Space Committees	
Adopt Scenic Upland Protection Zoning	Scenic upland protection zoning can regulate alterations to the land which may negatively affect the scenic and environmental quality of these areas.	Planning Boards, Commissions, Conservation Commissions,	

		Open Space Committees	
Protect Clean Drinking Water Supplies			
Complete Supply and Demand Forecasts for Public Water Supplies	In conjunction with Hazard Mitigation Plans development and updates, complete 5-year supply and demand projections for public water supplies	PVPC	
Implement Bi-State approach to Water Supply Protection in Westfield and Farmington River Watersheds	Promote contiguous land protection in southwest Hampden County, MA to Hartford, CT through Forest Legacy Designation for area, and water supply protection overlay zoning.	PVPC; CRCOG	
Inventory, Update, Assess Vulnerability and Protect Critical Infrastructure	Inventory, update and conduct vulnerability assessments of critical infrastructure to flooding and other weather impacts, including energy generation, electrical transmission and distribution, communication networks, drinking and wastewater facilities, roads and highways, railways, dams and flood dikes and healthcare facilities. Take needed steps to improve resilience.	Municipalities	
Storm-proof infrastructure	Increase resilience of water/ wastewater infrastructure, streets and roads, flood dikes, sewer and water lines, to severe storm events and flooding. Take action to harden and raise the level of infrastructure, as funds become available.	Municipalities	
Create Emergency Inter-municipal Water Connections	Identify options for creating emergency water supply inter-connections with neighboring communities, and seek formal agreements to purchase water in emergencies. Physical, piped emergency connections, and agreements to purchase water, should be put into place in advance of emergencies.	Municipalities	
Promote and Protect Healthy Fisheries and Wildlife			
Upgrade Stream Crossings, Bridges and Culverts	Pro-actively replace underperforming culverts and bridges with structures designed to meet the MA Stream Crossing	Public Work Departments, Conservation Commissions	

	Standards to accommodate floods and promote wildlife passage. Identify and prioritize culverts for replacement. Prepare for disaster replacement by designing generic plans for different types of stream crossings to implement in emergency repairs. Integrate replacements into road and utility infrastructure projects to off-set costs and access funding opportunities.		
Support Dam Removal of High Hazard Dams in Stressed Basins	Work with municipalities to design dam removal projects at high hazard dams in stressed basins to improve river continuity and flow.	PVPC, MA DER, Municipalities	
Update Flood Maps	Work with FEMA to raise priority for update of flood insurance maps in the region, using LiDAR elevation surveys and climate models, and identify at-risk facilities, and flood zones in need of protective zoning.	PVPC, Municipalities	 
Improve Flood Zoning	Adopt improved zoning to prevent new development in flood zones, increase flood resilience of buildings, and provide protection of basement and first floor levels.	Municipalities	
Implement Northeast Regional Mercury Total Maximum Daily Load (TMDL)	Implement the Northeast Regional Mercury Total Maximum Daily Load (TMDL), with a minimum of a 90 percent control on out-of-region coal fired power plant emissions and successful control of in-state/regional reductions in mercury sources.	MA DEP	
Subsistence Fishing Survey and Fish Consumption Advisory Outreach	Conduct a study to determine level of subsistence fishing on CT River; Conduct outreach to these communities about fish consumption advisories	PVPC	
Create Vibrant Human-Riverfront Connections			
Conduct Bi-State Trail Linkages Study	Conduct bi-state trail linkages study to identify opportunities for connecting New Haven, CT to Northampton, MA along multiple routes.	PVPC	 
Greenway System of Trails and Parks	Design and construct missing trail links between states and regions, focusing on Priority Protection Areas where feasible.	PVPC, Municipalities	 

Support design and implementation of Connecticut River Paddlers Trail	Expand trail southward from Vermont into Massachusetts and Connecticut.	VT River Conservancy, AMC, TPL	
Support Pioneer Valley Regional Trails Coalition and Connecticut River Paddlers Trail	Participate in the development and implementation of the PV Regional Trails Coalition to increase local/regional capacity for developing and stewarding regional trail networks, and support the four-state creation of the Connecticut River Paddlers Trail.	PVPC	
Implement Zoning for Bike and Pedestrian Amenities to Support an Intermodal Pedestrian and Bicycle Network	Zoning bylaws can require sidewalks, bike path connectors, bike parking and amenities in new developments, and internal pedestrian linkages in large projects.	Planning Boards, Public Works Departments, PVPC, MDOT	
Continue to enhance www.ConnecticutRiver.us to Support Recreational Use of the River	Connect 'Live Well Springfield' and Pioneer Valley Asthma Coalition's initiatives with the website to promote use of riverwalk and river access sites in Springfield; promote river user groups such as PV Rows; encourage linkage with the CT River Blueways web atlas (under development) and ConnecticutRiver.us.	PVPC	
Place-Based Strategies			
Seek funding for New England National Scenic Trail Access	Design and construction of a new trailhead, including improved trailhead signage, interpretive information and safe, attractive parking for the New England National Scenic Trail (NENST) near its crossing of the Connecticut River Byway.	PVPC	
Seek funding to build out Connecticut River Byway Trail System	Design and construct four trails and river access areas along Connecticut River Byway: • Red Rocks River Trail along the riverbank in North Hadley, MA, • Porter Phelps Huntington House to Mount Warner Trail in Hadley; • Connecticut River to Mount Holyoke Range Trail in South Hadley;	PVPC; MA DCR	

	• Connecticut River Car-top Boat Access at Ferry Road in North Hadley, MA.		
Connecticut River Greenway Park and Trail, Northampton, MA	Support the City of Northampton's efforts to develop river access for CT River Greenway riverfront park and multi-use trail along CT River from Norwottuck Rail Trail on Damon Road to Elm Court, Hatfield.	City of Northampton	
Chicopee River Delta Park	Promote linkage with the Connecticut Riverwalk at the Chicopee River delta, and connection to the Chicopee Riverwalk in downtown Chicopee.	City of Chicopee; PVPC	
Continue CT River Bacteria Monitoring Program at Recreational Access Sites in VT, MA and CT	Continue monitoring *E.coli* bacteria for Primary and Secondary Contact standards on main stem of CT River.	PVPC, CT River Watershed Council	
Connecticut Riverwalk and Bikeway Build-out	Work with Chicopee, Agawam, West Springfield and Holyoke to complete the design and build-out of Connecticut Riverwalk segments	PVPC, municipalities	

IMPLEMENTATION PROJECTS

PROJECT NAME	RESPONSIBLE PARTY
Compact for Pioneer Valley Conservation – land protection and stewardship programming in Priority Protection Areas	PVPC
CT River Bacteria Monitoring Project	PVPC
Connecticut Riverwalk and Bikeway Network Build-out and Linkages	PVPC
Bi-State CT River Corridor Management Plan	PVPC; CRCOG; FRCOG
Perform LID Code Review for MS4 Communities	PVPC
Promote Stormwater Utility Adoption, Conduct Feasibility Study for an MS4	PVPC
Expand Public Access to Parks and Open Space in EJ Areas	PVPC
Connecticut River CSO Clean-up Funding Initiatives and Bi-state Collaboration	PVPC
Upgrade culverts and stream crossings through Hazard Mitigation and other grants	PVPC

APPENDICES

APPENDIX A: LITERATURE REVIEW

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