Water Resources

Connecticut River Management Plan

Mount Ascutney Region

CONNECTICUT RIVER JOINT COMMISSIONS INC

2009

Water Resources

Mount Ascutney Region River Subcommittee of the Connecticut River Joint Commissions

Adopted November 13, 2007, Updated August 2009

Produced with support from the New Hampshire Department of Environmental Services. the National Oceanic and Atmospheric Administration, US Gen New England, the Davis Foundation, and the American Recovery and Reinvestment Act of 2009.

Drafted by the Mount Ascutney River Subcommittee with the assistance of Adair D. Mulligan

This report is also available at www.crjc.org/waterresources.htm

Connecticut River Joint Commissions

PO Box 1182
Charlestown, New Hampshire 03603
603-826-4800 ~ www.crjc.org

Cover image: The "Hen and Chicks" on the Connecticut River, looking downstream between Plainfield, N.H. and Hartland, Vt.

Table of Contents

Key Recommendations

- **Monitor river water quality to identify problems and track improvements.** Town conservation commissions, tributary watershed groups, school groups, and other interested citizens should work with their state's water quality agency to ensure more regular and sustained monitoring of the Connecticut River and its tributaries.

- **Ensure that wastewater discharges no longer compromise the quality of the river.** Communities with combined sewer overflows, including those upstream of the Mount Ascutney region, should continue their efforts to eliminate them as quickly as possible. The U.S. Environmental Protection Agency should provide funding to assist with these expensive projects. The river is affected by three large wastewater discharges just upstream in the Upper Valley region, as well as those within.

- **Discourage development too close to the river.** Towns should adopt ordinances prohibiting building in the 100-year floodplain and ensure that buildings are set a safe distance back from the river even when outside of the floodplain, to reduce the risk of property loss in erosion-prone areas. Vermont should adopt statewide shoreland protection. New Hampshire towns and N.H. Department of Environmental Services (NH DES) should inform landowners about the Comprehensive Shoreland Protection Act. Towns should not issue permits for projects that violate state law.

- **Pay more attention to soil conditions, including varves, and to erosion.** Towns should work with state geologists to map varves within their boundaries, to be sure major construction does not take place on unsafe soils. State and federal agencies should examine the severe erosion involving varves at Commissary Brook, identify its causes, and fund a means to halt the surge of sediment into the Connecticut River mainstem.

- **Retain, protect, and enhance riparian buffers.** Towns should require developers and landowners to establish and/or maintain buffers of native vegetation along rivers and streams for privacy and pollution control. Landowners should encourage native plants on their riverbanks and remove invasives.

- **Continue and enhance good river stewardship by TransCanada.** Other riparian landowners should follow TransCanada's example of riparian buffer planting on riverfront lands. The Federal Energy Regulatory Commission should include best management practices such as moderated ramping rates in the 2018 license for Wilder and Bellows Falls Dams.

- **Examine culverts to ensure proper drainage.** The Cold River flood experience suggests that towns should ask regional planning commissions for help with culvert and bridge surveys to identify those that are undersized. State agencies should assist towns with engineering costs for sizing culverts and bridges. State and local highway departments should ensure that, when replacing them during road work, culverts are properly sized and do not impede fish movement on perennial streams.

- **Improve stormwater management.** Towns should look at ways to include "low impact development" ideas as they review projects, and at how to change existing development to reduce runoff and promote stormwater infiltration.

- **Ensure that farm operations help protect water quality.** Farmers should employ best management practices and work with conservation districts and the Cooperative Extension Service to prepare a total nutrient management plan for their farm, to make best use of available nutrients, reduce potential for water quality impacts, and save money in purchasing fertilizer.

- **Reduce mercury contamination.** The states should continue to act to reduce sources of mercury contamination that affects Connecticut River fish and other wildlife. Congress should join this effort.

I. Preface

A. Citizen-based Plan for the Connecticut River

The Mount Ascutney region's plan is a blueprint for stewardship of the Connecticut River for communities, landowners, businesses, and agencies on both shores. Gathering together to create this plan for the Mount Ascutney segment of the river were representatives from the New Hampshire towns of Plainfield, Cornish, Claremont, and Charlestown, and Hartland, Windsor, Weathersfield, Springfield, and Rockingham in Vermont.

The strength of the Mount Ascutney River Subcommittee's planning process lies in the diversity of its membership. These citizens, as directed by RSA 483, represent local business, local government, agriculture, recreation, conservation, and riverfront landowners. All of the recommendations of the Mount Ascutney River Subcommittee's plan represent the consensus of this diverse group of citizens. Subcommittee members are listed in Appendix A.

B. Origin of the Connecticut River Management Plan

The Connecticut River Joint Commissions (CRJC) mobilized hundreds of valley residents and local officials to join them in nominating the Connecticut River into the N.H. Rivers Management and Protection Program in 1991-2. The New Hampshire Legislature subsequently designated the river for state protection under RSA 483, which authorized CRJC to develop a river corridor management plan. CRJC sought support from the Vermont Legislature as well, so citizens from both states could engage in planning for their shared river. With backing from both legislatures, CRJC then contacted select boards or city councils from the 53 New Hampshire and Vermont riverfront communities and asked them to nominate representatives to serve on five bi-state local river subcommittees. This partnership between local town representatives and the state commissions for the Connecticut River enabled CRJC to publish the first edition of the *Connecticut River Corridor Management Plan* in 1997, after five years of work by the Commissions and the five bi-state local river subcommittees. Since this planning process began in 1993, nearly 200 citizens have thus participated in the subcommittees' work.

"A lot of the authenticity of the River Commissions comes from this participation at the grassroots level."

Cleve Kapala, past president, CRJC

Following its publication, communities on both sides of the Connecticut River examined its findings and used them as a basis for enacting new or enhanced protection for the river. State and federal agencies also pursued its recommendations, embarking on studies of sediment and water quality and fish tissue toxins. The *Connecticut River Corridor Management Plan* was cited as a basis for designation of the Connecticut River as an American Heritage River by the White House in 1998. A summary of progress on the plan's recommendations appears in Appendix B.

C. A New Water Resources Plan

At the request of the Connecticut River Joint Commissions, a new assessment of water quality in the Connecticut River mainstem was conducted in 2004 by NH DES with the support of the EPA. Following announcement of the results in January, 2005, CRJC asked the local river subcommittees to begin work on updating, revising, and expanding the 1997 Water Quality chapter, exploring new topics such as flow, flooding, drought, groundwater, and other areas, in an attempt to portray and address the full range of water resources in the region. Because tributaries are responsible in large part for the river's condition, the subcommittees included an examination of tributary issues. Several members conducted windshield assessments of smaller tributaries within their towns, previously unstudied.

D. Plan Process

The Mount Ascutney Region River Subcommittee met at the Windsor Connection Resource Center from January, 2005 until November, 2007 to develop the new water resources chapter of the Connecticut River Management Plan for this section of the river. CRJC's conservation director transcribed the subcommittee's discussions to construct drafts of the plan, which the members revised and approved. Hartland and Weathersfield did not send representatives to participate in crafting this update.

A first draft of the plan was circulated for public comment in May, 2007. After considering comments from the agencies, general public, and CRJC's Water Resources Committee, the Subcommittee adopted a final version in November, 2007.

E. Scope of the Plan

The Subcommittee has concentrated its planning upon the 39 miles of the Connecticut River in this segment. While the recommendations are directed toward this area, the Mount Ascutney River Subcommittee believes that their consideration beyond the riverfront towns could benefit the river, its tributaries, and the region as a whole. Recommendations are presented within each topic area, and are summarized in Appendix C, arranged by responsible party. Some are aimed beyond town boundaries, to guide state and federal agencies. The Subcommittee recognizes that proper care of the river is such a big job and important public duty that help from beyond the watershed is sometimes appropriate and needed from those agencies which share responsibility for the river.

F. Local Adoption of Recommendations

New Hampshire RSA 483, the Rivers Management and Protection Act, encourages communities on protected rivers such as the Connecticut to adopt a locally-conceived means of conserving the river and its shoreline. The Legislature sought also that "the scenic beauty and recreational potential of [the Connecticut River] shall be restored and maintained, that riparian [river-side] interests shall be respected" without preempting the land zoning authority already granted to the towns. The mechanism for adoption of this plan in both states is the conventional local planning process. Planning boards and commissions can review recommendations in the water resources

Ascutney Region

New Hampshire Rivers
Management & Protection Program

Legend

- Dams

Designated Rivers - River Classification

- Natural
- Rural
- Rural-Community
- Community

Connecticut River Joint Commissions Subcommittee Regions

- Upper Valley
- Wantastiquet
- Mt. Ascutney

1:330,000

0 1 2 4 Miles

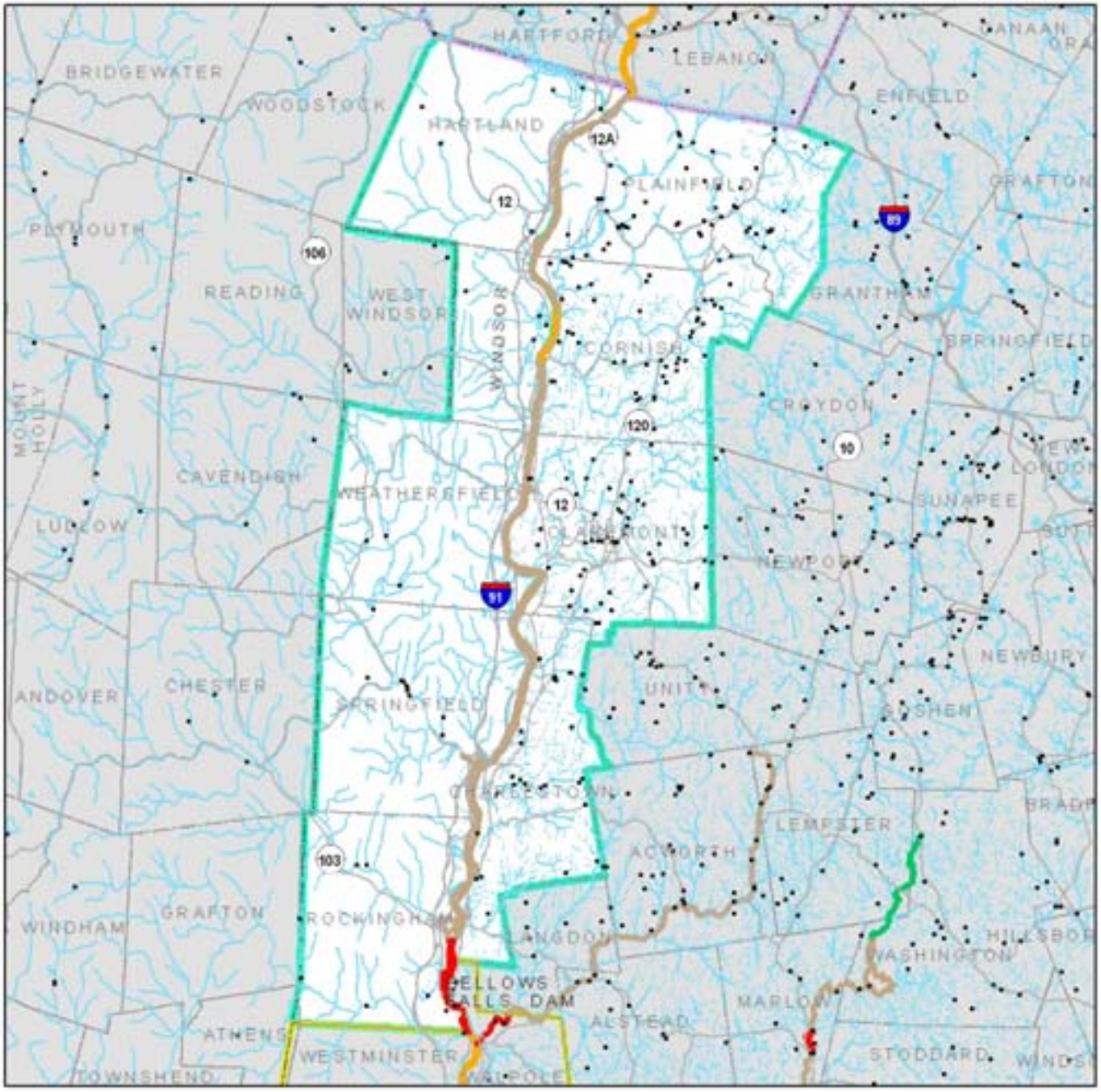
N
W E
S

New Hampshire Department of Environmental Services
Watershed Management Bureau
29 Hazen Drive
P.O. Box 95
Concord, NH 03302-0095

Map produced January 11, 2008
New Hampshire State Plane Feet Projection
North American Datum 1983

DATA SOURCES
Hydrology and Political boundaries generalized from 1:100,000-scale US Geological Survey digital line graph data.

River designation per Chapter 483, by the New Hampshire Rivers Management and Protection Program.



chapter and integrate them into the local master plan, and select appropriate recommendations to bring to townspeople for adoption as specific additions to their zoning ordinances. The Subcommittee has also made many recommendations which are non-regulatory in nature, inviting landowners and others to put them into action.

G. The Connecticut River Joint Commissions

The New Hampshire Legislature created the Connecticut River Valley Resource Commission in 1987 to preserve and protect the resources of the valley, to guide growth and development, and to cooperate with Vermont for the benefit of the valley. The Vermont Legislature established the Connecticut River Watershed Advisory Commission in the following year. The two commissions banded together as the Connecticut River Joint Commissions in 1989, and are headquartered in Charlestown, N.H.. The Commissions are advisory and have no regulatory powers, preferring instead to advocate and ensure public involvement in decisions that affect the river and its valley. CRJC's broad goal is to assure responsible economic development and economically sound environmental protection. The thirty volunteer river commissioners, fifteen appointed by each state, represent the interests of business, agriculture, forestry, conservation, hydro power, recreation, and regional planning agencies on both sides of the river.

H. Acknowledgments

The strength of this plan lies largely within its creation by a cross-section of local citizenry. From time to time, however, the local subcommittee called upon the expertise of state agencies, regional planning commissions, and local watershed group leaders to educate them about issues of particular concern. We would like to express our gratitude to those who lent their time to share information with the Mount Ascutney River Subcommittee:

- Cyndy Kozara, S. Windsor County Regional Planning Commission
- Marie Caduto, Water Quality Division, Vermont Agency of Natural Resources
- Steve Couture, Rivers Coordinator, NH. Department of Environmental Services
- Ken Alton, TransCanada Hydro Northeast
- Kelly Stettner, Black River Watershed Action Team
- Eleanor and Lou Thompson, Sugar River Watershed Alliance
- Ken Bishop, Nancy Franklin, Cheston Newbold, and Steve Walasewicz, Connecticut River Commissioners.

We are particularly grateful to the Windsor Connection Resource Center for providing meeting space.

Technical assistance - Mapping and other technical assistance was provided by the Upper Valley Lake Sunapee Regional Planning Commission through a grant from USGen New England.

Funding to support the work of the Mount Ascutney River Subcommittee came from:

- N.H. Department of Environmental Services
- National Oceanic and Atmospheric Administration
- USGen New England
- Davis Foundation

The publication was printed with funding from the American Recovery and Reinvestment Act of 2009 awarded to NH DES.

A list of acronyms appears in Appendix J.

II. Introduction

A. Water Resources in the Mount Ascutney Region

For thousands of years, humans have been drawn to this part of the Connecticut River, establishing communities from the ancient Native American gathering at Skitchewaug and the pioneering settlement of Fort Number Four to the modern industrialized centers of Claremont, Springfield, and Windsor. The Connecticut River Valley has offered fertile soils yielding fine agricultural products and waterpower to fuel the manufacture of fine machinery. In the last century, it was the destination for legendary log drives. Presiding over the river is the ancient monadnock of Mount Ascutney, the landmark chosen by the Subcommittee for its name.

Mt. Ascutney dominates the view of the Connecticut River near the Cornish Windsor Covered Bridge.

The Mount Ascutney Region River Subcommittee's segment covers 39 miles of the Connecticut River as it runs from the northern boundaries of Plainfield and Hartland south to the Bellows Falls Dam. The character of the river is distinctly different in the northern and southern parts of this segment. In the upper 10 miles, water moves with a perceptible current and there is an opportunity for flushing of nutrients and sediment. Rapids at Sumner Falls and other areas of riffle habitat return oxygen to waters that may have acquired pollutants from upstream sources.

The remaining 29 miles of the Mount Ascutney segment are captured by the 1,720-acre Bellows Falls impoundment, which at maximum pool height extends almost to the northern boundaries of Windsor and Cornish. In what was once the realm of magnificent farms that went down to the river, the Bellows Falls Dam has created stiller water and numerous setbacks which have become favorites of fishermen. The flow of the river in this segment is also influenced by the Wilder Dam just upstream. Major tributaries of the Connecticut include the Ottauquechee, Black, and Williams Rivers and Mill Brook in Vermont, and the Sugar and Little Sugar Rivers in New Hampshire.

The quality of Connecticut River waters has improved vastly since the 1950s, when many thousands of homes were discharging raw sewage and industries were releasing untreated chemical wastes into the river and its tributaries, particularly on the Black and Sugar Rivers. Today, thanks to the Clean Water Act and investments by the public and private sectors, the Connecticut River has substantially recovered from its former reputation as "New England's best landscaped sewer." Major improvements in tributary water quality, especially in the Black River, have benefited the Connecticut. Still, the Mount Ascutney region's reach of the river carries nutrients, sediments, debris, and other forms of pollution delivered from upstream, from within the region, and by the tributaries, and faces new challenges from increasing riverside development.

III. River Quality

A. Clean Water Has Clear Economic Value

We believe that the vitality of the Connecticut River is economically important to our region. This plan encourages continued economic development that is compatible with the well-being of the river. Good water quality is an important economic as well as aesthetic and ecological resource for the Mount Ascutney region. Today the river is once again safe for canoeing, kayaking, boating, wildlife habitat, and productive fisheries. River water is also suitable and used for agricultural and industrial water supplies. The Connecticut River Byway, a nationally designated heritage tourism initiative that is building strong momentum, highlights the river's appeal for recreation and its importance to local economies.

The river offers good, clean fun that brings dollars into the region.

A 2007 study in New Hampshire found that about $379 million in total sales is generated by those who are fishing, boating or swimming in New Hampshire fresh waters, or about 26 percent of all summer spending in the state.[1] Fishing, boating and swimming have about the same economic impact as snowmobiling, downhill skiing, cross-country skiing, and ice-fishing combined. Interviews with users of 11 public boat ramps in the Dartmouth-Sunapee region (none on the Connecticut River in the Mount Ascutney region), found that 85 percent of anglers, boaters and swimmers say they would decrease their intended visits to the Dartmouth-Sunapee region if water clarity and purity diminished. For the purpose of this study, "water clarity and purity" include pollution by milfoil or other invasives, mercury, and algae. Of those who would decrease their intended visits, 23 percent would leave the state and 26 percent would leave the region. Approximately 9 percent would go to some unspecified

1. *The Economic Impact of Potential Decline in New Hampshire Water Quality: The Link Between Visitor Perceptions, Usage and Spending.* Prepared for the New Hampshire Lakes, Rivers, Streams and Ponds Partnership by Anne Nordstrom, May 2007.

location in New Hampshire, and 42 percent would remain in the region. Those recreationists who would leave the state because of declining water clarity and purity would create a loss of 12 percent…a loss of about 35,000 visitor days.

The study found that overall, surface water recreation in the 33 towns in New Hampshire's Dartmouth-Sunapee tourism region generates over 100 jobs. These jobs equate to over $2.6 million in personal income and almost $7.5 million in business sales, totaling about 3.5 percent of the recreational revenue generated by anglers, boaters and swimmers in the state of New Hampshire. A perceived decline in water clarity and purity in the Dartmouth-Sunapee region would lead to a loss of loss of almost $1 million in business sales. While similar figures not available for Vermont, it is clear that Vermont residents and visitors are also enjoying these waters.

Habitat for fish and other aquatic life highly dependent upon excellent water quality is a notable feature of the Mount Ascutney segment, which is home to the federally endangered dwarf wedgemussel. The presence of this and other rare, threatened, and endangered species in this segment of the river has stimulated action by public and private agencies and organizations to improve water quality and other habitat values of the river here.

B. Connecticut River Water Quality

1. River Management Planning

Cheshire Bridge, Charlestown, N.H.

The states approach river planning differently in the Connecticut River watershed, the many thousands of square miles between the Green and White Mountains that drain into the Connecticut River. New Hampshire designated the Connecticut River into its Rivers Management and Protection Program in 1992 with the support of local citizens and CRJC. As part of this designation, the state required CRJC to act as the local advisory committee for the river and to develop a river corridor management plan with the help of five local river subcommittees set up under state law.

New Hampshire Rivers Management and Protection Act - RSA 483 provides general guidance for future land use in the New Hampshire corridor of the Connecticut River. While the majority of the Mount Ascutney segment is designated as "rural," there are also "rural-community" and "community" sections that have included both commercial/industrial centers for almost 200 years.

Rural river segments - The law defines these waters as "adjacent to lands which are partially or predominantly used for agriculture, forest management and dispersed or clustered residential development. Management of rural river... segments shall maintain and enhance the natural, scenic, and recreational values of the river for agricultural, forest management, public water supply, and other purposes which are compatible with the instream public uses of the river

and the management and protection of the resources for which the...segment is designated." In the Mount Ascutney region, two extensive segments of the Connecticut River are designated as rural:

- from the Lebanon-Plainfield town line to Blow-Me-Down Brook in Cornish
- from the north end of Chase Island to the southern side of the Williams River in Bellows Falls.

Local zoning in Plainfield, Cornish, Claremont, and Charlestown, N.H. should honor the stipulations of this designation. Hartland, Windsor, Weathersfield, Springfield, and Rockingham, Vt., should also consider these provisions.

Rural-community segments – According to RSA 483, these river segments "flow through developed or populated areas...(and) possess existing or potential community resource values such as those defined in official municipal plans or land use controls. Such rivers have mixed land uses in the corridor reflecting some combination of open space, agricultural, residential, commercial and industrial land uses. Such rivers are readily accessible by road or railroad and may include impoundments or diversions."

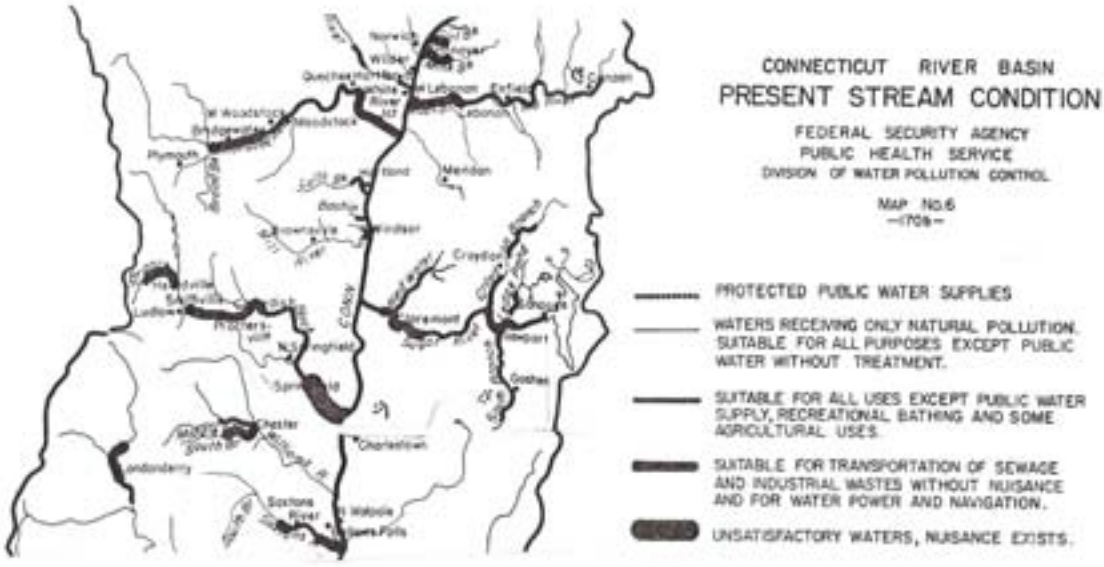
The Act further states that "Management of rural-community...segments shall maintain and enhance the natural, scenic, recreational and community values of the river and shall consider, protect, and ensure the rights of riparian owners to use the river for such uses as agricultural, forest management, public water supply, residential, recreational, commercial, industrial, flood control, and other community uses which are compatible with the instream public uses of the river and the management and protection of the resources for which the...segment is designated." In the Mount Ascutney region, one segment of the Connecticut River is designated as "rural-community" because of the location of the community of Windsor on the Vermont side of the river:

- from the Blow-Me-Down Brook in Cornish to the northern end of Chase Island.

Local zoning in Cornish, N.H. should honor the stipulations of this designation. Windsor, Vt. should also consider these provisions.

Community segments - According to RSA 483, community river segments are those "which flow through developed or populated areas...and which possess existing or potential community resource values, such as those identified in official municipal plans or land use controls. Such rivers have mixed land uses in the corridor reflecting some combination of open space, agricultural, residential, commercial and industrial land uses. Such rivers are readily accessible by road or railroad, and may include existing impoundments or diversions, or potential sites for new impoundments or diversions for hydro power, flood control or water supply purposes, and may include the urban centers of municipalities.

"Management of community...segments shall maintain and enhance the natural, scenic, recreational and community values of the river and shall consider, protect, and ensure the rights of riparian owners to use the river for such uses as agricultural, forest management, public water supply, residential, recreational, commercial, industrial, flood control and hydroelectric energy



Mount Ascutney Region water quality in 1951.

"I've seen the Sugar River red, I've seen it green, I've seen it yellow, all from the woolen mill in Claremont. We've had a lot of changes for the good."

Former city councilor, Claremont

production purposes which are compatible with the instream public uses of the river and the management and protection of the resources for which the...segment is designated."

One segment of the Connecticut River in the Mount Ascutney region, bracketing the Bellows Falls Dam and the village of Bellows Falls, is designated as "community":

- from the southern side of the Williams River in Bellows Falls to the Saxtons River in Westminster, Vt.

Vermont Basin Planning - Vermont embarked upon watershed planning in 2002, with a mandate from the legislature that originally gave the Department of Environmental Conservation until 2006 to complete basin plans for the state's 17 watersheds, although this will now not be complete until after 2011. Under the guidance of state basin planners, citizen committees are developing basin plans in a process modeled partly on the grassroots approach used by the Connecticut River Joint Commissions. At the same time, the state agency is moving ahead with watershed assessment and restoration projects, such as geomorphology studies. Watershed planning has just been completed in Basin 11 (West, Williams, and Saxtons Rivers), and attention has turned to Basin 10 and the Black and Ottauquechee Rivers. Finally, planning for Commissary and Mill Brooks and other small direct tributaries (Basin 13) will begin when Basin 10 is completed. However, severe sedimentation problems on Rockingham's Commissary Brook create a strong need for basin planning to begin sooner here.

2. Water Quality has Improved in the Last Fifty Years

In 1951, the federal Public Health Service rated 219 miles of the Connecticut River between New Hampshire and Vermont as Class C ("Damaged. Unsuitable for recreational uses except boating, unsuitable for use in some industrial processes without treatment, and unsuitable for irrigation of crops consumed without cooking"), and six miles were rated Class D ("Damaged. Unsuitable for most legitimate water uses.[1] Suitable only for the transportation of sewage and industrial wastes without nuisance and for power development and limited industrial uses. Aesthetic quality poor.") These two classifications, and the rivers that portrayed them, are thankfully a thing of the past.

A mere half century ago, the river carried untreated domestic sewage from 13,700 people in the Mount Ascutney region of Vermont and 5,700 in New Hampshire. It also carried untreated wastewater from sawmills, textile mills, dairy operations, metal workshops, machine tool factories, paper mills, and slaughterhouses on the Black, Sugar, Mill, and Connecticut Rivers, all in addition to the burden brought by the Connecticut from many miles upstream. Parts of the Black River above Ludlow were deemed "unsatisfactory for all present water uses during critical periods except power development," and the two-mile section from Springfield down to the Connecticut was simply labeled "nuisance exists." Some people living today along the Sugar River still remember seeing raw sewage and slaughterhouse offal in their river.

"I've been working on this river for 34 years, and I never thought in 1970 that I'd see how clean this water has gotten. I didn't see too much swimming in 1970; it depended on what color the water was running that day."

Ken Alton
TransCanada Hydro Northeast

3. Water Quality Management by the States

New Hampshire water quality standards apply to the Connecticut River. Water classifications, set by the states, give the management goals for a stretch of river. Water quality standards are used to protect the state's surface waters, and each state defines water quality in its own way, based on its statutes and administrative rules. An interesting difference appears between the two states' water quality standards, such as their concepts for bacterial contamination. Vermont has the strictest standard for *E. coli* in the nation, although the Department of Environmental Conservation does not have the resources to enforce these standards consistently. Class B waters must not exceed 77 *E. coli* organisms per 100 milliliters

Once a source of pollution, the historic Sugar River mills in Claremont are now a source of pride.

1. Federal Security Agency, Public Health Service, Connecticut River Drainage Basin: A Cooperative State-Federal Report on Water Pollution, 1951.

of water, while New Hampshire tolerates 126 per 100 ml. State water quality standards may be compared at www.neiwpcc.org/PDF_Docs/i_wqs_matrix04.pdf.

New Hampshire - Today, the state of New Hampshire has two classifications: A and B, and has designated the entire Connecticut River in New Hampshire as Class B, although back in 1951, only 44 miles of the river met the standards for this level.

New Hampshire Water Quality Standards

Tracking water quality is the responsibility of the Watershed Management Bureau of the New Hampshire Department of Environmental Services (NH DES). Standards in New Hampshire consist of three parts: designated uses, including swimming, fishing, boating, and aquatic habitat; numerical or narrative criteria to protect the designated uses; and an anti-degradation policy, which maintains existing high quality water that exceeds the criteria. New Hampshire measures physical and chemical aspects of water, and also has a relatively new biological monitoring program for assessing aquatic life.

Class A waters - *Escherichia coli* are not to exceed a geometric mean of 47 *E. coli*/100 ml (based on at least 3 samples obtained over a 60-day period) or more than 153 *E. coli*/100 ml in any one sample. There shall be no discharge of any sewage or wastes into these waters.

Class B waters - *Escherichia coli* are not to exceed a geometric mean of 126 *E. coli*/100 ml (based on at least 3 samples obtained over a 60-day period) or more than 406 *E. coli*/100 ml in any one sample, shall have no objectionable physical characteristics, and shall contain a dissolved oxygen content of at least 75 percent of saturation.

Vermont - Vermont considers most of the Connecticut River to be Class B, with the exception of Waste Management Zones. Waste Management Zones are a specific reach of Class B waters designated by a permit to accept the discharge of properly treated wastes that prior to treatment contained organisms pathogenic to human beings. Throughout the receiving waters, water quality criteria must be achieved, but increased health risks exist in a waste management zone due to the authorized discharge. In the Mount Ascutney region, there is a 0.34 mile designated waste management zone around the Bellows Falls discharge.

Total Maximum Daily Load (TMDL)

Each state must identify those water bodies that are not meeting their water quality standards, and calculate the maximum amount of a pollutant that each can receive and still meet these standards. It also develops a means to reduce these pollutants. TMDLs can be calculated for correcting water pollution from specific discharges or throughout a watershed and balance how much the pollutant needs to be reduced based on location. The draft 2008 state water quality assessments (Clean Water Act Section 303d List of Impaired Surface Waters) are the most recent available as this study was prepared.

New Hampshire TMDL list: Many miles of tributaries feeding the Sunapee Lakes and the Sugar River appear on New Hampshire's TMDL list due to low pH, and to a lesser but still significant

Vermont Water Quality Standards

The Water Quality Division of the Department of Environmental Conservation, in the Vermont Agency of Natural Resources, manages water quality information for this state. Standards in Vermont include designated uses, including swimming, fishing, boating, aquatic biota, wildlife and habitat, and aesthetics, numerical or narrative criteria to protect the designated uses including flow, and policies for flow, anti-degradation, and basin planning, among others. Vermont's water quality monitoring program emphasizes biomonitoring (an ambient monitoring program started in 1982) and also measures physical and chemical aspects of water bodies.

Class A waters - *Escherichia coli* are not to exceed a geometric mean based on at least 3 samples obtained over a 30 day period of 18 organisms/100 ml, no single sample above 33 organisms/100 ml. None attributable to the discharge of wastes.

Class B waters - *E. coli* are not to exceed 77 organisms/ 100ml. Vermont's water quality standards also include criteria for turbidity, dissolved oxygen and temperature based on whether the waters are designated for cold or warmwater fish habitat, and for aquatic biota, wildlife and aquatic habitat. Standards for phosphorus exist for the Lake Champlain basin, but not for the Connecticut River watershed. Nitrate standards exist for all waters, based on flow.

Vermont's Water Resources Board will eventually designate all Class B waters as either Water Management Type 1, 2, or 3, in order to more explicitly recognize their attainable uses and the existing level of water quality protection. Until waters are designated as a specific type, the criteria based on such designations do not apply. Vermont's Water Management Typing process has been before the Water Resources Panel for a long time and at this writing has not been resolved.

extent for the presence of *E. coli*. Lake Sunapee is on the state's list of acid ponds. Blow-Me-Down Brook in Cornish has problems with aluminum. Highway and bridge runoff has polluted an unnamed brook near Lake Sunapee with chloride. The Sugar River does not meet water quality standards for aluminum, pH, dissolved oxygen, and *E. coli* due partly to industrial and municipal discharges in Newport and Sunapee. A total of 13.21 miles of the North Branch of the Sugar River suffer from low pH and 7.98 miles from E.coli contamination, and 8.24 miles of the South Branch are impaired due to these two factors. Of the Sugar River mainstem, a total of 20.14 miles are impaired by low pH, and all but 1.3 of them also by *E. coli*. Aluminum, which often enters surface waters under such acid conditions, impairs 15.91 miles of the Sugar River. Low dissolved oxygen impairs aquatic life in 1.3 miles of the river. For more information see http://des.nh.gov/organization/divisions/water/wmb/swqa/index.htm..

Vermont TMDL list: In the Mount Ascutney region, the lowest 2.5 miles of the Black River do not meet water quality standards due to contamination by *E. coli* resulting from combined sewer overflows. Several tributaries in Ludlow are contaminated with landfill leachate (tributary to Jewell Brook) and possible talc mine drainage (Soapstone Brook). Roaring Brook, a tributary of the Ottauquechee River, is affected by stormwater runoff, land development, and erosion. Leachate from the Bridgewater landfill is entering the river via a wetland.

Vermont also publishes a list of priority surface waters that are outside the scope of Clean Water Act Section 303(d) including impaired surface waters for which no TMDL determination is required, surface waters in need of further assessment, those with completed TMDLs approved by EPA, and waters altered by exotic species, flow regulation, and channel alteration. Among those streams the state believes needs further assessment are Lull's Brook and the Ottauquechee River from the Taftsville Dam to the Hartland Reservoir in Hartland, Mill Brook in Windsor from Reading to Mill Pond, and Commissary Brook in Rockingham. The state believes that five more miles of the Black River from 2.5 miles above its mouth need further assessment for the effects of urban runoff and land development upon sediment, nutrients, and bacteria in the river. For more information see www.vtwaterquality.org/planning.htm.

4. Water Quality Monitoring Activities

Surface waters are sampled to see whether they meet each state's water quality standards, but not on a regular basis, because of staff and funding shortages. The Clean Water Act requires the states to report surface water quality conditions and problems to the EPA every two years.

The kinds and variety of aquatic life surviving in a stream give a good picture of the quality of the water and sediments in which they live. NH DES started a biomonitoring program that began sampling in 1997, and has looked at the upper reaches of Sugar River. Vermont has used a similar approach for many years. Biologists visit streams to collect fish and macroinvertebrates (aquatic insects), gather basic physical and chemical water quality data, and assess the condition of aquatic habitat.

Volunteers sample the Connecticut River at Sumner Falls.

Both states are now welcoming the help of citizen volunteers in gathering data about their local waters. In 1998, NH DES started the Volunteer River Assessment Program (VRAP), providing training, water quality monitoring equipment, and technical support. VRAP supports over a dozen volunteer groups throughout the state who conduct water quality monitoring, including Stevens High School in Claremont, which monitored the Sugar River for three years. Students at the New Hampshire Community Technical College in Claremont took over this challenge in 2006. VRAP data are available on-line at http://des.nh.gov/organization/divisions/water/wmb/vrap/index.htm. The National Park Service has been monitoring the quality of Blow-Me-Down Brook in Cornish at Saint-Gaudens National Historic Site since 1997.

As of this writing, a two-year effort to monitor the effects of combined sewer overflows has taken place in the Lebanon/Hartford to Cornish/Weathersfield section of the Connecticut River, sponsored by a grant to CRJC and partners from the EPA. Results are posted at www.cesd.umass.edu/twi/TWI_Projects/Water_Quality_Monitoring/index.html.

Otherwise, there is currently no regular, on-going water quality monitoring program on the Connecticut River or most of its New Hampshire tributaries in the Mount Ascutney region. A volunteer monitoring program known as Connecticut RiverWatch operated in the late 1980s and early 1990s, but the information collected is now out of date.

In Vermont, water quality monitoring rotates through the various basins on a seven year schedule. A volunteer school monitoring program was active on Mill Brook in Windsor, assisted by the Southern Windsor County Regional Planning Commission. However, it has proved difficult to find volunteers dedicated enough to drive the samples to the state lab in the short time frame required. A vigorous watershed group, the Black River Watershed Action Team, has formed around that tributary, and has conducted a visual assessment, riparian buffer inventory, and a number of major clean-ups, but has not yet become involved in water quality monitoring. Monitoring and river clean-ups are suitable community service projects for area students that can help develop a lifelong sense of river stewardship.

5. Water Quality in the Connecticut River Today

In preparation for the update of this plan and at the request of the Connecticut River Joint Commissions, NH DES, assisted by the EPA, assessed the entire river mainstem in New Hampshire in 2004. (1, Appendix D) NH DES added a sampling location at Sumner Falls in order to better understand water quality in this section. The study looked at bacteria, to see if the water is safe for swimming, boating, and fishing, and also measured fish habitat quality by looking at dissolved oxygen, pH, specific conductance, and temperature. Sampling locations were:

- Sumner Falls, Hartland
- North Star Canoe Launch, Cornish
- Ascutney Bridge, Claremont
- Cheshire (Route 11) Bridge, Charlestown
- Arch Street Bridge, Walpole

"We benefit from everything done above us to improve water quality, and in our region, we try to do our part."

Ted Putnam, Mount Ascutney Subcommittee Co-Chair, Charlestown

Bacteria - For 29 miles from Cornish/Windsor downstream to the Bellows Falls Dam, the river's quality fully supports swimming and other contact recreation, according to the 2004 study. However, while no bacterial contamination was present during the five days of sampling in 2004, New Hampshire still considers that CSOs in the wastewater collection systems serving Lebanon, discharging to the Mascoma River, and until recently CSOs in White River Junction discharging to the White River, render the Connecticut River unsafe for swimming for 13.8 miles from the confluence of the White River to Blow-Me-Down Brook in Cornish. River contamination is more likely during and immediately after heavy rainfall, although only one bacteria violation was noted during the rainy summer of 2009.

The part of the river considered threatened by CSOs includes Sumner Falls, where kayakers and swimmers often immerse themselves. The area just upstream also receives treated wastewater

from the three plants serving Hanover, Lebanon, and White River Junction. Bacteria can also reach rivers through poorly functioning septic systems and through runoff, such as drainage from a pasture or stormwater carrying pet waste into the river from urban areas.

Aquatic habitat - The New Hampshire study noted threats to aquatic habitat in the area of the Cheshire Bridge (Route 11) from invasive aquatic plants, but no problems with pH or dissolved oxygen. Invasive plants have become more widespread in the few years since this study was done. (see "Invasive Species" later in this document).

Vermont report - In 2002, VT DEC described threats to aesthetics, swimming, boating, fishing, fish consumption, drinking and agricultural water supplies in the Connecticut River mainstem from pathogens and sedimentation, flow fluctuations, metals and organics from streambank erosion, flow regulation, upstream impoundment, and hazardous waste at the Goodyear site in Windsor. Threats to swimming and drinking water supply from pathogens, turbidity, and polyaromatic hydrocarbons exist between the Sugar River confluence and the Bellows Falls Dam.

6. EPA Pollution Reconnaissance

The U.S. Environmental Protection Agency conducted a pollution reconnaissance of the Mount Ascutney region in 1999,[1] in Claremont and Newport, NH and Springfield and Bellows Falls, VT. EPA looked at potential pollution sources, updated the agency's information, and offered help in complying with water quality standards. EPA also conducted training and workshops for local officials on local emergency planning and how to manage and keep better track of stored pollutants. The study also surveyed the riverfront for point source discharges.

These four towns are dealing with abandoned industrial properties, and some of the properties have been taken as payment for back taxes, leaving the towns with the immense legal and financial responsibility of cleaning them up. The study concluded that many communities do not understand the environmental and financial liabilities of seizing such properties, and that it would be helpful to offer training for local officials on how to evaluate properties before they are acquired.

Recommendations for Water Quality Monitoring

- Town conservation commissions, tributary watershed groups, and other interested citizens should work with their state's water quality agency to do more regular and sustained monitoring of Connecticut River tributaries.

- State water quality agencies could better coordinate water quality monitoring with regional planning commissions, using water quality planning grants.

- The Black River Watershed Action Team should consider starting a water quality monitoring program.

---

1. *Pollution Reconnaissance Report for the Mount Ascutney Region of the Connecticut River,* US EPA Office of Environmental Measurement and Evaluation, 1999.

- Vermont should begin basin planning for Rockingham's Commissary Brook as soon as possible, due to severe sedimentation problems and resulting pollution of the Connecticut River.

- Schools and youth groups should encourage students to take on water quality monitoring and river clean-ups as suitable community service projects.

C. Connecticut River Sediment Quality

Several studies of river sediments have shed light on what may be present in the silts and sands of the river bottom. In response to the 1997 *Connecticut River Corridor Management Plan,* EPA conducted two studies of sediments that sampled sites in the Mount Ascutney region. In general, sediments looked relatively clean, although results indicate that road runoff probably has an effect upon aquatic life. Heavy metals and polyaromatic hydrocarbons associated with automobiles appear in the sediments in relatively low levels.

"Low effects level" = level at which effects on aquatic life might be expected.

In 1998, EPA conducted a sediment study of ten sites on the New Hampshire/Vermont portion of the river. One of the sites is located in the Mount Ascutney region, below the confluence of the Sugar River.[1] Seven metals were sampled, with none above the "low effects" level, although four polyaromatic hydrocarbons were above the "low effects" level. This site had the highest polyaromatic hydrocarbon level of any of the ten sites examined in this study. These chemicals can get into streams when roads closely follow waterways, from leaks and drips from automobiles, snowmobiles, or other vehicles, and from leaking underground storage tanks.

Two years later, EPA returned for a more detailed study, and sampled sediment at 100 sites on the northern part of the river, as far south as the Ottauquechee River in Hartland, just above its confluence with the Connecticut River.[2] Here, EPA found that only chrysene, a polyaromatic hydrocarbon, was present above screening levels. Sediment quality results are summarized in Appendix D.

D. Connecticut River Fish Tissue

In 2000, EPA worked with the four Connecticut River states to conduct a comprehensive fish tissue toxin study.[1] This landmark study, which may be the first river-wide study of fish tissue in the nation, represents significant cooperation among the four states, each of which contributed substantial funding and staff. The concept for the study comes directly from the public, raised in the 1997 *Connecticut River Corridor Management Plan,* and stimulated by a question from Springfield's representative to the Mount Ascutney Region River Subcommittee.

---

1. *Connecticut River Fish Tissue Contaminant Study: Ecological and Human Health Screening (2000)*. Prepared for the Connecticut River Fish Tissue Working Group by Greg Hellyer, Ecosystem Assessment Unity, US EPA - New England Regional Laboratory, N. Chelmsford, Mass., May 2006.

Biologists sampled white sucker, yellow perch, and smallmouth bass from eight sections of the Connecticut River, choosing fish species that represent different levels of the food chain and are widely found in most of the 410 mile long river. Smallmouth bass, yellow perch and white suckers were collected during 2000 from the mainstem of the Connecticut River and composite samples were analyzed for total mercury, coplanar (dioxin-like) PCBs and organochlorine pesticides, including DDT and its breakdown products. EPA banned the use and manufacture of PCBs in the U.S. in 1977. DDT use was severely restricted by EPA in 1972 after application of over 1.3 billion pounds during the previous 30 years. Dioxins and PCBs break down very slowly in the environment and bio-accumulate in food chains.

Fish Consumption Guidelines:
(do not apply to stocked fish): Pregnant and nursing women, and women who may get pregnant can safely eat one 8-ounce meal per month of freshwater fish. Children under age 7 can safely eat one 4-ounce meal per month of freshwater fish. All other adults and children age 7 and older can safely eat four 8- ounce meals per month of freshwater fish. When eating bass, pickerel, white perch or yellow perch, limit consumption to fish 12 inches or less in length while following the above guidelines. Stocked trout contains relatively low levels of mercury. For rainbow and brown trout, women of childbearing age and children can safely eat one meal per week, others can eat 6 meals per week. Brook trout could be either stocked or from a reproducing population, therefore they should be consumed at the rate of the general statewide advisory.

Mount Ascutney Region fish were sampled as part of Reach 5 (Wilder Dam to Vernon Dam). In this reach, mercury in fish is a threat to subsistence fishers and to fish-eating birds and mammals, but not to recreational fishers. Dioxin-like PCBs pose a risk to recreational and subsistence fishers and to fish-eating mammals and fish-eating birds. DDT and related breakdown products pose a risk to human subsistence fishers and to fish-eating birds, but not to recreational fishers or fish-eating mammals.

The study found that total mercury concentrations in all three species of fish were significantly higher upstream than downstream. Risk from PCBs was generally lower in upstream areas than in downstream areas, although this varied by fish species and was different for the humans, mammals, birds or fish that eat them.

E. Invasive Aquatic Species

Exotic aquatic plants and animals have been an increasing problem in New Hampshire and Vermont since the mid-1960s. They now infest many dozens of water bodies in each state. The first recorded invasive in the Connecticut River was Eurasian milfoil at Hoyt's Landing, reported in 1995 by a member of the Mount Ascutney Subcommittee. The most recent unwanted arrival is the invasive alga Didymo in 2007, discovered upstream in the Connecticut River at Bloomfield, Vermont and in the White River. A list of invasive aquatic species in the Mount Ascutney region appears in Appendix E.

Native plants have evolved together over thousands of years with animals such as beetles and other insects that have become specialized to feed on them. Exotic species, growing without such natural controls, can crowd out natives, disrupting the food chain and stunting fish growth. Exotic aquatic plants can interfere with boating and swimming and reduce the value of waterfront property. The zebra mussel could harm boating, swimming, fisheries, and even industry.

Once an invasive plant or animal is established in a water body, continuous management is the only way to control it. Therefore, it is important to prevent infestations in the first place and identify new ones early. State biologists conduct field searches each summer, but volunteer help is critical. Both states offer grants to local lake associations and towns for control and treatment of exotic aquatic weeds, and have programs and training for volunteer "weed watchers."

Sources of invasive aquatics - Exotic invasive plants and animals reach the river in many ways. Plants such as milfoil can come in on the propellers and trailers of boats that have been in infested waters, or spread through drainage from such waters. Zebra mussel larvae can survive several days in bait buckets, live wells, or engine cooling systems. Aquatic invasives could come from aquariums dumped into surface waters or from flooding of landscaped "water gardens" planted with exotic plants. Road crews can spread soil and fill contaminated with the seeds or root fragments of plants such as Japanese knotweed. Didymo apparently arrived in the watershed on the soles of fishing waders belonging to a fisherman who had recently traveled to New Zealand.

Didymo - *Didymosphenia geminata* (Rock Snot, also called Didymo), is an invasive freshwater diatom (microscopic algae). It can form extensive colonies on the bottoms of rocky river beds, smothering aquatic life such as macroinvertebrates (aquatic insects). Its appearance is very unattractive, making the water less appealing for recreation.

Didymo is generally a northern circumpolar species of river systems with cobble or rock bottoms, although biologists are noticing a shift to streams in warmer climates and with more nutrients. While it may not pose a threat to sandy or silty portions of the Connecticut River in the Mount Ascutney Region, it could move from there into tributaries.

Biologists believe that Didymo can be spread by any recreational equipment, including felt-soled waders, bait buckets, diving gear (neoprene), water shoes, canoes, kayaks, and life jackets. There is currently no way to control or eliminate Didymo. The alga can remain viable for several weeks if kept moist. The agencies have concluded that the best approach is to attempt to prevent further spread by humans, especially to tributaries.

Milfoil - Since its appearance in 1995 at Hoyt's Landing in Springfield, milfoil has since spread, especially downstream of this area. There is no boat/trailer check program in place anywhere in the region to ensure that boats are not delivering hitch-hiking weeds from other waters or bringing it elsewhere from the Connecticut River.

Other Invasive Aquatic Plants - The 2006 Connecticut River Aquatic Invasive Plants Outreach & Survey Project, funded by the Connecticut River Joint Commissions' Partnership

Program, surveyed for invasive plants at 21 mainstem sites including two in the Mount Ascutney region, and found the northernmost population of curly leaf pondweed. A subsequent study in 2007 has been completed through the Sullivan County Conservation District.

Water Chestnut - An isolated infestation of this noxious plant was discovered in 2005 in North Springfield Lake by a member of the Mount Ascutney River Subcommittee, apparently early enough for a removal effort to be successful. This is thought to be the only known infestation of this plant in the upper watershed.

Purple Loosestrife - This invasive wetland plant has become noticeably more common in the last 10 years in the region. Releases of *Galerucella* beetles to control purple loosestrife have occurred in a number of areas. While some success has been reported with this bio-control, water level fluctuations in the Bellows Falls impoundment may affect winter beetle survival in riverfront soils.

Site	Town	Invasive Species Found
Lower Ottauquechee River/CT River confluence and mainstem	Hartland, VT & Plainfield, NH	Purple Loosestrife Japanese Knotweed
CT River from upstream end of Chase Island to Balloch Crossing	Cornish, NH & Windsor, VT	Eurasian Milfoil Purple Loosestrife Phragmities - Giant Reed Japanese Knotweed
Lower Mill Brook and nearby Connecticut River	Cornish, NH & Windsor, VT	Eurasian Milfoil Purple Loosestrife
Hoyt's Landing, Black River/CT River confluence & portion of Connecticut River, VT side	Springfield, VT	Eurasian Milfoil Curly Leaf Pondweed Purple Loosestrife Japanese Knotweed
CT River above South Charlestown boat launch	Charlestown, NH	Eurasian Milfoil Purple Loosestrife Japanese Knotweed
Herrick's Cove, Connecticut River, VT side; Public boat launch	Rockingham, VT	Eurasian Milfoil Curly Leaf Pondweed Purple Loosestrife

Japanese Knotweed - The Black River Watershed Action Team reports that this invasive plant has formed very large colonies on riverbanks in this tributary watershed. Research into control methods is underway in this region.

Invasive aquatic animals - The zebra mussel has not yet invaded the Connecticut River, which is considered one of the few New Hampshire water bodies susceptible to this invader because of the chemistry of the water. The zebra mussel is becoming a scourge in Lake Champlain, covering intake pipes, boat hulls, docks, and beaches. There is concern that tournament fishermen may inadvertently deliver zebra mussel larvae to the Connecticut River, especially at Hoyt's Landing or Herrick's Cove. Upstream in the White River watershed, studies indicate that the exotic rusty crayfish is increasing after fishermen using them as bait released them into the water. This species is an aggressive competitor of native crayfish. The status of other invasive aquatic animals in the Mount Ascutney region is currently unknown.

Recommendations for Invasive Aquatic Species

- State environmental and fisheries agencies should continue to cooperate to better understand and address the Didymo infestation.

- River users must carefully clean their gear after visiting the Connecticut River and report sightings of invasive aquatic species to state agencies. Do not release unused bait into the water.

- Local outfitters and guides should educate their customers about Didymo and other invasives, and to clean gear.

- Boaters or divers traveling from waters infested with zebra mussel must wash and dry all equipment before reuse, hose off the boat, diving gear or trailer, and drain and flush the engine cooling system and live wells of the boat, bait buckets and the buoyancy control device from diving equipment.

- Aquarium owners should not dump aquarium plants or animals into any water body, but dispose of them by freezing or drying before putting them in the trash.

- Transportation agencies and road crews should make efforts not to transport fragments of invasive plants during road construction projects.

- Town conservation commissions should help educate the public about invasive species.

IV. River Flow

A river is much more than just the runoff of rainfall. Rivers also draw their waters from underground springs of groundwater, slow seepage from wetlands, melting snow, and tributaries large and small. The amount of water in a river changes naturally during the year as the ground freezes and thaws, as trees leaf out and draw moisture from the soil, and as warm winds evaporate surface water.

Humans can affect the amount of water in a river by withdrawing water for irrigation or industrial use, building dams, clearing forests, filling wetlands, covering soil with hard surfaces like pavement and roofs, and by drilling wells to pump out groundwater that otherwise might reach the stream. Some of these actions, like withdrawals, simply reduce the amount of water flowing in the river. Others, such as clearing and development, send runoff to the river more quickly and erosively, rather than slowly and steadily. Dams can influence river flow by holding back water and allowing only a portion to flow, and by creating an impoundment where water can evaporate before it has a chance to flow downstream.

All rivers rise and fall through the year and respond to changes in weather and watershed. A healthy river has enough water flow to keep fish and aquatic life alive year-round and to dilute and flush pollutants. A healthy river also naturally floods, but humans can affect the severity of floods by where they build and how they alter water's natural path to the river. Local regulations regarding protection of wetlands and shorelands are summarized in Appendix F.

A. Streamflow Gaging Stations

Gaging stations measure water level and flow rates, and are useful in helping to forecast flooding, set floodplain levels and regulations, and see historical flooding trends in river systems. Gages tell river managers, state and local officials, and landowners about flow conditions on the river and its tributaries, essential during times of low and high water. Gages are also cited in water use permits and help define operations of hydro generating plants that affect flow. Good river management requires good knowledge of current river conditions, now possible due to satellite communication technology. There are currently two gaging stations on the Connecticut River in the Mount Ascutney region, and six on tributaries that enter the river in this area. Gage data are available at www.crjc.org/riverflow.htm.

Table 1a. Active gages relevant to the Mount Ascutney Region

Location	River	Gage number	Drainage area(sq.mi.)	Measurements available (real time)	Years of Record	Funding source
West Hartford VT	White River	01144000	690	discharge, gage height	since 1915	USGS, VT DEC and other state agencies
West Lebanon NH	Connecticut	01144500	4,092	discharge, gage height (includes flow of White River)	since 1911	National Streamflow Information Program
W. Bridgewater VT	Ottauquechee	01150900	23	discharge, gage height, precipitation	since 1984	USGS, VT DEC and other state agencies
North Hartland VT	Ottauquechee	01151500	221	discharge, gage height, precipitation, air temperature	since 1930	USGS & U.S. Army Corps of Engineers
West Claremont NH	Sugar	01152500	269	discharge, gage height	since 1928	USGS and NH DES
Springfield VT	Black River	01153000	158	discharge, gage height	since 1929	USGS, VT DEC and other state agencies
Rockingham VT	Williams	01153550	112	discharge, gage height	since 1986	USGS, VT DEC and other state agencies
North Walpole NH	Connecticut	01154500	5,493	discharge, gage height, precipitation, air temperature	since 1942	USGS and NH DES

Funding for gage upkeep is shared by the U.S. Geological Survey (USGS) with VT DEC, NH DES, and other agencies. The actual average cost of maintaining one stream gage is approximately $12,500 per year. This cost includes gage calibration, equipment maintenance, data analysis, and data management. The units are solar-powered and unmanned. There have been threats to gage funding in recent years, primarily as a result of efforts to cut state budgets, and gages have been eliminated in other parts of the river basin. Since more extreme weather patterns seem to be emerging, and water is an increasingly valued commodity, it is important to be sure gages remain funded so that the data will continue to be available. TransCanada needs as much information as possible to manage flow at mainstem dams in high water situations, and uses gage data to do this.

New Hampshire's Rivers Management Advisory Committee is recommending addition of some gages, particularly in the watersheds of designated rivers such as the Connecticut. Gages suggested for the Mount Ascutney region include one on the Sugar River near its outlet from Lake Sunapee and another on Blood Brook, to help ensure good water quality from the Meriden

Table 1b. Discontinued Gages in the Mount Ascutney Region				
Location	**River**	**Gage number**	**Drainage area (sq.mi.)**	**Years of Record**
Brockways Mills, Vt	Williams River	01153500	103	1940-1984

wastewater treatment system. The dam at Sunapee is manned, providing a source of information about discharges. Other possible sources of flow information are wastewater treatment plant operators and volunteer citizen monitors.

Recommendations for Gages

- USGS, NH DES, VT DEC should cooperate to maintain existing gages for public safety.
- NH DES and USGS should add a gage at Blood (True's) Brook to help ensure proper operation of the Meriden wastewater treatment facility.
- NH DES and USGS should consider a new gage at Lake Sunapee as a lower priority, because information can be sought from the manager of the dam at the foot of the lake.
- NH DES, VT DEC, and USGS should approach TransCanada for funding assistance to maintain gages, if necessary.

B. Flow & Flooding

The Connecticut River in the Mount Ascutney region typically experiences heavy flows with spring ice-out and snowmelt. Flooding at this and other times of the year is now controlled to a minor extent by flood control dams on the Ottauquechee and Black Rivers and also one upstream of this region on the Ompompanoosuc River. These dams control less than 10 percent of the flow from the 5,400 square miles of the Connecticut River's watershed that drains through Bellows Falls. These tributaries once had more influence on the mainstem in this part of watershed, although the White River, Vermont's largest undammed tributary, still has a significant effect on the Mount Ascutney segment, especially during ice-out. On a smaller scale, but important locally, beaver dam failure can also be dangerous.

"It is a great river and has big problems when it has them."

Barry Cahoon, Vermont stream scientist

1. Instream Flow

Instream flow refers to how much water is flowing in a river or stream...how often, how long, when, and how fast it changes. Instream flow is affected by rainfall, snowmelt, drought, and also by damming, diversion, withdrawals, and development. This can in turn affect water quality, erosion, temperature, recreation, nearby water supplies, and especially habitat. Water withdrawn from Lake Sunapee for snow-making at Mount Sunapee Ski Area remains on the slopes as snow well after spring flooding begins to subside, reducing flooding downstream.

Except in very high water conditions, instream flow of the Connecticut River in most of the Mount Ascutney region is controlled almost completely by operations at Wilder and Bellows Falls Dams. (see chart in section on Dams) A factor adding natural variation to the closely managed mainstem flow is the large watershed of the free-flowing White River, entering just below Wilder Dam.

As a river designated into New Hampshire's Rivers Management and Protection Program, the Connecticut River is to be governed by instream flow rules to ensure that there is adequate flow for "public uses including but not limited to navigation, recreation, fishing, storage, conservation, maintenance and enhancement of aquatic and fish life, fish and wildlife habitat, wildlife, the protection of water quality and public health, pollution abatement, aesthetic beauty, and hydroelectric energy production."

Sumner Falls at high flow (32,000cfs) and low flow.

Instream flow rules for two New Hampshire rivers, the Souhegan and the Lamprey, have been drafted through a pilot process that will eventually be used on other rivers. At this time, there are no plans to attempt to create flow rules for the Connecticut River.

Vermont considers instream flow when issuing dam permits and water quality certificates, snow-making withdrawals, stream alteration permits, and Act 250 projects. The purpose is to "assure the passage of adequate water to maintain fisheries interests, aesthetic qualities, recreational and potable water supply uses appropriate to the water body in question." The state focuses on minimum flows adequate for fisheries-related interests, and uses the "7Q10" level, which means a drought flow equal to the lowest mean flow for seven consecutive days, adjusted to nullify any effects of artificial flow regulation, that has a 10 percent chance of occurring in any given year.

2. Flood Control

Flood control dams - The U.S. Army Corps of Engineers manages two flood control dams on tributaries that enter the Connecticut River in the Mount Ascutney segment: on the Ottauquechee River in North Hartland and on the Black River in North Springfield. Both were constructed by the federal government in response to flooding during hurricanes that affected the region in the 1950s. In recent years, partly as a result of a recommendation in the 1997 *Connecticut River Corridor Management Plan*, the Army Corps has communicated information about its water releases and dam operations much more effectively to managers of mainstem dams.

"They're holding the tail of a tiger when they try to control that river."

Kurt Staudter, Mount Ascutney Subcommittee Co-Chair, Springfield

The Army Corps has begun to look at structural changes to these dams to determine the best way to provide fish passage and to better regulate flow

Table 2. Flood Control Dams in the Mount Ascutney Region		
	North Hartland	**North Springfield**
Owner	U.S. Army Corps of Engineers	U.S. Army Corps of Engineers
Date built	1961 (cost: $7.3 million)	1960 (cost: $7 million)
Location	Ottauquechee River, Hartland, VT	North Branch of the Black River, Springfield, VT
Operating limits	managed for flood control	managed for flood control
Dam size	185 feet high, 1,640 feet long	120 feet high, 2,940 feet long
Dam type	earthen and concrete	earthen
Impoundment	1,100 acre lake capable of storing 23.1 billion gallons of water; 71,400 acre-ft	100 acre lake; 1,200 acre lake capable of storing 16.6 billion gallons of water
Drainage area	220 sq. mi.	158 sq. mi.
Flow control	three 6′ x 10′6″ hydraulically operated gates. Flood releases normally made from 12′ x 8′4″ radial bypass control gate downstream of dam near powerhouse.	three 5′ x 12′ hydraulically operated gates.
Spillway	465 feet long	384 feet long
Fish passage	none	none
Property size	1,728 acres, managed for flood control, public recreation and forestry	1,870 acres, managed for flood control, public recreation and forestry

and temperature to lessen their effects on downstream waters. An updated master plan was completed in 2004 for the North Springfield Flood Control Dam. These earthen dams are aging and will need significant maintenance in the coming years. Some people believe that the recreation lakes at these two dams have reduced the dams' usefulness for flood storage, their primary purpose.

Role of mainstem hydro dams in flood control - The dams on the mainstem of the Connecticut River were built for hydropower generation, not for flood control, although when possible, they are operated to help ease flooding in the Connecticut River. However, it is a mistake to assume that even the largest hydro dams are able to control flooding at all times. Following heavy rains in October, 2005, flood water exceeded storage capacity at both Moore and Comerford Dams many miles upriver at Fifteen Mile Falls, and flooding occurred below them. Wilder Dam is a much lower dam whose impoundment has little room to store water to keep the Mount Ascutney region from flooding. TransCanada operates the Bellows Falls Dam in coordination with Wilder Dam upstream and Vernon Dam downstream.

"It is wishful thinking to believe that an ice jam can be controlled. Ice is a chaotic system."
Springfield resident

River dredging for flood control - Years ago, some rivers were dredged in the belief that this would create more storage room for flood water. The U.S. Department of Agriculture and other resource management agencies actually encouraged this practice at a time when sediment transport in streams and other stream mechanics were poorly understood. Contrary to expert advice and public opinion, extensive gravel mining contributed directly to the destabilization of river channels and increased bank erosion and flood-related property damage as the streams began to readjust to their natural shape. The states no longer permit gravel dredging in rivers

except under very limited circumstances. A better way to prevent flood damage is to restore a stable stream form and protect the stream corridor from incompatible development.

Role of ice in flooding - Ice-out events on the Connecticut River in the Mount Ascutney region can be spectacular. Ice jams can block the water's flow, sending it in a new path or causing sudden release and flooding as the jam breaks. Ice movement and management are very important here, due in part to the contribution of ice from the White River, its largest tributary, which enters the mainstem just above the Mount Ascutney section. Depending upon winter conditions, ice from the White River will enter the mainstem at flows between 9,000 and 14,000 cubic feet per second (cfs). Once this ice enters the mainstem, it breaks up sheet ice there and grounds itself in several prominent locations. One such site is above the Cornish/ Windsor Covered Bridge, which has been lost three times to ice jams during its long history. There are at least four more locations where major jamming occurs before the ice reaches the Bellows Falls Dam. Ice flow can damage the gate cylinders and seals at Bellows Falls, so river ice is monitored during spring runoff. TransCanada attempts to manage water levels at Wilder Dam and Bellows Falls to help prevent ice jams.

The Army Corps of Engineers' Cold Regions Research and Engineering Laboratory has conducted research on ice formation in the Connecticut, specifically around the Cornish-Windsor Covered Bridge. *Frazil* is a type of ice crystal that forms in moving, super-cooled water, which may stick together, some forming anchor ice on the bottom, and some forming floating snowballs that converge into pans, and finally floes. Floes may stretch across the river, joining shelf ice at the banks, and slow the river's flow – eventually creating an ice jam and flooding if water gets backed up behind it. If dislodged, anchor ice may move even large rocks and carry away significant amounts of sediment. Blocks of ice moving during a surge – when a large amount of water is freed all at once, such as when an ice jam breaks – can scour a riverbed.

"Maybe the Alstead incident is the pot of gold at the end of the rainbow, to wake everybody up on the need to look at culverts and flood hazards."

Springfield citizen

There have been three major ice-out events in the last century in this region. Ice jams created an extreme hazard during a fast ice-out in 1996, when ice backing up behind the Bellows Falls Dam was forced under the surface and caught on the submerged log boom islands that remained on the river bottom from the days of the log drives. Eddies and ice eroded a high sandy bank in North Walpole, threatening homes, Route 12, and the rail line. An ice jam created flooding in Charlestown and residents of a mobile home park located in the floodplain had to be evacuated by boat.

Residents note diminished ice thickness in the Connecticut River in recent years, an observation confirmed by researchers with the Army Corps of Engineers. The hydro power company has monitored snow pack in order to predict snowmelt, although the company no longer has the manpower to monitor gages. Fortunately, there has not been a troublesome ice-out since the days when New England Power Company managed the mainstem dams. On the Connecticut, the hydro dams reduce the chances of dynamic break ups and ice jams by controlling the up- and downstream flow, although some years ago the Black River had an ice jam that lasted a month and acted like another, uncontrolled dam.

Floodplains are important in absorbing flooding from ice jams. There is concern about whose responsibility it is to monitor ice jams, and whether TransCanada, the current owner of the mainstem power dams, would alert towns if a problem is anticipated. TransCanada river managers headquartered at Wilder Dam will send someone out to scout the river for ice jams if signals indicate a possible problem.

3. Extreme Storms

The Mount Ascutney region has recently experienced some sudden, severe rainstorms, although none as strong as those that have affected the Cold River watershed, Hanover, or the Headwaters area in 2004 and 2005. Flows on the Sugar River in West Claremont on October 9, 2005 were measured at 9,760 cfs, the highest flow since a flood in 1936 flood. Such storms have been described as symptoms of climate change. Whether this is true cannot be known for certain, but such storms can have very damaging effects on smaller streams in particular.

Culverts and bridges must be sized properly in order to carry the water that might come their way. A 2005 study by Michael Simpson at Antioch New England Graduate School in Keene, N.H., concluded that current engineering design specifications for culvert sizing is inadequate to handle the higher frequency of storms of greater intensity that can be expected with climate change.

In other parts of the river valley, regional planning commissions are helping towns with surveys of their bridges and culverts, to identify those that may be too small and could be a public safety hazard in times of high water. An undersized culvert contributed to devastating flooding in Alstead in the nearby Cold River watershed in October, 2005. Going back and looking at those culverts with today's knowledge could avoid future trouble.

Climate Change and water resources - According to the most recent research climate change is already underway, and the Northeast can expect higher temperatures and shifting seasons, reduced snow cover, and more extreme weather.[1] How large these changes will be depends on emissions choices we make now and in the near future, both here in the Mount Ascutney region, in the Northeast, and globally.

Temperature - The build-up of heat-trapping gases – primarily carbon dioxide, methane, and nitrous oxide – is already affecting the earth's climate, as human activities alter the chemical composition of the atmosphere.[2] During the 20th century, the average temperature in Hanover, N.H., increased 2 degrees F, while in Vermont, the average temperature in Burlington increased 0.4 degrees F. [3, 4]

---

1. *Climate Change in the U.S. Northeast.* A report of the Northeast Climate Impacts Assessment, Union of Concerned Scientists, Cambridge, Mass., 2006.
2. *Climate Change 2007: the Physical Science Basis; Summary for Policy Makers*. Intergovernmental Panel on Climate Change, Paris, February 2007.
3. *Climate Change and New Hampshire*. US Environmental Protection Agency, Office of Policy (EPA fact sheet 230-F-97-008cc), September 1997.
4. *Climate Change and Vermont*. US Environmental Protection Agency Office of Policy (EPA fact sheet 236-F-98-007aa), September 1998.

With continued high emissions, scientists predict dramatic warming in the Northeast of 7 to 12 degrees F by the end of the century, while lower emissions would cause roughly half this warming. At the present rate of emissions, this warming could mean that summer in New Hampshire and Vermont would feel like summer in North Carolina.[1]

Precipitation - Climate change would do more than add a few degrees to today's average temperatures. Some places would be drier, others wetter. More important, more precipitation may come in short, intense bursts (more than two inches of rain in a day), which could lead to more flooding. Measurable increases in the number of heavy rain storms have already occurred across the Northeast in recent decades, and both average and extreme precipitation are expected to continue to increase. Similar increases are expected on both the lower- and higher-emissions pathways.[1] More flooding could lead to greater erosion and increases in sediment, fertilizers, and other pollutants in runoff.

Droughts - On a higher-emissions pathway, a short seasonal drought can be expected every year in most of New England by the end of this century, while the frequency of longer droughts could triple. On a lower-emissions pathway, the risk of drought is projected to be only slightly greater than today.[1] Such droughts could lower groundwater levels and affect the drinking water supply of some smaller towns and rural residents who depend on shallow aquifers and wells. Farmers finding reduced soil moisture in their fields due to drought and increased evaporation may turn more toward irrigation to satisfy their crops' water needs, at a time when river flow is already down, setting up a possible conflict between flows needed to support fisheries.

Snow pack - The number of days of snow cover is predicted to fall. With higher emissions, the Mount Ascutney region may no longer retain winter snow cover for at least 30 days by the end of this century.[1] By contrast, lower emissions would result in a 25 percent reduction in snow-covered days. Therefore, while some winter warming and reduced snowfall appears inevitable, the most extreme change is not. Local people remember ice fishing at the mouth of the Black River in November, but in recent years, they have had to wait until late December before the ice is strong enough.

Winter snow accumulation and spring melt strongly affect river flow. Precipitation that falls in early winter as rain rather than snow can run off frozen ground, rather than staying to melt in the spring. A warmer climate could also lead to earlier spring snowmelt, and result in higher streamflows in winter and spring and lower streamflows in summer and fall.

Stream flow - During the summer, the flow of many rivers and streams is typically down, creating low water levels and putting stress on fish and other aquatic life. Fall rains usually bring the streams back up and conditions improve. With higher emissions, however, projections show that stressful low water levels could occur nearly a month earlier in the summer and persist almost a month longer into the fall. With lower emissions, the low-flow period is also expected to expand by roughly two additional weeks in fall.[1]

---

1. *Climate Change in the U.S. Northeast*. A report of the Northeast Climate Impacts Assessment, Union of Concerned Scientists, Cambridge, Mass., 2006

Because evaporation is likely to increase with warmer temperatures, and over a longer growing season, it could result in lower river flow and lake levels, especially in summer. Warmer water temperatures also reduce dissolved oxygen, adversely affecting fish habitat, and lower summer streamflows could reduce the ability of rivers to assimilate waste. Less flow in summer streams could mean less dilution of pollutants and poorer water quality.

State action - Both New Hampshire and Vermont have adopted state climate change action plans:

New Hampshire Climate Change Action Plan - http://des.nh.gov/organization/divisions/air/tsb/tps/climate/index.htm.

Vermont Comprehensive Energy Plan and Vermont Greenhouse Gas Action Plan, 1998 http://publicservice.vermont.gov/pub/state-plans-compenergy.html

Recommendations for Flow and Flood Control

- Towns should be very aware of the potential for catastrophic events, and coordinate with the U.S. Army Corps of Engineers and TransCanada in monitoring runoff and snowmelt.

- The Army Corps should ensure that the earthen flood control dams at North Springfield and Hartland are well maintained for the safety of the public, and devote the proper resources to these facilities.

- TransCanada should alert towns if a problematic ice jam is anticipated.

- Towns should adopt ordinances prohibiting filling and building in the 100-year floodplain and on flowage rights of way; consider establishing a building setback that reflects local soil conditions and the historic record of soil loss into the river, and ensure that buildings are set a safe distance back from the river even when outside of the floodplain; encourage developers and landowners to establish and/or maintain buffers of native vegetation along rivers and streams for privacy and pollution control.

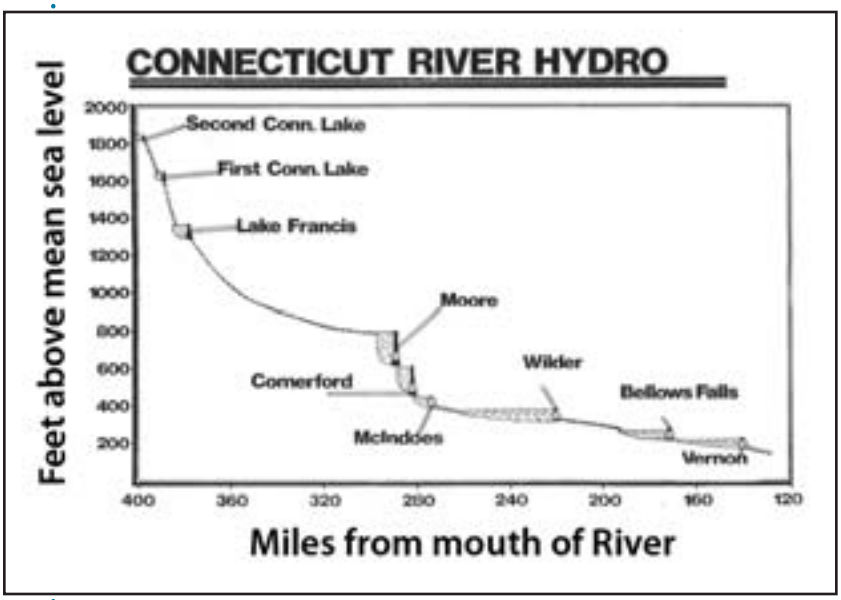
- Towns should seek help from regional planning commissions to identify culverts and bridges that are undersized and might not carry the water that might come their way during larger storms. Increase the minimum design standards for bridge and culverts to bankfull width to reflect current climate research.

- Landowners should obey the law against filling wetlands.

- Federal, state, and local governments should identify mechanisms for decreasing carbon dioxide emissions to help reduce the possible effects of climate change.

V. Working Rivers - Hydro Power Dams

Two major hydro power dams influence the Mount Ascutney segment of the Connecticut River mainstem. Wilder Dam is located just above the river segment in Lebanon/Hartford and Bellows Falls Dam is at the foot of the segment in Rockingham/Walpole.



Location of Wilder and Bellows Falls Dams on the upper river. From New England Power Company.

Both Wilder and Bellows Falls dams were purchased in 2005 by TransCanada Hydro Northeast from USGen New England. They have been fixtures on the river for more than half a century. Their current federal operating licenses expire in 2018, as does that of Vernon Dam.
Both are daily peaking generation plants, raising and lowering water in the Bellows Falls impoundment as they store and release water during the day. The timing and amount of this release depend upon flow conditions in the river and upon market price for electricity.

A. Wilder Dam

Wilder Dam straddles the river between Lebanon and Hartford five miles upstream of the Mount Ascutney segment. Because Wilder impounds a long section of the river, this dam is normally operated to release water when high flows are expected from upstream. This anticipation can affect operations at the Bellows Falls dam downstream.

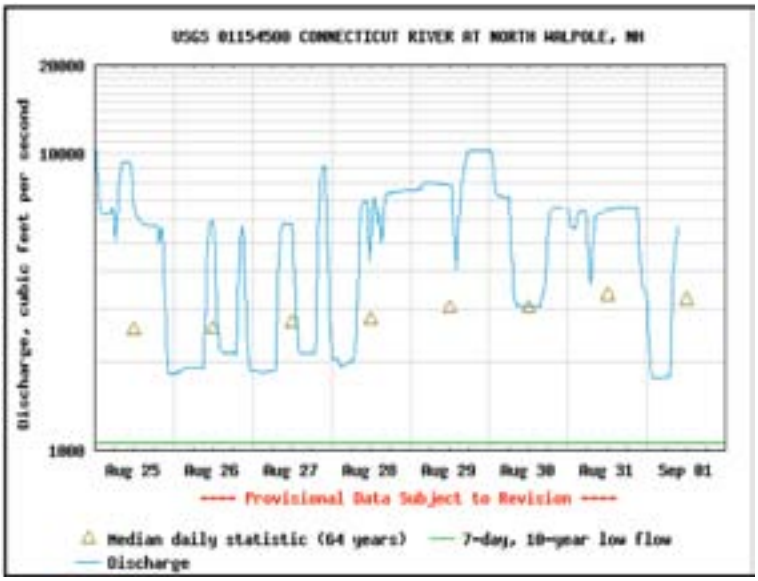
B. Bellows Falls Dam

The Bellows Falls Dam is located between the villages of Bellows Falls, Vt. and North Walpole, N. H. It sits at the head of the 60-foot thundering cascade where the river narrows at the base of Fall Mountain. Once known as the Great Falls, this gorge has been the upstream limit for migrating American shad and a focal point for fishing for perhaps as long as the river has run. The original bed of the river at this rocky chasm is now largely dry for 1,700 feet, except in spring, as the river is diverted through turbines at the dam.

Table 3a. Wilder Dam	
Owner	TransCanada Hydro Northeast
Date constructed	1950
Location	Wilder (Hartford) VT/Lebanon NH, river mile 217
Dam type	concrete
Operating limits	380 feet to 385 feet above mean sea level
Normal operating range	382.0 and 384.5 feet above msl
Required minimum flow	675 cfs or inflow, year round
Spill capacity	101,400 cubic feet per second (cfs)
Fish passage	upstream and downstream
Impoundment	approximately 46 miles; storage of 13,350 acre feet
Generating capacity	42 megawatts (two 19.5 MW turbines and one 3 MW turbine)
watershed area	3,375 square miles
Bypass	none
Time of flow to next impoundment	8 hours

There has been a dam on this site since the late 1700s. The current powerhouse, located on the Vermont side, occupies the site of the first canal built in the United States, in 1802, to bypass the falls. Through the next two centuries, the river powered the growth of major paper factories, including International Paper Company.

The Bellows Falls Dam is equipped with two 115-foot long roller gates and three stanchion board bays, a 1,700-foot long, 100 foot wide canal, skimmer gate, a powerhouse, and associated switch yards. The roller gates are used to pass high water flows up to approximately 68,000 cfs. Flows greater than this require dropping the stanchion bay boards. Bellows Falls generates hydroelectric power by operating as a daily peaking facility.



Water level fluctuations at North Walpole gage, just below Bellows Falls Dam, August 2006.

The Bellows Falls Dam has limited water storage, of about 7,476 acre-feet of water in three feet of drawdown. In recent years, Subcommittee members who are riverfront landowners or who visit the river regularly for fishing and boating report that water levels in the Bellows Falls impoundment fluctuate more dramatically than in the past, with higher highs and lower lows. This could affect the rate of riverbank erosion. While the operations at the dam are recorded in daily operating logs, an independent gage should be installed to verify that these operations are within license limits.

For the first 75 years of its operation, Bellows Falls was fully staffed 24 hours/day, 7 days/week. In 2005, the station was automated and is now controlled remotely by river managers at Wilder Dam. The Town of Rockingham pursued a possible purchase of the Bellows Falls Dam for several years, although voters eventually rejected the idea in 2005.

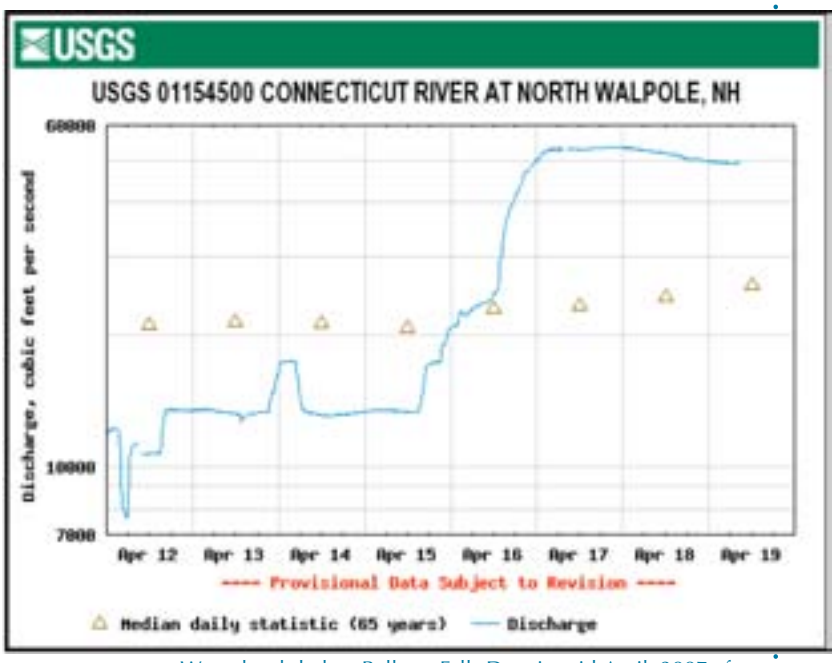
Table 3b. Bellows Falls Dam	
Owner	TransCanada Hydro Northeast
Date constructed	1928
Location	Bellows Falls VT and North Walpole, NH, river mile 174
Dam type	concrete
Operating limits	288.6 feet to 291.6 feet above mean sea level
Normal operating range	289.6 and 291.6 feet above msl
Required minimum flow	1,083 cfs or inflow, year round
Spill capacity	58,800 cfs
Fish passage	upstream (since 1984) and downstream
Impoundment	approx. 30 miles, 26,900 acre feet at full reservoir; surface area of 2,804 acres
Generating capacity	49 megawatts (3 turbines)
Watershed drainage area	5,414 square miles
Bypass length	1700 feet

Pump storage at Fall Mountain - Many years ago, New England Power Company (NEP) purchased the summit and a large portion of Fall Mountain, close to the river in Charlestown and Langdon, New Hampshire, anticipating construction of a pump storage unit similar to Rowe Mountain in the Deerfield River watershed. Having later abandoned these plans, USGen, NEP's successor, sold the property to The Nature Conservancy in 2004, protecting significant habitat on the mountain and preserving its natural hydrology.

New Dams - No new dams may be built on the Connecticut River in the Mount Ascutney region, according to the N.H..Rivers Management and Protection Act. In river segments designated natural, rural, or rural-community, the Act allows repair of a dam which was in place when the river was designated in 1992, at the same place and with the same impoundment level, but only within six years of the failure. The one designated "community" segment, which runs from the southern side of the Williams River to the Saxtons River, embraces the Bellows Falls Dam. In this selected area, the Rivers Act permits hydroelectric production and flood control.

Sumner Falls - While a dam was once considered for the Sumner Falls area, this part of the river has been designated as a rural segment, precluding the possibility of dam construction here and inundation of one of the most biologically rich areas of the entire Connecticut River. TransCanada is preparing to divest itself of property at Sumner Falls, following an agreement that is part of the new license for Fifteen Mile Falls, a major hydro development many miles upstream. TransCanada's 67 acre property includes a small landlocked parcel in Plainfield in addition to the land on the Hartland side of the river. The property is to be protected from development.

Tributary dams - There are a number of dams on Connecticut River tributaries in this region, ranging from farm pond berms to hydro dams on the Sugar and Black Rivers to abandoned water supply reservoir dams. An example is the Springfield Reservoir dam in the Black River watershed in Vermont, owned by the town of Springfield but located in Weathersfield. This dam is in disrepair with an estimate of $15 million to repair. A town employee checks the dam daily because of the hazard posed by the dam to a home located just below it. While the Springfield town plan mentions developing a recreation area here and has appropriated a small amount of money to repair the dam, VT DEC recommends removal of the dam. The reservoir area is a very important wildlife corridor, where mammal use is being monitored, and should remain undisturbed for wildlife, rather than being developed for public recreation.



Water levels below Bellows Falls Dam in mid-April, 2007 after a major storm brought heavy rain to the region.

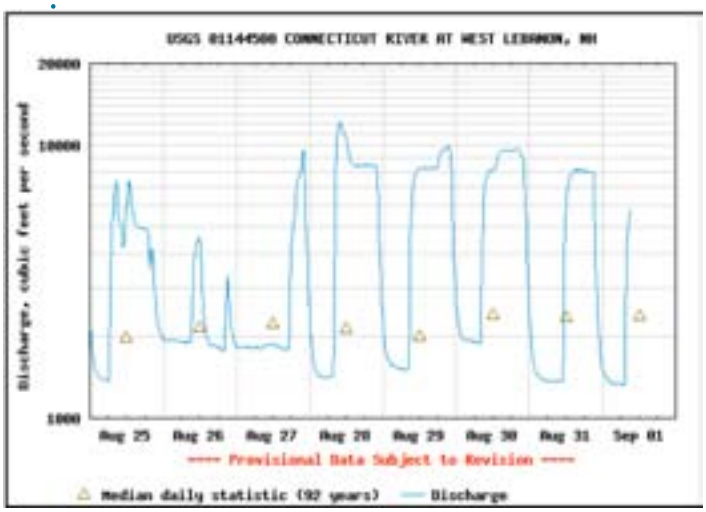
The Subcommittee agrees that when dams such as the Springfield Reservoir Dam no longer serve a purpose and cost more to fix than the benefits they offer, or are a threat to areas downstream, they should be breached. This is the least expensive and safest thing to do, and will bring environmental benefits, although there are high costs and complicated permitting requirements involved with dam removal. More is now known about the effects of dams than when most were built. Grant funding may be available to help with the cost of dam removal. Both NH DES and VT DEC now have dam removal and river restoration programs.

Dams on area tributaries are in various conditions. The dam at Halls Pond in Charlestown has been repaired. The Upper Dam, located on Mill Brook at Kennedy Pond 0.9 miles above its confluence with the Connecticut River, is currently intact. The Lower Dam, a former hydro site owned by the town of Windsor, is partially breached and does not hold back much water. The town has begun work on an emergency action plan to identify who will monitor the dam during unusual and high flow conditions and who will be notified if there are problems.

C. Effects of Dams

Dams have both positive and negative effects on the local economy and the environment. They provide renewable electric energy and contribute to a town's tax base. The Bellows Falls impoundment provides deeper water for power boating, which was not possible on the river until the dam was built, although the dam forces paddlers to portage their craft for a mile and a

half. Local people recall that it was possible to walk across the river at Ashley Ferry before the dam was built, and that farmers delivered hay by wagon to sheep pasturing on islands in the river. Local people recall that the fishing exploded in the second year after Bellows Falls was built, because of the increased habitat area.



Water level fluctuations measured at the West Lebanon gage just below Wilder Dam, August 2006.

While dams create new habitat for some species of fish and wildlife, they block passage for other species. TransCanada's predecessors invested some $15.5 million in both upstream and downstream fish passage at these three dams to remove this obstacle for both migratory and resident fish, and the Bellows Falls station includes an underwater window for viewing fish in the ladder. Walleye, perch, and bass now inhabit the warmer water of the Bellows Falls impoundment, using the shallows of tributary setbacks for spawning.

Dams create impoundments that slow the movement of water, allowing it to warm up, evaporate, and lose oxygen, thus reducing the river's ability to clean its waters. They also break up ice, reducing the potential for ice jams and related erosion downstream. The impoundments trap nutrient-rich sediments, preventing enrichment of the river's floodplain. Because Wilder and Bellows Falls are operated in a peaking mode, where water is alternately stored and released, they can affect the stability of riverbanks and impoundment shorelines, creating erosion. There are currently no required "ramping rates," or controls on the suddenness with which water is stored and released, for the three dams at Wilder, Bellows Falls, and Vernon. Sending large amounts of impounded water into the tailrace can also abruptly change water temperatures there, which can affect spawning and other fish movements. The renewal of the dams' federal operating license in 2018 is an opportunity to include best management practices such as moderated ramping rates in the dams' new license.

Recommendations for Dams

- The Federal Energy Regulatory Commission should include best management practices such as moderated ramping rates in the 2018 license for Wilder and Bellows Falls Dams. FERC should review the daily operating logs to be sure that the water levels remain within license limits, and require an independent gage to be installed to verify dam operations.

- Dam owners should strongly consider removing those dams that no longer serve a purpose and cost more to fix than the benefits they offer or dams that pose a threat to areas downstream. Springfield should seek state assistance for removing the Springfield Reservoir Dam.

- TransCanada should ensure that its land at Sumner Falls in Hartland and Plainfield are protected from development and remain open to the public, while retaining some responsibility for public safety there.

- Federal and state agencies should avoid further impoundment of the river to keep aeration at rapids and drops.

VI. Using the Water

A. Water Withdrawals

Water withdrawals could influence the instream flow of the river, even here in the Mount Ascutney region where the river has gained substantial size. Its status as a designated river in New Hampshire's Rivers Management and Protection Program shields the Connecticut River from actions that would divert its water outside of New Hampshire's portion of the watershed.

New Hampshire water withdrawals
New Hampshire requires registration of water withdrawals over a certain size, but does not require a permit unless there is a physical disturbance to the river. There is no charge for using the public's water. This registration program helps identify potential future problems of well interference, declining water tables and/or diminished streamflows, but does not actually limit withdrawals or provide a means of avoiding these problems.

NH policy on surface water withdrawals
New Hampshire requires registration of water withdrawals with the NH Geological Survey of DES that exceed 20,000 gallons per day averaged over any 7-day period from a single location or exceed a total of 600,000 gallons during any 30-day period. Once registered, monthly water use must be reported on a regular basis as long as the source is being used. No permit is required unless the withdrawal involves a physical disturbance to the bed or banks of the river. Examples of those affected uses include: water supply for domestic, commercial, industrial or institutional use, dilution of treated or untreated municipal or industrial discharges, including industrial process water, contact and non-contact cooling water, water for agricultural irrigation and snow making, and water used for power generation.

In the Mount Ascutney region, there are 11 registered water withdrawals in New Hampshire, including five water suppliers, two hydro plants, and an industrial plant in Claremont, one aqua culture site in Plainfield, and two agricultural irrigation sites. Country Estates Water Supply in Ascutney serves some 60 residents and at least that many mobile homes, as well as some commercial interests and the Middle School. A list of registered New Hampshire water withdrawals appears in Appendix G.

Vermont water withdrawals - Vermont requires permits for water withdrawals from in-state waters, limiting them to the "7Q10" level, which means a drought flow equal to the lowest mean flow for seven consecutive days, adjusted to nullify any effects of artificial flow regulation, that has a 10 percent chance of occurring in any given year. However, the state has no system for tracking withdrawals from the Vermont side of the Connecticut River. The amount of water that would otherwise have flowed in the Connecticut River from Vermont is unknown.

VT policy on surface water withdrawals
Vermont rules provide a means for determining conditions which preserve, to the extent practicable, the natural flow regime of waters. Act 250 and Stream Alteration permits may be needed, as well as a permit from the U.S. Army Corps of Engineers and a Section 401 Water Quality Certification. For most types of water withdrawals, the Agency has adopted a procedure for determining the minimum streamflow necessary to meet Vermont Water Quality Standards.

Recommendations for Water Withdrawals

- Vermont should adopt water withdrawal registration rules for the Connecticut River mainstem similar to New Hampshire's.

B. Groundwater and Drinking Water Supplies

Clean drinking water may be our most valuable but under-appreciated commodity. In the Connecticut River watershed, stratified drift aquifers, where large stores of groundwater are available, are closely associated with the river and its tributaries. No individual actually owns groundwater. Surface water and groundwater are closely linked. Groundwater feeds the river's flow, and the water beneath the river feeds groundwater. Pollution in groundwater can therefore pollute a nearby stream, and vice versa.

1. Identifying Groundwater Supplies

Stratified drift aquifers have now been mapped for the state of New Hampshire. New Hampshire's state geologist is now pursuing even more detailed mapping in the Connecticut River valley to give a more precise idea of where water supplies are located, and surficial geology mapping has been completed for the topographic quadrangles that include south Claremont and Charlestown.

Vermont's aquifers have not been mapped as comprehensively as New Hampshire's, although the state is now moving in this direction. An older set of maps covering most of Vermont called "Groundwater Favorability maps" show rough aquifer delineations based on surficial geology. Source Protection Area maps are available for Vermont community water systems.

Rockingham has taken a constructive step toward protecting its groundwater supplies by undertaking an aquifer recharge area study and mapping project. This will enable the local planning commission to refine the town's land use mapping and zoning maps to protect potable water resources from inappropriate development. The study was funded in 2006 by a grant from the state Municipal and Regional Planning Fund. Springfield has also recognized the possibility of threats to its water supply and has arranged for detailed mapping.

Groundwater regulation by the states - In New Hampshire, DES has regulated new groundwater withdrawals for public community water systems since 1991, to ensure that these wells have a sustainable yield and are sited in appropriate places, and, since 1998, has regulated all groundwater withdrawals larger than 57,600 gallons/day. The legislature's intent is to prevent harm to existing water users and nearby ponds, streams, and rivers from large withdrawals at a new well, such as for a bottling plant.

Vermont requires that new public community water systems have delineated the areas from which the groundwater is drawn, with potential sources of contamination identified. However, without a statewide policy on groundwater withdrawal, and without adequate aquifer mapping, Vermont remained until recently a target for commercial water bottling companies looking for private profit from a resource that belongs to the public.

2. Threats to Groundwater

Groundwater, which many residents pump into their homes for drinking, can be contaminated by a long list of pollutants which are difficult if not impossible to remove. Septic systems located within the floodplain and inadequate or failed septic systems are a problem, because they can send disease-carrying pathogens, and whatever else homeowners put down the drain, to groundwater which may also reach the river. Leaking underground fuel storage tanks, chemical spills, pesticide application areas, leaking sewer lines, junkyards, auto service centers, dry cleaners, industrial sites, sludge piles and lagoons, landfills, metal-working shops, improperly built manure storage, and even cemeteries can contaminate groundwater. Both states have set up permitting programs to eliminate groundwater contamination by the improper disposal of waste.

Salt contamination is a growing concern. Salt in groundwater makes the water unhealthy for drinking, since it can lead to high blood pressure and other diseases. Salt dissolves easily in water, and can reach groundwater through road salting, road salt storage areas, and places where snow is dumped, since there is often road salt mixed with the snow. For more on the threat of salt contamination, see Road and Railroad Issues.

MtBE - This gasoline additive, methyl tertiary butyl ether, now banned, was intended to increase the octane rating and reduce air pollution from burning gasoline, but has proved to be a worrisome problem for groundwater. Considered a possible carcinogen, MtBE degrades very slowly, is colorless, and is highly soluble in water. In Vermont, there is an MtBE problem in the town of Hartland, where 39 private wells and the town recreation center well have been contaminated. Tap water is undrinkable at the Hartland Library. The source is thought to be a 4,000-gallon spill from a fuel tanker truck some years ago.

Landfills - Groundwater contamination of nearby wells by the BFI landfill in Rockingham required capping and a groundwater interception trench, which appears to be working. Groundwater, surface water and seep sampling are performed semi-annually. Charlestown's landfill and transfer station have contaminated groundwater, and there is no alternative water source in the area.

3. Protecting Drinking Water Supplies

Recent studies demonstrate that conserving land to protect drinking water quality makes good economic sense. A study of 27 surface water supplies in watersheds with 10 to 60 percent forest cover found that the more forest cover in a watershed, the lower the treatment costs. For every 10 percent increase in forest cover, treatment and chemical costs decreased approximately 20 percent.[1]

While clean drinking water is essential, few communities have taken steps to protect it. A New Hampshire study in 2000 showed that only 11 percent of lands through which water flows to sources of public drinking water are protected by ownership or conservation easement, and 39 percent of community water systems do not even own the sanitary protective radius around their wells (75 – 400 feet).[2]

In the Mount Ascutney region, only Charlestown has groundwater protection regulations, regulates the use of land on top of underground water supplies, and identifies public well supply areas. On the Vermont side, Springfield, Windsor, Weathersfield, and Rockingham have taken steps in this direction. Local regulations regarding groundwater protection are summarized in Appendix F.

New Hampshire's Source Water Protection Program offers grants to help communities conserve land around their public water supplies to protect the quality of the water that reaches the wells. Vermont currently offers low interest loans from the Drinking Water State Revolving Fund for public water supply protection, but not a specific grant program. However, each state's conservation license plate program offers grants that can be used to protect water supplies.

Most homes in the Mount Ascutney Region rely on private wells for their drinking water, although only a small percentage of people test the quality of the water in their wells. As our area becomes more densely populated, people should pay more attention to groundwater. Towns should better map and understand their groundwater resources.

As part of the EPA-funded Connecticut River Tri-State Targeted Watershed Initiative, Upper Valley Lake Sunapee Regional Planning Commission is developing a variety of smart growth tools for water supply protection that can be adopted by any community.

Recharging groundwater - The quantity of groundwater is as important as the quality. If groundwater supplies drop, there is less water to feed both wells and streams. Prolonged drought is one of the few causes of reduced groundwater levels that people cannot control. Changing the surface of the soil, such as through paving, development, or diversion through storm drains, prevents rain and melting snow from soaking into the soil to restore (or "recharge") groundwater. By building many small vegetated areas, such as "rain gardens" to capture water that might otherwise have run off, and keeping impervious surfaces and development on steep slopes to a minimum, careful developers can invite water to soak in and recharge groundwater as it

---

1. *Protecting the Source: Land Conservation and the Future of America's Drinking Water,* Trust for Public Land and the American Water Works Association, 2004.
2. Research funded by NH DES and performed by the Society for Protection of NH Forests.

might have naturally. Sometimes the groundwater is withdrawn and not replaced in the same watershed. Imagine water pumped from an aquifer in Rockingham to be sold as bottled water in Burlington. The water will not return.

Recommendations for Groundwater

- State agencies and towns should not permit landfills, salvage yards, and junkyards to be located on aquifers.
- Vermont should map its aquifers.
- States should be vigilant about possible MtBE contamination.
- State environmental agencies should map contaminated groundwater sites.
- Towns should take advantage of source water protection grant and loan programs.
- Towns and regional planning commissions should educate people to keep their septic systems in good shape and to handle automotive fluids, pesticides, and other chemicals properly so they don't contaminate their own wells.
- Towns should offer an annual testing day for private well water.
- Developers should ensure that their developments keep natural drainage patterns and use swales and depressions ("rain gardens") to reduce runoff and recharge groundwater. All stormwater should be collected and treated on site, with extensive use of vegetation.

"Water has a voice. It carries a message that tells those downstream who you are and how you care for the land."
Valley resident

VII. Land Use and Water Resources

A. Point Source Pollution - Wastewater Discharges

The Connecticut River has long served to take away wastewater from Mount Ascutney area residents and businesses. Thanks to the Clean Water Act and major local investments, the wastewater the river is asked to carry today is much cleaner than it was 30 years ago. At that time, the federal government bore 80 percent of the burden of building wastewater treatment plants and the state contributed 10 percent. The government's participation has evaporated in the years since, leaving towns responsible for the heavy cost of upgrading their plants to meet new needs.

1. Direct Discharges

A number of communities discharge treated wastewater into the Connecticut River and its tributaries. Just upstream of the Mount Ascutney region, the river receives wastewater from Hanover, Lebanon, and White River Junction. Hanover and Lebanon's wastewater treatment plants are running near capacity, and their discharges can affect the river noticeably during periods of low flow. Springfield, Vermont, has recently completed a major upgrade of its wastewater treatment facility, vastly improving the quality of its discharge. Several industries in Claremont, including Wheelabrator and APC Paper, send their discharges to the city's wastewater treatment plant.

Springfield has made substantial improvements, with the assistance of the state, to remove phosphorus from its discharge. This removed a key source of the nutrients that were causing a large algal bloom each summer at the mouth of the Black River that interfered with recreational use at nearby Hoyt's Landing. Vermont, followed recently by New Hampshire, has taken steps to discourage phosphorus in detergents to help reduce the phosphorus entering wastewater treatment plants and then waterways.

Improvements at Springfield's wastewater treatment plant have resulted in improved water quality in the Black and Connecticut Rivers.

Pharmaceutical and personal care product pollutants - Many substances, some harmful and some not, can pass through wastewater treatment systems and are not removed before the water is discharged into rivers and streams or when septic system leachate passes into groundwater. Scientists have only been able to detect these chemicals in streams since about 2000, and little is known about their effect upon groundwater. In 2002, 80 percent of streams sampled (139 rivers in 30 states) by the U.S. Geological Survey showed evidence of drugs, hormones, steroids, and personal care products such as soaps and perfumes. While no studies have been done in the Connecticut River watershed to see whether this is a problem, disturbing evidence of the effects of these chemicals has been found in deformed fish in other rivers, including the Potomac and Shenandoah.

Painkillers, antibiotics, contraceptives and other hormones, chemotherapy drugs, and other medicines can pass through the body and through a wastewater treatment plant. Antibiotics flushed down the toilet can harm the beneficial bacteria that break down waste in septic systems and wastewater treatment plants. Dartmouth Hitchcock Medical Center, just upstream of the Mount Ascutney region, could potentially contribute a significant load of such drugs to the Hanover wastewater treatment plant, in addition to patients using and discarding medicines all over the region. Hormones, fragrances, other substances have been detected in all urbanized and farm-intensive watersheds in the U.S.. Cosmetics, cleaners, insect repellant, and even

---

1. Kolpin, D. W.; et al. Pharmaceuticals, Hormones, and Other Organic Wastewater Contaminants in U.S. Streams, 1999–2000: A National Reconnaissance. *Environ. Sci. Technol*. 2002, 36, 1202–1211.

nicotine and caffeine have been detected in some studies of waterways.[1] Wastewater treatment plants are not required to upgrade to remove these chemicals. Most tend to be largely removed or broken down but remain in sludge, where they usually do not mix with water but could become a problem if biosolids erode into streams or if pH changes. Biosolids aged more than 15 days are safer than fresher sludge.

Recent studies indicate that half of antibiotics produced are given to farm animals, which metabolize only 10-30 percent. The antibiotic level in manure slurry is thousands of times higher than municipal wastewater, landfill leachate, or sludge. Research suggests that soils rich in clay and iron oxides will be good at holding antibiotics in land-applied manure, although adding lime or phosphorus to cropland could prompt release into waters. Ironically, the requirement to use organic farming methods on power company lands may lead to more contamination by excess manure spreading on lands that were formerly fertilized by nitrogen injection.

For years, patients have been told to discard unused or expired medications by flushing them down the toilet, where they go directly into the wastewater stream. Federal rules for disposal of controlled medications have not changed since the 1970s, and require the presence of a law enforcement officer. The conventional method of disposal in many hospitals, hospices, and nursing homes is to flush unused narcotics and other medications after the death of a patient, even when they are enclosed in sterile packaging and could be reclaimed for use by other patients.

A better way to dispose of these materials is urgently needed. In, 2007, EPA advised that individuals wishing to dispose of medicines could add a small amount of water to solid drugs and flour, kitty litter, or sawdust to liquid medicines before capping, double sealing, and placing in the trash. To protect its surface waters and drinking water supplies, Maine began to experiment with collections of unused drugs in 2005, and in 2006, began allowing residents to mail unused drugs to the state. However, more direction is needed.

Industrial discharges - A number of industries discharge wastewater to the river and its tributaries. Discharge from a former ice cream plant in Springfield is now being pre-treated, reducing nutrient pollution from this plant. All industrial discharges in Claremont are now routed to the wastewater treatment facility.

Illegal discharges - At least one commercial property in Claremont may have a straight pipe to a storm drain. Straight pipe septic discharges to the Black River were eliminated several years ago.

2. Combined Sewer Overflows

Combined sewer overflows (CSOs) can allow runoff from a heavy storm to mix with untreated sewage, sending it into the river. River contamination is therefore more likely during and immediately after heavy rainfall. Eliminating CSOs is an expensive burden on small communities. However, CSOs render the water unsafe for swimming and diminish its value for recreation.

Several communities are under orders to update this antiquated system of stormwater treatment.

The uppermost 10 miles of the Mount Ascutney reach are considered unsafe for swimming due to CSOs just upstream in Lebanon and (formerly) White River Junction. Lebanon is making progress and has eliminated four of its six CSOs. While withdrawal of federal funds had forced the City to request an extension in the timetable to eliminate the remaining two, work will proceed with funding through the American Reinvestment and Recovery Act. In the last several years, the six CSOs in White River Junction have been eliminated.

Springfield is the only town in the Mount Ascutney region that has had a problem with CSOs. It once had 26 overflows, and has worked aggressively to eliminate them.

Table 4: Wastewater Treatment Plants Affecting the Mount Ascutney reach

Wastewater Treatment Plant	age	condition of discharge	Comments
Hanover NH (just upstream)	1960s	*E.coli* violations	upgraded 2003-2005, including moving the discharge pipe to the middle of the Connecticut River. The plant is running close to capacity.
Lebanon NH (just upstream)	1978	generally good; CSOs	under EPA order to eliminate CSOs; 4 of 6 CSOs have been eliminated as of 2006, although the city has asked for an extension of the deadline for completion since federal funds have been withdrawn from the project and the cost to the city is very high; National Award Winner for operations & maintenance, "due to the plant's energy-efficiency and its work with industrial sewer users to prevent the disposal of materials that could harm the treatment plant." Further work will be undertaken with American Reinvestment and Recovery Act funding in 2009.
Hartford/WRJ (just upstream)	1970s	CSOs	once had 6 CSOs, all eliminated. Undergoing plant system evaluation.
Quechee, VT (to Ottauquechee River)	1975	generally good	lagoon updates 2000; 90% complete plant system evaluation
Meriden Village, Plai nfield, NH (to Blood Brook)	1981	TRC violations	has recently installed dechlorination
Windsor Weston Heights, VT		generally good	17,500 gallons/day, 15,000 permitted
Windsor Main, VT		generally good	495,200 gallons/day (1,130,000 permitted) this plant handles Ascutney Mountain and the Harpoon brewery; less than half of capacity is used.
Claremont, NH (discharges to Sugar River)	upgrades 1987, 1995, 1998	Iissues of infiltration/ inflow; copper violations	modified aeration system, blower, dechlorination; under EPA Order in September 2002 for copper violations; working on reducing copper from influent sources first, progress made. There is adequate capacity if remove this. Plant is operating at about one-third its capacity.
Holiday Inn, Springfield	30+ years	no chlorine violations during 2005	plans to connect the Holiday Inn, the AOT garage and the nearby gas station to the new municipal sewer line which was constructed to serve the new state prison. The Holiday Inn WWTF will thus be abandoned/ dismantled.
Springfield WWTF	upgrades 2003	CSOs	Major improvement in phosphorus removal. Were once 26 CSOs in Springfield, all have been eliminated.
Charlestown, NH	1963	generally good	structural improvements made recently; under capacity

Recommendations for Wastewater Discharges

- Health care institutions, the Food and Drug Administration, and EPA should teach people to wrap and discard their unused and out-dated medicines in regular household trash rather than flushing.
- The US Fish & Wildlife Service, EPA and the Food and Drug Administration should devise new rules for handling and disposing of controlled medications.

B. Non-point Source Pollution

These sources of pollution are sometimes difficult to identify because they do not come from an easily observed point, but can include home landscapes, road runoff, storm drains, farms, logging sites, failed or inadequate septic systems, and eroding riverbanks. Tributaries can also deliver such pollution to the mainstem.

1. Landfills, Junkyards, & Transfer Stations

In years gone by, people simply dumped their refuse in a stream gully, off a bridge, or over a riverbank, thinking that it would be gone by spring. The Connecticut River and its tributaries are still home to these old informal dumps.

Most public dumps have been identified and capped. Many older landfills are not lined, and their contents can still seep into groundwater. Modern landfills are built with liners and internal collection systems that gather the liquid leachate so it can be sent to the nearest wastewater treatment plant. The leachate, however, still reflects the materials in the landfill, which can include heavy metals, poisons, and all kinds of hazardous materials that were dumped there, such as products containing mercury, rather than collected for safer disposal.

On the New Hampshire side, new solid waste facilities (including transfer stations) are not permitted within the 500 year floodplain of the Connecticut River and must be set back at least 100 feet beyond this level and screened from the river with a vegetative or other natural barrier to minimize visual impact. An existing solid waste facility located within 250 feet of the normal high water mark may continue to operate under an existing permit, provided it does not cause degradation to an area beyond where it was allowed in 1992. A resource recovery operation can occur at such a landfill. Vermont's regulations require a 300-foot setback from surface waters.

Landfills must be carefully sited, and based upon good surficial geologic mapping. When a new solid waste landfill was proposed in Rockingham in 2004, a partial knowledge of the location of unstable varved soils (see Shoreline and Floodplain Development, below) was important in reaching a decision not to locate the landfill close to the Connecticut River.

The Mount Ascutney reach of the river is vulnerable to any problems that might occur at the Lebanon landfill close to the river and just upstream. In May, 2007, NH DES inspected the landfill and discovered that leachate was breaking out in 11 areas and reaching the Connecticut River. DES also cited litter built up around fences and in drainage swales. The city repaired the problems and no concerns were found during an inspection several months later.

Recycling and hazardous waste - Communities are working to reduce the tonnage of solid waste they bring to landfills, by recycling, although rates vary greatly, and it is likely that not all recycling activity is reported. WinCycle in Windsor, Vt., recycles old computer equipment, thus removing an important source of hazardous material from the waste stream. Springfield and Hartland sponsor hazardous waste collections for Vermont area towns, as does Lebanon, N.H., through the regional planning commission.

Claremont ash landfill - The ash landfill in Claremont has been capped. This facility, which began as a burning dump, is built upon varves (see below). There are monitoring wells sunk 50 feet deep below the bottom of the landfill in order to detect contaminants. The ash produced by Wheelabrator is now shipped to an ash landfill in Shrewsbury, Mass.

Table 5: Municipal Solid Waste and Recycling - reported by NH towns in 2007 (source: DES)

Town	Combined municipal solid waste (tons)	Commercial/ Industrial Waste (tons)	Construction/ Demolition Waste (tons)	Compost (tons)	Recycling (tons)	Recycling rate
Plainfield	862	0	143	0	184	18%
Cornish	479	0	3	0	169	26%
Claremont	8273	0	52	68	221	3%
Charlestown	1534	0	366	56	501	27%

Rockingham landfill - At the unlined Browning-Ferris landfill site just west of the Connecticut River in Rockingham, monitoring wells down-gradient from the landfill, between Route 5 and the river, showed benzene, arsenic, manganese, chromium, nickel, and tetrochloroethene at levels higher than the clean-up criteria. This municipal landfill also received liquid industrial wastes from 1968-1979, resulting in contamination of several nearby residential supply wells. In 1994 a multi-layer low permeability cap was constructed over the entire landfill and a down gradient groundwater interception trench was installed. Groundwater, surface water and seep sampling are performed semi-annually. Remedial measures appear to be effectively controlling migration of contaminants.

In 2005, concerned citizens of Rockingham organized an effective opposition to locating a new municipal solid waste facility along the banks of the Connecticut River near Commissary Brook. A combination of well-attended public meetings, participation in local and Act 250 hearings, and acquisition of land parcels caused the developer to withdraw from the site.

Proposed Upper Valley Solid Waste District landfill in Hartland - A landfill was proposed by Upper Valley Solid Waste District for land in Hartland in 2001. The landfill site is set back 600 feet from the river, although state regulations call for a 300 foot setback. The bottom of the landfill is designed to be 130 feet above the water table. A flood plain of 35 acres will remain untouched. Fields bordered on the south by the Ottauquechee River and on the east by the Connecticut River are currently leased for agricultural use by Lemax Farm. The landfill would have a double liner with a base lining of two feet of clay, and would be built in phases.

Other area landfills and junkyards - When the waste incinerator in Claremont went on line, all open dumps in riverfront towns on the New Hampshire side were closed and capped. However, the Unity Dump is still open and unlined. Silver's Junkyard in Claremont has not been capped and is not protected with a fence. A stream runs close to the junkyard before entering the Connecticut River.

Claremont waste incinerator - There has been concern about the Claremont incinerator's air emissions and whether they could affect health and local waters. Since New Hampshire required maximum available control technologies to be applied to this incinerator and others, a carbon injection system has been installed that has reduced mercury emissions and other

pollutants by approximately 98 percent. The state now considers pollutant emissions here to be fully controlled.

Construction and demolition debris - A relatively new question is how to dispose of debris from construction and demolition sites, which can include woodwork painted with lead paint, heavy metals, insulation, and other materials that, if incinerated, could put dangerous pollutants in the air. However, the volume of waste produced in the area continues to be high, and requires disposal. New Hampshire enacted a ban on incineration of this material in 2007.

Volunteer members of the Black River Action Team collect boatloads of junk during a river cleanup.

It would be wise to look at new ways to re-use this material, such as with a swap shop for construction materials. Currently, construction and demolition debris is ground at Claremont.

Littering - Many towns in the area hold an annual "Green Up" Day in spring, encouraging residents to help pick up the winter's accumulation of roadside trash. From time to time, people still illegally dump tires in the Connecticut River. Roadside dumping is also still a problem. The amount of litter in the river has declined due to efforts by the Connecticut River Watershed Council. The Council holds an annual source to sea cleanup, and area people have participated for several years. The Black River Action Team has energized local citizens for a series of highly successful cleanups on this partly urban tributary.

"Towns should be sure they enforce the regulations they already have on their books."

Kurt Staudter, Mount Ascutney Subcommittee Co-chair, Springfield

Recommendations for Landfills, Junkyards, and Transfer Stations

- Vermont should adopt landfill siting regulations to match New Hampshire's.
- States should not permit landfills to be located on top of aquifers or varves.
- Towns should encourage regular and more frequent household hazardous waste collections, perhaps charging a small fee to offset costs. The service should rotate among towns, and in each town at least once a year.
- Towns and regional planning commissions should encourage mercury product recycling; encourage paint swaps and educate homeowners on how to dispose of paint, since paint is expensive to treat.
- Towns should hold an annual "Green Up" Day.

- States should promote a regional processing facility for construction and demolition debris that will encourage recycling where possible, such as a swap shop.

- Towns should consider contributing to computer recycling by WinCycle in Windsor.

- Towns should arrange for roadside and riverbank cleanups by people who have to do court-ordered community service.

2. Shoreline & Floodplain Development

Riverfront land, which is all the more attractive now that the river is no longer a "nuisance" or a health hazard, is now attracting people seeking waterfront home sites, because lakefront and oceanfront land has now largely been developed. The value of shorefront property has risen sharply, and riverfront homes are appearing at an increasing rate, although new shorefront owners are not always entirely aware of the hazards associated with being neighbors to the largest river in New England.

New Hampshire Comprehensive Shoreland Protection Act -The Connecticut River, the Sugar River, and a number of other streams on the New Hampshire side of the region are covered by the Shoreland Protection Act within 250 feet of the ordinary high water mark. The provisions of the law and the waterways it covers in the Mount Ascutney region are described in more detail in Appendix H. The goal of the state law is to protect the river for the public, and avoid "uncoordinated, unplanned and piecemeal development along the state's shorelines, which could result in significant negative impacts on the public waters." The law also protects property owners by preventing investments dangerously close to the river. Towns must not issue permits for projects that violate state law.

"If they buy a piece of land near the river, they seem to want to build as close to it as possible."

Ted Putnam, Mount Ascutney Subcommittee Co-chair, Charlestown, referring to new property owners

This law calls for buildings to be set back at least 50 feet from the river. All new riverfront lots are subject to subdivision approval by NH DES. Minimum lot size is determined by soil type in places dependent on septic systems, and must have at least 150 feet of shoreland frontage. No fertilizer, except limestone, shall be used within 25 feet of the reference line. Twenty-five feet beyond the reference line, low phosphate, slow release nitrogen fertilizer may be used on lawns or areas with grass. No other chemicals, pesticides or fertilizers of any kind shall be applied within 50 feet.

In 2007, New Hampshire enacted new, easier to understand riparian buffer protection. In the "waterfront buffer" area (within 50 feet of the reference line), no natural ground cover shall be removed except as necessary for a six foot wide path to the water. Limited pruning may be done to improve a view, and a minimum amount of tree cover must be maintained. Stumps and root systems within 50 feet of the river cannot be removed because they keep riverbank soil in place. Owners of lots legally developed before July 1, 2008 may maintain but not enlarge cleared areas, including existing lawns and beaches, within the waterfront buffer.

Between 50 and 150 feet from the reference line, in the "natural woodland buffer," at least 50 percent of the area outside of impervious surfaces shall remain undisturbed. Owners of lots legally developed before July 1, 2008 that do not comply are encouraged to, but shall not be required to, increase the percentage of area maintained in an undisturbed state. The updated law also limits impervious surfaces within 250 feet of the river to 20 percent of the lot, with some exceptions based on buffer and stormwater management. Property owners and developers are encouraged to seek creative solutions that utilize low impact development techniques. If impervious surface limitations are increased to 30 percent within the protected shoreland, a DES-approved stormwater management plan is required.

Until recently, the state has had limited ability to monitor or enforce this law, and violations have occurred. Many landowners are unaware of the law, or have found it hard to understand. The Subcommittee is concerned about development of lands along the river which could threaten water quality through changes in storm water movement, erosion during construction, and new septic systems. Homeowners may apply too much fertilizer or pesticide or underestimate the importance of riparian buffers in protecting their property against erosion and capturing sediment and other pollutants washing off the land.

Two of the four New Hampshire towns of the Mount Ascutney Subcommittee region have established protection for their river fronts that is more suited to such a large and powerful river. Plainfield and Cornish require a 100-foot building setback. A summary of local regulations appears in Appendix F.

The law also applies only to fourth order streams, and leaves protection of smaller streams up to the towns. The subcommittee believes that there should be more protection for smaller streams.

Vermont Shoreland Protection - Vermont is the only state in the Northeast that does not have a statewide shoreland protection law. Vermont's Agency of Natural Resources has issued riparian buffer guidance for Act 250-regulated projects. The guidance recommends 100 feet from lakes and ponds, and depending on the situation, either 50 or 100 feet from rivers and streams. This is only guidance, however, and does not protect rivers or streams in the case of smaller projects. However, Windsor, Weathersfield, Springfield, and Rockingham have their own shoreland protection for the Connecticut River and other streams which is comparable to or more effective than the New Hampshire law.

"Vermont has been lagging a little bit on shoreland protection, and so towns really need to step up."
Rockingham Planning Board member

TransCanada lands - In 2005, TransCanada acquired many acres of riverfront land in the Mount Ascutney region, and elsewhere, that are associated with the Bellows Falls hydro station. These lands, originally purchased for flood mitigation purposes in 1927, include a significant amount of floodplain, prime agricultural soils, and excellent wildlife habitat, and also flowage rights. The five most significant parcels include the Upper Meadows (287.7 acres) and Herrick's Cove (217.4 acres) in Rockingham and the Great Meadow (358.1 acres), Lower

Meadows (119.2 acres) and Meany's Cove (102.2 acres) in Charlestown. A study of these five parcels by the Upper Valley Land Trust describes their value for agriculture and wildlife, and explores options for their conservation.[1]

New England Power Company and USGen had been excellent stewards of these lands, hosting public boat ramps and picnic areas and leasing prime agricultural land to area farmers. Since approximately 2000, USGen had required that organic farming techniques to be used on its riverfront property. At this time, the company sponsored the largest riparian buffer planting project in New Hampshire history, on its Charlestown land. TransCanada is expected to be as good a steward of this land as its predecessors.

Building in floodplains - Most towns along the Connecticut River in the Mount Ascutney region currently permit building in both the flood hazard area and in the 100-year floodplain. Local regulations regarding shoreland and floodplain protection are summarized in Appendix F.

Such policy has led to heavy big box store development just upstream from the Mount Ascutney region in Lebanon, and trash from the parking lots and loading docks is increasing in the river, particularly after construction of a large store near the river's edge in 2005. Filling in floodplains invites flooding elsewhere. Mobile homes in floodplains are particularly threatened during high water, and the region has had experience evacuating flooded mobile home parks. Septic systems within the floodplain have also proved to be a source of contamination, as during the Cold River flood of October, 2005.

Building in floodplains takes over valuable farmland, transfers flooding problems downstream, and costs taxpayers money when flooding occurs. Cornish has passed an ordinance banning construction within the 100-year floodplain and protecting this "green infrastructure."

"Floodplains are called floodplains for a reason. If we keep building in floodplains, we use up the sponge."
Upper Valley riverfront farmer


Building in floodplains takes over valuable farmland.

The National Flood Insurance Program, administered by the Federal Emergency Management Agency (FEMA), requires special construction standards for buildings that are built in floodplains, but they still permit buildings on this questionable land, and a building is allowed to take up space that flood waters would otherwise have occupied. While this might reduce the amount of flood damage to the property, it does nothing to prevent pollution or stop increased flooding downstream. One building may not make much difference, but the effects of allowing many buildings to take up space in a floodplain can be a different story. Agricultural buildings

1. *Riparian Meadows Preservation Feasibility Study*, Upper Valley Land Trust, 2006.

are exempt from permit requirements in Vermont, even though they take up floodplain space as any other building would.

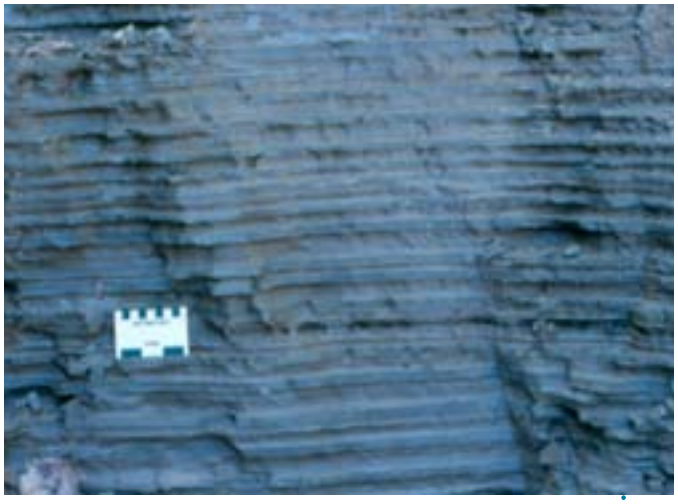
Floodplain maps - Landowners, town officials, and banks issuing mortgages and loans must have correct information on floodplain locations. The 1997 edition of this plan recommended that FEMA provide more accurate floodplain maps (Flood Insurance Rate Maps) to the towns. This request was answered by FEMA for the southernmost 16 towns in New Hampshire and Vermont in 2001, including all the Mount Ascutney region towns, based on a new study of the river from its headwaters down to the Massachusetts border. While the new maps have been provided, not all towns have adopted them.

Varves - Thousands of years ago, some of the river valley was a lake bed, with soil deposits that could pose problems for anything built upon them. Glacial Lake Hitchcock left behind layers of lake-bottom sediments that in some places sort themselves into varves, or layers that have differing physical properties that can create unstable drainage. Recent investigations indicate that the retreat of glacial ice stalled in the Claremont area, creating what geologists call the "Claremont gap." Immediately south of Claremont, very thick varves can be found. There are significant deposits of marine clays in Rockingham.

"You can spend a little now and preserve your floodplains or pay through the nose later."

Littleton Conservation Commission member

Knowledge of varves is important for land use planning, because they behave differently from other kinds of soils. If a town planning board knows where the varves are and can ask applicants to deal with the challenges posed by varves, then the board can then decide whether a proposed project is safe. Siting landfills, bridges, large buildings, and other important structures on varved deposits is risky. The ash landfill in Claremont is unfortunately located on varved soils. It is possible that an excavation intruding on varved soils in Rockingham led to the collapse of sediment into Commissary Brook and then into the mainstem of the river.



Varves are alternating clay/silt layers that once formed the lakebed of glacial Lake Hitchcock. They have distinct drainage properties that make them challenging for development.

Gravel pits - An esker follows the Connecticut River in Hartland and elsewhere in the region, and is mined for sand and gravel. At one location very close to the river just below Sumner Falls, where the riverbank is very high and steep, such excavations have been permitted very close to the bank. In 2007, the bank failed in several locations, sending sand into the river. This part of the river is influenced by water releases from Wilder Dam about six miles upstream, and from releases from the U.S. Army Corps of Engineers' flood control dam on the Ottauquechee River in North Hartland. The river is scouring the base of the high, sandy bank, while sand and gravel are being removed near the top of the

bank. Loading from heavy equipment and a berm built to control runoff have added to stress on the bank, which is composed of unconsolidated material.

Recommendations for Shoreland and Floodplain Development

- Towns should require developers and landowners to establish and/or maintain buffers of native vegetation along rivers and streams for privacy and pollution control.

- Towns should adopt ordinances prohibiting building in the 100-year floodplain and on flowage rights of way, to protect their citizens and businesses from damage, to avoid adding to flooding of their downstream neighbors, and to reduce the public cost of disaster relief.

- Developers should ensure that septic systems are properly engineered and designed.

- Towns should adopt new Flood Insurance Rate Maps.

- Towns should ensure that buildings are set a safe distance back from the river even when outside of the floodplain, to reduce the risk of property loss in erosion-prone areas.

- Towns should require sedimentation and erosion controls during and after construction.

- Towns should work with state geologists to map varves in their towns, to be sure major construction does not take place on unsafe soils. (50/50 match with USGS)

- NH DES and towns should inform landowners about the Shoreland Protection Act. Towns should not issue permits for projects that violate this state law.

- Vermont should adopt statewide shoreland protection.

- TransCanada should conserve and continue to lease its farmland to experienced area farmers and continue the tradition of stewardship set by its predecessors.

- State agencies and towns should review sand and gravel excavation plans with great care, ensuring that excavations are set well back from the riverbank and cannot threaten its stability. Ensure regular monitoring of operations.

3. Roads, Railroads, & Utilities

In the Mount Ascutney region, Routes 12 in New Hampshire and 5 in Vermont follow the Connecticut River on ancient routes that are little changed in the last two centuries, except that the river, especially where it is impounded, has attempted to claim parts of them. People have responded by widening, straightening, and armoring riverfront roads, rarely by moving them a safer distance from the river. A sudden heavy storm can cause problems with blocked culverts and send sediment from such a road into a stream. Better riparian buffers might help hold streambanks in place and help capture road-related pollutants escaping into the stream.

For nearly a decade Lebanon, just upstream from one of the most biologically interesting areas of the Connecticut River, proposed to build a road on the edge of the riverbank to relieve traffic problems at its heavily developed commercial district in West Lebanon. Observers note that the river already receives blowing trash from Lebanon's landfill and shopping district, especially after a new large box store opened on the riverfront in 2005. The Subcommittee strongly advises against adding more pollutants from a roadway so close to the river.

Towns rarely have the tools to take a 100-year view of road repair along rivers. It would be useful to have state and federal agencies develop and demonstrate technology to help them limit road collapse without resorting to riprap. Both states have programs designed to help local transportation departments and road crews to manage roads with water quality protection in mind: Vermont's Better Back Roads program and the University of New Hampshire's Roads Scholar program.

Railroad - The railroad follows the Connecticut River on the New Hampshire side as far as Cornish, and on the Vermont side. An important element in the history of the valley's industrial development, the railroad is the subject of renewed interest for passenger travel and freight. While the railroad has contributed much to the river valley over the century and a half of its presence, it has new and chronic implications for river health.

In many places, the railroad company has removed the riparian buffer growing between the tracks and the river, removing a source of protection for the bank and for water quality. Discarded railroad ties have been dumped near the river. More threatening, however, is the presence of a new salt storage shed very close to the river in Bellows Falls. This shed was built over the objections of state and local authorities, who were concerned about the potential for salt contamination of surface waters. The Mount Ascutney Subcommittee hopes that rail managers will manage this system with concern for the sensitive environment so close by.

Culverts and bridges - Town road agents deserve the respect of all for their long hours of work to keep roads passable and safe during long winters and in often tough terrain, but they do not always have the engineering experience to gage proper culvert sizing. An under-sized culvert or bridge can block with debris in a sudden storm and cause a stream to cut through a road. A similar problem in Alstead, New Hampshire, contributed to a major disaster on the Cold River in October, 2005. While logs and other woody debris create healthy fish habitat, culverts need to be kept clear to allow water to move through.

"We've learned that a kid's soccer ball is the perfect size to plug up a culvert."

Plainfield town manager

On the Vermont side, the regional planning commissions have completed bridge and culvert surveys for the towns in the region, and helped them identify some undersized and failing structures that could become public safety and flooding hazards during a heavy storm. However, no such inventories have been done in New Hampshire towns in the region. Because culvert and bridge size is so important for public safety, they should be checked in all towns. Vermont state engineers may be able to assist with sizing decisions. It is important to look upstream when making such decisions, and to include what flow and stormwater runoff might come from upstream from future development if it is planned.

Some culverts in flowing streams have been installed in such a way that they obstruct fish movement. Replacing such hanging culverts with natural bottom culverts or arches permit fish and other aquatic life to use habitat on the other side. Cost-sharing funds of 75-100 percent are available from the USDA Natural Resources Conservation Service's Wildlife Habitat Improvement Program and Environmental Quality Incentives Program. New Hampshire's Aquatic Resource Mitigation Fund, established in 2006, will soon be another source of funding for this. The NH.. Fish and Game Department has created Stream Crossing Guidelines that provide culvert sizing requirements for fish passage.

Road salt - Salt for winter de-icing of roads and railroads is a serious threat to the quality of surface and groundwater, since this compound, which is toxic to aquatic life, dissolves so easily in water and is not captured by conventional stormwater treatment systems. A recent study of three rivers, including one at the Hubbard Brook Experimental Forest in rural northern New Hampshire just east of the Connecticut River watershed, found that salt concentrations have been increasing for the past 30 years.[1] Research shows that sodium and chlorine, the elements that make up salt, are increasing and staying at elevated levels even when salt is not in use on the roads. In spring, summer and fall the levels of chloride concentrations at study sites were 10 to 100 times higher in the waters near salt use areas than in more isolated waters, and in the winter, concentrations were up to 1,000 times higher in the exposed waters. The study suggested that salt from a half century of use on winter roads is accumulating in soils, groundwater and rivers themselves.

"A well-set culvert equals fish portage."
regional planner

Storage of road salt - There are several places in the Mount Ascutney region in Vermont where salt is stored by town and state highway departments and by a rail company. The Springfield town salt shed is currently located on the banks of the Black River, and was moved to this site. Rockingham's salt shed is located near the Williams River. The state highway salt shed is located near the confluence of the Black and Connecticut Rivers. Green Mountain Railroad's salt storage shed is located close to the river in Bellows Falls. An attempt to ensure that it was located farther from surface waters was denied in Federal court.

"Salt sheds...the railroad seems to love to put these things near environmentally sensitive places."
former city councilor, Claremont

New Hampshire does not permit establishment or expansion of salt storage yards within 250 feet of the Connecticut, Sugar, or any other river covered by its Shoreland Protection Act. Vermont has no similar protection for its waters, beyond requiring that the Agency of Transportation (VTrans) store salt under cover and on an impervious material, so it does not leach into the ground. Vermont has guidelines that recommend that towns avoid storing salt on floodplains, over aquifer recharge areas, or where salt could run off into streams or wetlands, but these are only guidelines. The Vermont Local Roads Program assists town highway departments on the full range of road issues,

1. "Increased salinization of fresh water in the northeastern United States", Kaushal, Sujay S., et al, *Proceedings of the National Academy of Sciences of the United States of America*, September, 2005.

including storage building designs. VTrans must report weekly to the Agency of Natural Resources about the amount of de-icing material applied during the winter. VTrans is now offering grants to Vermont towns that require only a 20 percent match, for projects like moving sand and salt storage.

Snow dumping - The sand and salt used to keep roads clear in winter can easily end up in a stream or river. Plowed snow, which can also end up in the water, contains salt, sand, broken glass, oil, trash, and cigarette butts. Towns have not always followed state regulations on snow dumping and storage. Long-time snow dumping sites may also show signs of lead accumulation in the soil from the days of leaded gasoline. In Windsor, high concentrations of lead were found in a small area where the town has piled snow for years, and the contaminated soil had to be cleaned up. Other towns may unknowingly have a similar problem.

Utilities - A major new electric transmission line has been proposed for the Vermont side of the southern river valley that could cross a number of tributaries to the Connecticut River. While there may not be much effect upon the mainstem from this project, there could be effects upon the tributaries, especially if riparian buffers are cut or herbicide applied to keep vegetation down.

Recommendations for Roads, Railroads, & Utilities

- State agencies, towns, and developers should avoid constructing new roads near rivers and streams.

- State agencies should offer support to towns to cover engineering costs for sizing culverts and bridges.

- State highway departments and towns should ensure that culverts are properly sized when replacing them during road work.

- NH towns should ask for help from regional planning commissions to survey culverts and bridges to identify those that are undersized.

- Towns should seek funds for replacing culverts that undersized or block fish passage.

- Vermont DEC should monitor the railroad and nearby surface waters for salt migration related to the salt storage shed in Bellows Falls.

- Rail managers should manage the rail system to protect nearby surface waters, by ensuring that all waste is disposed of properly.

- Federal agencies should partner with the railroad to identify ways to help its management become more aware of ways to avoid pollution of surface waters.
- Towns should follow snow disposal best management practices (BMPs). Snow should be stored on flat, pervious surfaces, such as grass, and at least 100-200 feet from the edge of a stream or river, with a silt fence between the snow and the stream. Once snow melts, debris should be quickly cleared from the site and brought to the landfill.

- Towns should test the areas where they have piled snow for many years, to see if lead has accumulated in the soil. Keep culverts clear of woody debris.

- State transportation agencies and towns should include riparian buffer restoration in road projects near streams and rivers.

- Towns should consider working together on regional purchase and storage of road salt to reduce the number of sites where salt is stored and could contaminate rivers.

- Springfield, Rockingham, and VTrans should identify better sites for salt storage. Vermont should consider its salt storage guidelines and develop regulations for salt storage near water.

- Vermont Public Utilities Commission should ensure that if an electric transmission line is built in the region, herbicide for vegetation control is not used near waterways, and riparian buffers are not disturbed. Encourage use of native groundcover that grows thick with an extensive root system but does not grow tall.

4. Storm Water Runoff

"If you control your runoff at every single dwelling then you don't have a problem with all that water running into your stream."

Public Works Director, Colebrook

Drainage from mature forest is vastly different from cleared or developed land. Each one sheds water differently – faster or slower, with more or less chance to gather speed, cause erosion, and pick up litter and pollutants. Stormwater runoff may be the simplest but least understood means of water pollution. As a result, EPA and the states are phasing in stronger stormwater controls.

EPA regulates stormwater under the Clean Water Act and has phased in efforts to control this pollution. Beginning in 1992, permits have been required for manufacturing facilities, hazardous/solid waste processing, recycling facilities including junkyards, mining (including sand and gravel), timber processing, power plants, vehicle maintenance, sewage/sludge treatment plants, and construction activities that disturb more than five acres. More recently, permits have been required for construction sites from one to five acres and for town-owned activities such as sand and gravel pits, recycling centers, school bus maintenance, and publicly owned treatment works.

Impervious surfaces - Cleared, compacted, or paved land sends water downhill faster than when it is captured by thick vegetation and transpired by trees. Studies in Vermont show that when more than 10 percent of a stream's watershed is impervious (pavement, rooftops, compacted soil), the stream and its fish suffer from water quality problems.[1] Roads and parking lots can account for as much as 70 percent of the total impervious surface in urban areas. Towns should view commercial parking lots and down towns as hot spots for petroleum hydrocarbons,

metals, nutrients, or solids, and especially for salt and warming of water. Elevated salt and temperature typical of parking lot runoff can be lethal to aquatic life. Sediment studies tend to show more pollutants in the river where the roads are close.

Land clearing - Heavy clearing, whether for forestry or for development, can change stormwater runoff, how a tributary flows, and ultimately the Connecticut River itself and even property in another state. Towns may become concerned how such clearing can affect the roads and culverts they are responsible for maintaining.

Controlling stormwater - There are a number of common sense ways to keep runoff from causing trouble downhill. The main idea is to mimic the natural pattern of runoff when a property is developed, with "low impact development" techniques that slow it down and soak it up. Rather than channeling runoff into larger drainage ditches, the design recommends spreading runoff around and detaining it in many small vegetated catch areas and swales where it can soak into the ground and recharge groundwater rather than run off the land. Low impact design also recommends narrower or shared driveways, porous paving materials, smaller parking lots, directing runoff to places with porous soils, building on soils that are less porous, flattening slopes on cleared areas, keeping as many trees as possible or planting more, and avoiding construction close to streams. The water that eventually arrives at the stream tends to be cleaner, and more moves through the ground, keeping water levels up in wells and in waterways. Oil separators should be required for development projects with discharges to surface waters.

Stormwater regulation by the states

The state of New Hampshire does not issue its own stormwater permits, but reviews and certifies EPA's permits. The state does limit impervious surfaces within 250 feet of lakes, ponds, and fourth order and larger streams, and considers stormwater in its Alteration of Terrain program. Otherwise, the state is involved only to provide technical assistance and public education. If NH receives a water quality related stormwater complaint, the state will go out to be sure there is a federal stormwater permit and a stormwater pollution prevention plan. Controls on stormwater are otherwise through any local regulation that might exist.

In Vermont, the Department of Environmental Conservation Stormwater Program issues separate permits for runoff from impervious (i.e. hard) surfaces, construction sites and industrial facilities. These last two permits are requirements of the federal Clean Water Act, and in Vermont, the Agency of Natural Resources is delegated by EPA to issue these permits.

"Terrain drains!"
Springfield Act 250 administrator, speaking of flooding

As part of the EPA-funded Connecticut River Tri-State Targeted Watershed Initiative, Southern Windsor County Regional Planning Commission is assisting Springfield with an innovative stormwater rebate program to encourage property owners to disconnect residential roof leaders

1. Pease, James, "Urban Nonpoint Pollution Source Assessment of the Greater Burlington Urban Stormwater Characterization Project," Vermont Department of Environmental Conservation, 1997, in *Champlain Initiative, The Case for a Healthy Community: The History of Sprawl in Chittenden County*, March 1999.

and sump pumps from the CSO/storm sewer system and re-route water to rain gardens, rain barrels, and other on-site recharge areas. The planning commission is also assisting the town in developing low impact development stormwater zoning and subdivision regulations.

Recommendations for Stormwater Management

- Towns should ask regional planning commissions for advice in how to avoid runoff problems related to large scale clearing, and consider whether culverts are sized in anticipation of runoff from future cleared slopes.

- Towns should ask developers to include infiltration methods such as many small swales and runoff basins to capture runoff for groundwater recharge; look at ways to include "low impact development" ideas as they review projects, and at how to change existing development to reduce runoff and promote stormwater infiltration. Development that adds impervious surface should be designed to capture stormwater on site.

- Towns should consider discouraging roads and development on steep slopes to control stormwater runoff.

- Towns should require additional treatment to remove oil from parking lot runoff and if possible, to remove heavy metals. Require long-term maintenance of the unit so it continues to work.

"People don't want to ruin the river, but sometimes they don't know. People want to do the right thing - they just need to know what it is."

Riverfront landowner, Rockingham

- Trail managers should ensure that all local trails have water bars to keep stormwater from eroding the compacted soils on the path.

5. Home Landscapes

Residential development in the Mount Ascutney region continues to occur, often very close to the river. Rivers and streams provide a beautiful backdrop to a home landscape, but what a homeowner does on his or her land can have an important effect on that water.

Many people building on a waterfront parcel are tempted to cut down the vegetation along the stream in order to get a view of the water, not realizing that they are removing the protective barrier that keeps runoff from their lawns and gardens from reaching the water, or keeps the riverbank from eroding. Unlike farmers, who are professionally trained to apply fertilizers and pesticides (especially restricted use pesticides) in the proper amount and at the proper time in the growing season, homeowners have no such training and are likely to use much more of these potential pollutants than is necessary or advised.

The N.H. Comprehensive Shoreland Protection Act does not permit use of fertilizer (other than lime) within 25 feet of the Connecticut and other fourth order rivers, and between 25 and 250 feet from the river, only low-phosphate fertilizer may be used. While these rules apply to

fourth order rivers on the New Hampshire side, care with fertilizers around homes located on tributaries large and small is also wise.

Runoff from driveways, roofs, and lawns can carry away these pollutants, delivering them to streams. Sometimes it's what a homeowner doesn't do that can cause trouble, such as neglecting to maintain a septic system, so that it fails and pollutes a nearby stream. Homeowners living near water have a responsibility to be sure they are good caretakers of those waters.

Waterfront homeowners should avoid mowing close to the water's edge.

Recommendations for Home Landscapes

- Waterfront landowners should learn about the proper use and disposal of fertilizers, pesticides, and toxic materials; refrain from using fertilizer within 250' of rivers, and consider alternatives to chemical fertilizers, herbicides, and pesticides. Consult CRJC's Homeowner's Guide to Nonpoint Source Pollution in the Connecticut River Valley (1994).

- Landowners should make use of CRJC's *Riparian Buffers for the Connecticut River Valley* to learn how to plant and enhance riparian buffers on their property with attractive landscape plantings that help control erosion and provide food and cover for wildlife.

- Landowners should encourage native plants on their riverbanks, remove invasive plants, and resist the temptation to cut and mow to the water's edge. Know the location of and regularly maintain on-site septic systems.

- Towns should educate landowners to establish, maintain and enhance the native riparian buffer vegetation on their property.

"It's a very good concept not to utilize riverfront land all the way to the edge."
Riverfront farmer

6. Farms and Rivers

Agriculture keeps the river valley looking the way it does. Prime agricultural soils distinguish much of the floodplain in the Mount Ascutney region. Land on both riverbanks has a long farming tradition. Development pressures focus easily upon the remaining available farmland, which is often flat and easy to build upon. Few functioning farms remain, and those that do should be encouraged by spirited local markets for their produce and, for those who are willing, with assistance in conserving their land. Not all farms in this region are well-prepared to protect runoff quality, and there is concern about erosion and contamination of at least one New Hampshire brook by uncontrolled livestock access.

Vermont has voted in extra dollars to make the Conservation Reserve Program more helpful to farmers for water quality improvements, and funds are available in the Connecticut River

Conservation protected this fertile Windsor floodplain's agricultural future.

valley. Unfortunately, similar assistance is not available from the State of New Hampshire. The U.S. Department of Agriculture offers several cost-sharing programs to assist with riparian buffers, fencing, and other farm projects that improve water quality.

Farmers working near the river and its tributaries are aware of the need to manage manure and other fertilizers well so that they serve the farm and are not lost to the river, where they could cause algal growth downstream. Farmers are educated and licensed to deal with herbicides and pesticides. Vermont requires a minimum farm buffer of 10 feet, but there is no such requirement in New Hampshire for this good management practice.

Several farms in the Mount Ascutney region rely upon the Connecticut River as a source of irrigation water. The vibrations of flexible irrigation hose sometimes cause channels to form on the riverbank which could lead to erosion.

TransCanada owns a significant amount of farmland in conjunction with the Bellows Falls Dam, including hundreds of acres in Charlestown. The company maintains a restriction on operating farm equipment within 50 feet of the river, and in a quest for water quality protection, requires organic farming techniques to be used by the farmers to whom the company leases the land.

Recommendations for Farms

- Farmers should work with conservation districts and Cooperative Extension Service to prepare a total nutrient management plan for their land, to make best use of available nutrients, reduce potential for water quality impacts, save farm money by reducing cost of fertilizer purchases, and determine where and when biosolid application could benefit the farm operation; employ best management practices

- Towns should investigate how conservation easements on farmland can help keep town service and school costs down if the farm is not developed into house lots or into second homes which could later become year-round residences.

- Vermont farmers should inquire about how the state's Conservation Reserve Enhancement Program could help with water quality protection on the farm.

- Those using the river for irrigation should stabilize the hose so it cannot vibrate and start a channel for erosion.

- Farmers should ensure that livestock watering does not unduly affect streambanks and water quality.

- The NH. Department of Agriculture should require a minimum riparian buffer on farms, as does Vermont.

- Farmers should retain and encourage 50-100 foot riparian buffers to help minimize erosion of valuable soils.

7. Forests and Rivers

A forest is the best guardian of water quality. Forest landowners can use forested riparian buffers to control flooding and erosion, trap pollutants, shelter coldwater fisheries, and provide an attractive streambank and recreational opportunities.

Those planning to make a timber cut for personal use in New Hampshire can cut up to 10,000 board feet, or 20 cords, without the need to file an "Intent to Cut" form with the town. This translates to two fully loaded logging trucks. In Vermont, a landowner must submit an Intent to Cut Notification to the Vermont Department of Forests, Parks and Recreation only if he or she plans to conduct a heavy cut of 40 acres or more.

Cutting within a riparian buffer or on a steep slope could affect nearby waters. However, the Vermont Current Use program is set up in many ways to protect the forest products industry rather than water quality, and presently does not permit protection of a riparian buffer.

Flash flooding and siltation can result from increased surface runoff when large areas of forest cover are removed. Siltation can result in impacts to fisheries, water quality, and aesthetics, and pose problems at downstream industrial water intake pipes. Forestry rules in New Hampshire restrict cutting along streams. It is wise to check a planned cut with a professional forester before proceeding, to be sure that it will not affect surface waters.

Recommendations for Forests

- Forest landowners should discourage logging on steep slopes near the river, and in the riparian buffer. They should use best management practices and be sure their forest management plans include riparian buffers.

- Vermont should update its current use taxation program to permit protection of riparian buffers.

8. Airborne Pollutants

The Connecticut River and its tributaries are not secure from contaminants that arrive on the wind. Both New Hampshire and Vermont have issued fish consumption advisories for the Connecticut and other rivers, based on mercury levels.

EPA and the four Connecticut River states cooperated in 2000 on a study of fish tissue toxins in Connecticut River fish.[1] The study found that mercury poses a risk to recreational and subsistence fishers and to fish-eating wildlife. Much of this mercury originates from Midwest power plants and urbanized eastern seaboard emissions, and local sources. Once in the river,

1. *The Connecticut River Fish Tissue Contaminant Study*, U.S. Environmental Protection Agency Region I, 2000.

mercury bio-accumulates to high levels in the food chain. Older fish tend to have higher levels of mercury and other contaminants, such as PCBs and dioxins.

Dioxins are produced in nature and also inadvertently by humans, often through combustion processes such as at waste incinerators or through burning trash in backyard barrels, which is illegal. Recently enacted state controls have successfully reduced emissions on New Hampshire incinerators, including the Claremont waste incinerator, by 90 percent. Vermont is also considering regulation of emissions from outdoor wood fired units.

The states are doing a good job at addressing this problem. In 2007, the New England Interstate Water Pollution Control Commission worked with New Hampshire, Vermont, and the other New England states and New York to form a draft mercury reduction plan using the federal Clean Water Act to establish the maximum levels of mercury that local lakes and rivers can absorb ("total maximum daily load"=TMDL). The federal government has not set national standards.

Recommendations for Airborne Pollutants

- Congress and the states should continue to reduce sources of mercury contamination.
- Citizens should obey the ban on barrel burning of trash.
- States should regulate outdoor wood-fired units to control emissions.
- The states and EPA should revisit the fish tissue toxin study in 5-10 years to track progress in removing mercury and other contaminants from the environment.

9. Brownfields

"Brownfields" is a term coined by EPA for land that cannot be easily redeveloped or reused due to the potential or perceived presence of hazardous substances or other pollutants. Historical industrial sites along the Connecticut River, such as Bellows Falls, Springfield, Claremont, and Windsor, are likely to have such properties where contamination may linger in the soil and prevent the property from contributing once again to the tax rolls and economic vitality of the community.

The Southern Windsor County and Windham Regional Planning Commissions can assist property owners and prospective purchasers of brownfields with environmental site assessments of brownfield properties, and with grants and loans for cleanup of contaminated sites. Bellows Falls tells a brownfields success story, where a long-unused brownfields site on the island close to downtown was identified, cleaned up, and redeveloped as part of the waypoint center and farmer's market area.

Upper Valley Lake Sunapee Regional Planning Commission has not yet received brownfields funding. Claremont has conducted its own brownfields studies with NH DES using a $200,000 EPA Brownfields Assessment Grant to assess and develop several clean-up and re-use plans for the historically significant mill buildings along the Sugar River. The Sawtooth Mill once housed

a chemical lab and forge. The former Woven Label Mill Building, cleaned up and ready once again for public use, has become a restaurant.

Jones & Lamson, Springfield - The story of Jones & Lamson is a good example of the brownfields dilemma and opportunity. The company was established in Springfield, Vermont in 1888, and produced everything from wrenches to rifles. Soon after James Hartness joined J&L as superintendent, he invented the flat turret lathe, a key development in the history of precision manufacturing. As a result, Springfield became one of the most important producers of precision machine tools in the world. As the global economy shifted in other directions, however, the business closed and the plant fell into disrepair, ending up on the growing list of old industrial sites in need of cleaning up.

Cleaning up contaminated brownfields brings a place back to life. In Bellows Falls, this site now hosts a farmer's market and visitor center.

The J&L manufacturing process used cutting oils with PCBs, and the metals were cleaned and purified using chlorinated solvents. Contaminated sites on the property include the chip shed, where metal chips were treated with oils and stored while waiting for rail transport; the solid waste disposal site near the banks of the Black River; the solvent storage and heat treatment site, and the oil storage in an above-ground storage tank. There is also an underground, off-site source of coal-tar that seems to be migrating onto the J&L site from across Clinton Street. The chlorinated solvent has spread out under the building. Testing was completed in late 2006, and demolition and removal of contaminated materials may follow. Redevelopment plans call for rehabilitating a third of the building, keeping another third for five years and marketing it for redevelopment, and taking down the remaining third.

Vermont is monitoring for metals and other contaminants in the Black River above and below the J&L site, and there are monitoring wells between the building and the river.

"Many of our towns were organized around rivers. Rivers were the power for the industry and also the dumping ground for industry."

Becky Basch, S. Windsor County Regional Planning Commission

Goodyear Tire and Rubber Company, Windsor - The Goodyear Tire and Rubber Company operated a rubber manufacturing plant on a key property from 1936-1986. Prior to Goodyear's purchase of the facility, National Acme and Gridley Automatic Machine Company operated machine tool manufacturing operations on the site. The first facility was built in 1900. By 2004, over $100,000 in grants from EPA and the Vermont Community Development Program and $30,000 from the Goodyear Tire and Rubber Company had been spent for site investigation work on the 28 River Street property. While the Goodyear Company has been acknowledged by the state as a potentially responsible party for the contamination found on the site, the company has made minimal contributions to the

environmental work being done on the property.

Recommendations for Brownfields

- State environmental agencies should continue to pursue brownfields cleanup and make up to date information on brownfields assessment discoveries readily available, especially for nearby residents who may be affected.

VIII. Riverbank Erosion

Riverbank erosion is a significant cause of concern for landowners on this segment of the Connecticut River. While it is a natural process, and is caused primarily by shear stress of water forced against the bank, wind-driven waves, and abrasion by ice, erosion is made worse by human actions, including water level fluctuations at the dams, boat wakes, and removal of the riverside vegetation that naturally holds the bank together. Area farmers report that they sometimes lose up to 5 - 10 feet each year to erosion. Erosion occurs both upstream of dams, when water level fluctuations cause soil piping in the banks due to sudden water pressure imbalances, and downstream, when water released at the dams scours the bed and banks.

"People think the Connecticut River doesn't need any help because it flows all by itself."

Hank Swan, Connecticut River Commissioner

Erosion sends sediment into streams, where it impairs fish spawning and can back up behind dams and reduce water storage or even threaten the dam itself, such as at the dam where Mill Brook leaves Mill Pond in Windsor.

Several Mount Ascutney region towns, including Plainfield, have faced riverbank erosion problems that threaten town roads. Rarely can towns afford more than a simple, conventional riprap project to stabilize the bank, even if that is not the best approach to the problem. Towns need help to plan a better approach, as Plainfield received from NH DES.

Vermont's River Management Program provides technical assistance to conduct geomorphic assessments of streams and their watersheds. The state has done a preliminary assessment of the Mill Brook watershed in Windsor, the only local tributary of the Connecticut that has yet been studied in this way. Understanding the natural tendencies of a stream, its current condition, and what changes may be anticipated in the future is invaluable to making sound protection, management, and restoration decisions.

A. US Army Corps of Engineers Study

Causes of erosion are many and complex on the Connecticut River, as on most large alluvial rivers. Erosive forces can act alone or together, making it difficult to pinpoint exact causes. The New England Division of the U.S. Army Corps of Engineers conducted a study of riverbank erosion on the Connecticut River in 1979 between Wilder and Turners Falls Dams (in Massachusetts), and concluded that the primary cause of erosion is shear stress of high-velocity flows, especially on banks composed of non-cohesive material.[1] The sandy to silty soils of the river in this part of the river valley are non-cohesive and so are very susceptible to erosion.

The Corps also identified pool fluctuations behind dams, boat wakes, gravity, seepage, natural flow variations, wind-driven waves, ice, flood variations, and freeze-thaw effects on the banks as causes of erosion, in that order of importance.

B. Erosion Inventories

Erosion on the Mount Ascutney segment of the Connecticut River was inventoried by the Sullivan and Cheshire County Conservation Districts in 1997 on both sides of the river.[2] Data were collected on riparian land use, bank height and slope, vegetation and soil type, river dynamics, and existing erosion controls. Results show that bank erosion is a significant problem in some places, with the more severe erosion along banks with steep, high, sandy slopes on inside bends. Power boat wakes are also one of the key causes of bank erosion on this part of the Connecticut River.

"If you get in there and try to put the river where you think it ought to go, it may not necessarily agree with you."

Ben Copans, Vermont basin planner

The report concluded that areas with severe and moderate erosion are largely attributable to natural forces such as higher velocity flows against concave banks and factors such as steep, high banks composed of sandy soils. Most of the reaches with moderate or severe erosion had moderate to high banks and slopes greater than 60 percent. Low banks with gentle slopes were generally stable. The water level in this reach fluctuates when water is released from Wilder Dam upstream, and a visible water line is apparent along the bank in many places. Banks with 0-3 percent slopes tend to be 6 - 8 feet in height, while eroding sites on steeper banks reached heights up to 150 feet. On sections where the flow was slower, watermarks indicate that wave action is a notable erosive force. Signs of spring flood levels and ice damage can be seen at heights of 6 - 8 feet. Along the railroad bed on the Vermont side, rock riprap has been installed and the bank is very stable. Otherwise, fewer attempts at erosion control were observed along the bank in Vermont than in New Hampshire.

In Sullivan County towns, 49 reaches were studied, nine showing slight erosion, 19 showing moderate erosion, and 21 showing severe erosion. Nearly half of the land along the river is in

---

1. *Report on Connecticut River Streambank Erosion Study: Massachusetts, New Hampshire, and Vermont.* U.S. Army Corps of Engineers, New England Division, Waltham, Mass. 1979.
2. *Connecticut River Erosion Inventory for Sullivan and Cheshire Counties, New Hampshire and Windham and Windsor Counties, Vermont.* Sullivan and Cheshire Counties Conservation Districts, 1997.

agricultural production, either cropland or hayland. No grazing livestock were noted along the river during this survey, but observers report that horses have trampled and denuded parts of Chase Island below the covered bridge in Cornish and the banks of Dickerson Brook, a small tributary of the Connecticut River in Charlestown. The remainder of the Sullivan County reach is evenly divided between forested land and either railroad/roads or residential.

In Windsor County towns, the land use is a more even mix of agricultural land, forest, residential, and railroad/roads. In these towns, 32 reaches were studied, eight showing slight erosion, 10 showing moderate erosion, and 14 showing severe erosion. At two gravel pits along the river, the study found significant deposits in the riverbed, especially at the Weathersfield pit just north of the Ascutney bridge. The study noted two severely eroding sites in Rockingham, one with an undercut, 15-foot high bank, and another site very close to Route 5.

Disturbed clay at Commissary Brook smothers vegetation and creates turbidity in the Connecticut River.

Commissary Brook - While the conservation districts identified a number of moderate to severe erosion sites in the Mount Ascutney region in 1997, Commissary Brook in Rockingham now exhibits erosion that far surpasses these, with documented influence on the Connecticut. Commissary Brook is now one of the worst sediment pollution problems on the upper Connecticut River. The brook has deposited a delta of gravel, silt, and clay into the river at their confluence approximately 6.5 miles upstream from the Bellows Falls Dam. Fishermen and divers report that in places where the Connecticut River was once 30 feet deep, it is now six inches deep, due to sediment delivered by Commissary Brook. The brook is sending a plume of turbidity into the river, measured by an official from NH DES in 2003, 200 feet downstream at a width of 40 feet. Turbidity measurements at that time showed that the plume violated the New Hampshire surface water quality standard, exceeding it by approximately 500 turbidity units. (In Class B waters, turbidity shall not exceed naturally occurring conditions by more than 10 units. When turbidity was measured on November 7, 2003, background turbidity of the Connecticut River was 505 units, and the turbidity in the plume was 1,010 units.)

The sediment is coming from a small tributary to Commissary Brook just upstream from its confluence with the Connecticut River. NH DES found that the sediment deposits are attributable to exposed, sloughed banks of an intermittent gully draining a reclaimed clay extraction pit, and determined that the plume will persist until the site is stabilized.

Changes in hydrology caused from removing trees to open the clay pit created the instability and failure of downstream embankments, according to the NH DES assessment. Increased water flow and head cutting in the gully of the intermittent stream draining this area led to further bank failure. It is believed that clay extraction penetrated to the depth of shallow groundwater, converting the intermittent stream to a perennial stream.

The presence of varved soils associated with glacial Lake Hitchcock appear to be a major contributing factor to the release of tons of sediment that have washed down the steep tributary stream into Commissary Brook and the Connecticut River. VT ANR and the state's Act 250 Environmental Board both granted permit approval for the clay extraction in the early 1990s, and did not foresee the subsequent severe erosion and sedimentation that later occurred. As of this writing, the sediment from Commissary Brook has continued to spread into the Connecticut River mainstem and a visible plume has moved hundreds of yards down river, reaching Roundy's Cove. A head cut is developing that could affect nearby homes.

C. Riparian Buffers

Riparian buffers are the single most effective protection for water resources in Vermont and New Hampshire. These strips of grass, shrubs, and/or trees along the banks of rivers and streams filter polluted runoff, capture sediment and nutrients, and provide a transition zone between water and human land use. Vegetated buffers have the added advantage of providing habitat for both land based and aquatic animal species and privacy for landowners. Shading streams with vegetation helps to optimize light and temperature conditions critical to the survival of certain species, such as trout.

Natural riparian buffers have been lost in many places over the years. The Conservation Districts concluded that human activity appears to be affecting erosion rates in some reaches where riparian vegetation has been removed from the bank, and that landowners needed to be more aware of the potential erosion problems that removing riparian buffers could cause. The erosion inventory noted that several farm parcels on both sides of the river lacked riparian buffers and crops were planted less than 10 feet from the top of the bank. Among these is a parcel owned by the N.H. Fish and Game Department next to the Cornish Boat Landing, that is leased for agricultural purposes, where farming activity has occurred very close to the water.

Local regulations regarding riparian buffer protection are summarized in Appendix F.

Riparian Buffer Planting on Power Company Lands - Demonstrating the importance of restoring buffers, US Gen New England sponsored the largest buffer planting projects in New Hampshire, on floodplain farmland owned by the company in Charlestown. In 2001, the company worked with the Cheshire County office of the USDA Natural Resources Conservation Service and 84 local volunteers for a total of 445 hours hand planting 1,300 trees and shrubs in a riparian buffer 100 feet wide and 1,630 feet long on the Lower Meadows. The following year, 163 volunteers turned out to plant 3,755 trees and shrubs for a 4,400 long, 100 foot wide buffer at the Great Meadows. Unfortunately, no provision was made for monitoring and care of the plantings in subsequent years, and there may be a need for some replanting.

Charlestown Riverbank Restoration at the Fort at No. 4 - The Connecticut River Joint Commissions asked the Conservation Districts to submit their highest priority erosion sites for consideration by their technical advisory committee. From among them, CRJC selected the 850-foot-long riverbank at the Fort at No. 4 in Charlestown for restoration. CRJC's three-year-long project involved local, state, and federal agencies in addition to the Fort staff and trustees. The riverbank had been scoured and eroded by ice and water, and boat wakes contributed

to bank instability. The site is also influenced by water level fluctuations in the impoundment behind Bellows Falls Dam. Archeological resources at the largest post-Contact Period site in the region, which had been the subject of a dig sponsored by CRJC a few years earlier, had been eroding into the river.

Planting a riparian buffer, here at Fort at No. 4, is a good way to restore the riverbank.

Because of the importance of this archeological site, state agencies would not permit use of conventional methods of sloping the bank back and replanting. Instead, a stone toe was applied to the base of the slope, new fill was added against the slope, and the fill was terraced and extensively planted with native shrubs, grasses, and large trees to provide root systems to hold the soil from further erosion. The Natural Resources Conservation Service, a Fort board member, and local volunteers planted a riparian buffer of 800 plants at the top of the bank, composed of native trees and shrubs which colonists would have found growing naturally at this site, and which they would have used for food, craft, or building supplies. During the course of the project, 20 endangered dwarf wedgemussels were discovered and temporarily moved to a safe location.

Since the installation of this project in 2003, the site has offered some lessons in buffer restoration. Unusually high water carrying ice later damaged some of the plantings, and a significant number of plants were overcome by competition from other plants.

"Anything that would reduce erosion rates would be good."

Rockingham riverfront landowner

Recommendations for Erosion

- Towns should consider and adopt shoreline protection and encourage retention of riverbank vegetation for its role in limiting boat wake erosion and protecting water quality.

- Landowners along rivers and streams should retain and enhance buffers of native vegetation on their banks to help hold soil together. Landowners should understand and obey state and local protection of riverbanks and buffers.

- NH Department of Safety should increase enforcement of boating speed laws, to minimize boat wake-induced riverbank erosion.

- The NH.. Fish and Game Department should ensure that agricultural activities at its property at the Cornish Boat Landing follow best management practices and that the riparian buffer is expanded on the property.

- NH Department of Agriculture should require minimum farm buffers, as in Vermont.

- Agencies and organizations sponsoring major buffer restoration projects should provide for professional monitoring and care of the plantings for several years to ensure success.

- EPA, the U.S. Army Corps of Engineers, NRCS, and VT DEC should examine the severe erosion at Commissary Brook, identify its causes, and fund a means to halt the surge of sediment into the Connecticut River mainstem.

- Landowners should include more vegetative and bio-technical components in their designs for streambank stabilization and contact their county conservation district office for advice.

- Landowners using irrigation pipes should monitor them and use best management practices so that the vibration of the pipes on the riverbank does not cause erosion to begin.

IX. Current Protection for the River

Tools for Protecting Riverfront Lands & Water Quality

A. New Hampshire

New Hampshire's Comprehensive Shoreland Protection Act (RSA 483-B) sets minimum shoreland protection standards for shore lands along New Hampshire's great ponds, fourth-order rivers, artificial impoundments and coastal waters. These standards are designed to minimize shoreland disturbance in order to protect the public waters, while still accommodating reasonable levels of development in the protected shoreland. Although the act sets minimum standards, section 483-B:8 gives municipalities the authority to adopt land use control ordinances which are more stringent. The legislature updated the Act in 2007 and 2009.

B. Vermont

Vermont is the only state in the Northeast that still has no statewide protection for shore lands. Section 1422 of Title 10 of the Vermont Statutes gives towns the authority to regulate shore lands to prevent and control water pollution; preserve and protect wetlands and other terrestrial and aquatic wildlife habitat; conserve the scenic beauty of shore lands; minimize shoreland erosion; reserve public access to public waters; and achieve other municipal, regional or state shoreland conservation and development objectives. Other state regulations set standards for management of agricultural land, silvicultural practices, and sediment and erosion control. In-stream water quality continues to be directly regulated at the state level, including withdrawals and discharges from and into surface waters.

C. Local Tools for Protecting Riverfront Lands

Besides the state statutes, many tools are available to communities and individuals to protect water quality; some are of a regulatory nature, some are non-regulatory. Local tools can include adopting a master plan (town plan) and/or water resources management plan with strong

recommendations for protecting water quality, scenic views, agricultural soils, riparian buffers, prime wetlands, floodplains, open space, and wildlife habitat. These recommendations could then be carried through to regulatory documents such as zoning, subdivision and site plan review.

1. Local Regulatory Measures

Floodplain Ordinances - Floodplain ordinances can prohibit construction in the floodplain. Floodplains provide flood storage, wildlife habitat and essentially act as buffers to protect water quality. Construction, development, or filling in of floodplains removes flood storage and displaces floodwater to locations further downstream. There is the added benefit of protecting buildings from flood damage which costs taxpayers millions of dollars each year. Vermont towns should update their floodplain ordinances, incorporating them into town zoning bylaws where possible.

Shoreland Overlays - A community can also adopt a shoreland protection ordinance or a buffer overlay to the zoning ordinance in which protection measures for surface waters can be more closely defined than for the rest of the town. In both states the requirements of the shoreland ordinance supersede that of the underlying zoning ordinance.

Fluvial Erosion Hazard Area Zone or Overlay District - Communities can help account for river erosion hazards and help to maintain the stability of a stream system by establishing an overlay district based on fluvial erosion hazard mapping. There are several ways that towns can implement fluvial erosion hazard overlay zones. Education of property owners is a less intensive way to implement these zones, and incorporating the zones into town zoning bylaws is ideal.

Others - Towns may also adopt measures to limit the amount of impervious surface created by new development to reduce the transportation of sediments and nutrients, require sediment and erosion control measures during and after construction, and minimize development on valuable agricultural soils.

2. Local Non-regulatory Methods

Vegetated Buffers - The use of riparian buffers can be either regulatory or voluntary, and is one of the best and most commonly used methods of protecting surface water. This strip of natural or planted vegetation along the riverbank can intercept harmful nutrients, toxic chemicals and sediments before they enter the surface waters, and control bank erosion.

Conservation Purchase or Easements - Towns or conservation groups can use these tools to provide a buffer on land adjacent to surface waters and wetlands, to protect water quality and to provide public access without creating new regulations. Prime agricultural soils, water supply recharge areas, floodplains, sites for rare and endangered species, and historic and archaeological sites can be protected in the same manner.

Incentives - Current use tax assessment programs in both states encourage landowners to keep their land undeveloped. A variety of incentive programs offered by the USDA Natural Resources

Conservation Service encourage landowners, especially farmers and forest landowners, to implement best management practices that benefit water resources, such as buffer planting, fencing of livestock, roof drainage improvements, and much more.

Education programs - Education programs through schools and non-profit education and land use organizations can increase the awareness of the general public regarding private property rights and ways to control nonpoint pollution on private land. Programs should emphasize the locations and use of existing public access and asking permission before stepping on private property.

X. Tributaries

In the Mount Ascutney region, the Connecticut River swells with the waters of dozens of tributaries draining the landscape from Lake Sunapee and Croydon Ridge in the east to the slopes of Okemo Mountain and the foothills of the Green Mountains in the west. These tributaries are described in Appendix I.

The Sugar River is by far the largest New Hampshire tributary in this region, followed by a half dozen large streams and some 15 first and second order streams. On the Vermont side, the Ottauquechee, Black, and Williams Rivers are major tributaries, followed by Lull's and Mill Brook and number of first and second order streams.

Tributaries in this region range in condition from cool forested havens for brook trout, such as the Little Sugar River, to warm and silty pasture drainages such as Dickerson Brook, and in the case of the Sugar and Black Rivers, powerful waterways recovering from centuries of industrial use and urban development. Common themes are loss of riparian buffers, erosion, sedimentation, encroachment by lawns and other development, and some agricultural disturbance.

On the Vermont side, basin planning is underway for the Ottauquechee and Black River watersheds, and has just concluded in the Williams River watershed. The smaller streams in this region, including Mill and Commissary Brooks, will be examined in the future.

On the New Hampshire side, the state has little information about most of the tributaries in the region other than the Sugar River, where some water quality assessment has occurred. Given the lack of knowledge about most of these tributaries, Mount Ascutney River Subcommittee members volunteered to conduct a windshield survey during the summer of 2006. Using maps prepared by NH DES for this purpose, members used a simple field recording sheet to assess the condition of small tributaries in their towns. Summaries of their reports are included in Appendix I.

XI. Conclusion

The Mount Ascutney region of the Connecticut River, with its fertile floodplains and ample waterpower, boasts a fine tradition of farming, textile production, and precision manufacturing. Area citizens and communities are more aware than ever of the value of their way of life and willing to roll up their sleeves to protect their waters. Leadership in ensuring a healthy future for the river must come from private landowners and decisions by town meeting and city council. The Subcommittee looks for all to participate in safeguarding the Connecticut River, life blood of the valley.

Appendix A. Subcommittee Members

These Local River Subcommittee members participated in development of this updated water resources chapter of the *Connecticut River Management Plan:*

Susan Anthony, *Windsor, VT*
Frank Anthony, *Windsor, VT*
Allan Berggren, *Claremont, NH*
Susan Fitch, *Cornish, NH*
Stephen Halleran, *Plainfield, NH*
Jabez Hammond, *Cornish, NH*
Thomas Hernon, *Rockingham, VT*
Janice Lambert, *Charlestown, NH*
Roger Marshall,* *Springfield, VT*
Margaret Perry, *Rockingham, VT*
Ted Putnam,* *Charlestown, NH*
Kurt Staudter,* *Springfield, VT*
Robert Woodman, *Claremont, NH*
** elected officers of the subcommittee*

The following Local River Subcommittee members participated in development of the 1997 *Connecticut River Corridor Management Plan* which formed the basis for the current plan.

Frank Anthony, *Windsor, VT*
Lamont Barnet, *Rockingham, VT*
Jay Boeri, *Hartland, VT*
Erik Christman, *Springfield, VT*
Jerry Evarts, *Cornish, NH*
Tom Fitzgerald, *Rockingham, VT*
Nancy Franklin, *Plainfield, NH*
John Hammond, *Cornish, NH*
Judy Hayward, *Windsor, VT*
John Leggett, *Springfield, VT*
Ted Moynihan, *Plainfield, NH*
Jim Newhaus, *Weathersfield, VT*
Phil Nothnagle, *Hartland, VT*
Alan Penfold, *Cornish, NH*
Ted Putnam, *Charlestown, NH*
Sharon Quackenbush, *Weathersfield, VT*
Al Stearns, *Charlestown, NH*
Bob Stone, *Charlestown, NH*
Gail Stewart, *Rockingham, VT*
Steve Sysko, *Springfield, VT*
Bob Woodman, *Claremont, NH*
John Yazinski, *Claremont, NH*

Appendix B. Progress Since 1997

Since publication of the first *Connecticut River Corridor Management Plan* in 1997, water quality is improving as river communities work to eliminate combined sewer overflows and upgrade their wastewater treatment plants. Voters are also investing more funds in land conservation to discourage polluting uses, and many landowners are improving pollution control on their property by enhancing riparian buffers and reducing use of fertilizers and pesticides near waterways.

The mouth of the Black River was long noted for the heavy mats of floating algae which developed there during warmer months, deterring swimmers and discouraging many boaters. Since Vermont was alerted to this problem by the 1997 edition of this Plan, the state has worked with Springfield, Vt., to upgrade the wastewater treatment facility to remove the phosphorus believed to be the cause of this heavy algal growth.

The State of New Hampshire has applied an improved Comprehensive Shoreland Protection Act to its side of the Connecticut River, and in some cases, local governments have enacted even stronger water quality protection for their shorelines. In early 2007, Vermont's citizen-based basin planning program turned its attention to the Black and Ottauquechee Rivers. Both states have greatly improved public access to water quality information in the last several years, through their Web sites. Vermont's regional planning commissions have made significant contributions by conducting bridge and culvert surveys for their communities, and seeking and applying hundreds of thousands of dollars to assess brownfields sites in Windsor, Springfield, and Rockingham, putting them on the path to redevelopment.

Perhaps even more encouraging is the news that watershed groups have formed around several of the tributaries, most notably the Black River Watershed Action Team. Citizens have also become involved in efforts to improve the Sugar River in New Hampshire and Mill Brook in Vermont.

Appendix C. Summary of Recommendations Arranged by Responsible Party

Federal	
Congress	• Identify mechanisms for decreasing carbon dioxide emissions to help reduce the possible effects of climate change. • Reduce sources of mercury contamination.
USGS	• Cooperate with states to maintain existing gages for public safety.
US Army Corps of Engineers	• Coordinate with towns in monitoring runoff and snowmelt. • Ensure that the earthen flood control dams at North Springfield and Hartland are well maintained for the safety of the public, and devote the proper resources to these facilities. • Examine the severe erosion at Commissary Brook, identify its causes, and fund a means to halt the surge of sediment into the Connecticut River mainstem.
FERC	• Include best management practices such as moderated ramping rates in the 2018 license for Wilder and Bellows Falls Dams. Review the daily operating logs to be sure that the water levels remain within license limits, and require an independent gage to verify dam operations. • Avoid further impoundment of the river to keep aeration at rapids and drops.
US Fish & Wildlife Service	• Devise new rules for handling and disposing of controlled medications. Work with health care institutions and the Food and Drug Administration to teach people to wrap and discard their unused and out-dated medicines in regular household trash rather than flushing.
EPA	• Devise new rules for handling and disposing of controlled medications. Work with health care institutions and the Food and Drug Administration to teach people to wrap and discard their unused and out-dated medicines in regular household trash rather than flushing. • Provide funding to assist with CSO elimination projects. • Partner with the railroad to identify ways to help its management become more aware of ways to avoid pollution of surface waters. • Work with the US Army Corps of Engineers and VT DEC to examine the severe erosion at Commissary Brook, identify its causes, and fund a means to halt the surge of sediment into the Connecticut River mainstem. • Revisit the fish tissue toxin study in 5-10 years to track progress in removing mercury and other contaminants from the environment.
NRCS	• Provide for professional monitoring and care of major buffer restoration projects to ensure success.
States	
Environmental Agencies	• Better coordinate water quality monitoring with regional planning commissions, using water quality planning grants. • Cooperate with USGS to maintain existing gages for public safety; add a gage at Blood (True's) Brook to help ensure proper operation of the Meriden wastewater treatment facility. Consider a new gage at Lake Sunapee as a lower priority, because information can be sought from the manager of the dam at the foot of the lake. Approach TransCanada for funding assistance to maintain gages, if necessary. • Identify mechanisms for decreasing carbon dioxide emissions to help reduce the possible effects of climate change. • Avoid further impoundment of the river to keep aeration at rapids and drops. • Do not permit landfills, salvage yards, and junkyards to be located on aquifers or varves. Map contaminated groundwater sites. Be vigilant about possible MtBE contamination. • Promote a regional processing facility for construction and demolition debris that will encourage recycling where possible. • Continue to reduce sources of mercury contamination. • Make up to date information on brownfields assessment discoveries readily available, especially for nearby residents who may be affected. • Examine the severe erosion at Commissary Brook, identify its causes, and fund a means to halt the surge of sediment into the Connecticut River mainstem. • Review sand and gravel excavation plans with great care, ensuring that excavations are set well back from the river-bank and cannot threaten its stability. Ensure regular monitoring of operations.

Appendix C. Continued

Transportation Agencies	• Avoid constructing new roads near rivers and streams. • Ensure that culverts are properly sized when replacing them during road work. Increase the minimum design standards for bridge and culverts to bankfull width to reflect current climate research. Offer support to towns to cover engineering costs for sizing culverts and bridges. • Include riparian buffer restoration in road projects near streams and rivers. • VT Agency of Transportation should consider its salt storage guidelines, develop regulations for salt storage near water, and identify better sites for salt storage in the region.
NH DES	• Inform landowners about the Comprehensive Shoreland Protection Act.
NH Agric. Dept.	• Require a minimum riparian buffer on farms, as is required in Vermont.
VT Legislature	• Adopt statewide shoreland protection. • Adopt landfill siting regulations to match New Hampshire's. • Update its current use taxation program to permit protection of riparian buffers.
VT Public Utilities Comm.	• Ensure that if an electric transmission line is built in the region, herbicide for vegetation control is not used near waterways and riparian buffers are not disturbed. Encourage use of native groundcover that grows thick with an extensive root system but does not grow tall.
Vermont DEC	• Begin basin planning for Rockingham's Commissary Brook as soon as possible, due to severe sedimentation problems and resulting pollution of the Connecticut River. • Adopt water withdrawal registration rules for the Connecticut River mainstem similar to New Hampshire's. • Map aquifers. • Monitor the railroad and nearby surface waters for salt migration related to the salt storage shed in Bellows Falls.
NH Fish & Game Dept.	• Ensure that agricultural activities at its property at the Cornish Boat Landing follow best management practices and that the riparian buffer is expanded on the property.
NH Dept. of Safety	• Increase enforcement of boating speed laws, to minimize boat wake-induced riverbank erosion.
Towns	
Town Management	• Towns with combined sewer overflows should proceed as quickly as possible to eliminate them. • Strongly encourage regular and more frequent household hazardous waste collections, perhaps charging a small fee to offset costs. The service should rotate among area towns, and be offered in each town at least once a year. Consider contributing to computer recycling by WinCycle in Windsor. • Arrange for roadside and riverbank cleanups by people who have to do court-ordered community service. • Do not issue permits for projects that violate the NH Comprehensive Shoreland Protection Act. • Ask for help from regional planning commissions to survey culverts and bridges to identify those that are undersized. Seek funds for replacing undersized culverts and those that block fish passage. • Consider working together on regional purchase and storage of road salt to reduce the number of sites where salt is stored and could contaminate rivers. • Springfield and Rockingham should identify better sites for salt storage.

Appendix C. Continued

Planning Boards & Commissions	• Adopt ordinances prohibiting filling and building in the 100-year floodplain and on flowage rights of way; consider establishing a building setback that reflects local soil conditions and the historic record of soil loss into the river, and ensure that buildings are set a safe distance back from the river even when outside of the floodplain • Require developers and landowners to establish and/or maintain buffers of native vegetation along rivers and streams. • Seek help from regional planning commissions to identify culverts and bridges that are undersized and might not carry the water that might come their way during larger storms. • Do not permit landfills, salvage yards, and junkyards to be located on aquifers. Take advantage of source water protection grant and loan programs. • Adopt ordinances prohibiting building in the 100-year floodplain and on flowage rights of way, to protect their citizens and businesses from damage, to avoid adding to flooding of their downstream neighbors, and to reduce the public cost of disaster relief. Ensure that buildings are set a safe distance back from the river even when outside of the floodplain, to reduce the risk of property loss in erodible areas. • Adopt new Flood Insurance Rate Maps. • Require sedimentation and erosion controls during and after construction. • Work with state geologists to map varves in their towns, to be sure major construction does not take place on unsafe soils. (50/50 match with USGS) • Avoid constructing new roads near rivers and streams. • Ask regional planning commissions for advice in how to avoid runoff problems related to large scale clearing, and consider whether culverts are sized in anticipation of runoff from future cleared slopes. • Ask developers to include infiltration methods such as small swales and runoff basins to capture runoff for groundwater recharge; look at ways to include "low impact development" ideas as they review projects, and at how to change existing development to reduce runoff and promote stormwater infiltration. • Consider discouraging roads and development on steep slopes to control stormwater runoff. • Require additional treatment to remove oil from parking lot runoff and if possible, to remove heavy metals. Require long-term maintenance of structural stormwater treatment units so they continue to function well.
Conservation Commissions	• Work with the state water quality agency to do more regular and sustained monitoring of Connecticut River tributaries. • Educate citizens about ways to decrease carbon dioxide emissions to help reduce the possible effects of climate change. • Educate people to keep their septic systems in good shape and to handle automotive fluids, pesticides, and other chemicals properly so they don't contaminate their own wells. Offer an annual testing day for private well water. • Encourage mercury product recycling; encourage paint swaps and educate homeowners on how to dispose of paint, since paint is expensive to treat. • Hold an annual "Green Up" Day. • Inform NH landowners about the Comprehensive Shoreland Protection Act. • Educate landowners to establish, maintain and enhance the native riparian buffer vegetation on their property. • Investigate how conservation easements on farmland can help keep town service and school costs down if the farm is not developed into house lots or into second homes which could later become year-round residences.
Road Crews	• Ensure that culverts are properly sized when replacing them during road work. Keep culverts clear of woody debris. • Follow snow disposal best management practices (BMPs). Snow should be stored on flat, pervious surfaces, such as grass, and at least 100-200 feet from the edge of a stream or river, with a silt fence between the snow and the stream. Once snow melts, debris should be quickly cleared from the site and brought to the landfill. Arrange to test the areas where snow has been piled for many years, to see if lead has accumulated in the soil. • Include riparian buffer restoration in road projects near streams and rivers.
Regional Planning Commissions	
	• Educate people to keep their septic systems in good shape and to handle automotive fluids, pesticides, and other chemicals properly so they don't contaminate their own wells. • Encourage mercury product recycling; encourage paint swaps and educate homeowners on how to dispose of paint, since paint is expensive to treat. • Assist towns with bridge and culvert surveys. • Assist towns with model ordinances for the actions described above.
Utilities	
Trans Canada	• Continue to monitor snow pack in order to predict snowmelt; alert towns if a problematic ice jam is anticipated. • Conserve its 67-acre parcel at Sumner Falls in Hartland or transfer the land to the town of Hartland for continued public use, free of development, while retaining some responsibility for public safety. • Conserve and continue to lease its farmland to experienced area farmers and continue the tradition of stewardship set by the company's predecessors.

Appendix C. Continued

Railroad	• Manage the rail system to protect nearby surface waters, by ensuring that all waste is disposed of properly.
Volunteer Groups	
Watershed Groups	• Work with the state water quality agency to do more regular and sustained monitoring of Connecticut River tributaries. • Provide for professional monitoring and care of major buffer restoration projects for several years to ensure success.
Trail Groups	• Ensure that all local trails have water bars to keep stormwater from eroding the compacted soils on the path.
Youth Groups	• Encourage students to take on water quality monitoring and river clean-ups as suitable community service projects.
Landowners	
Dam Owners	• Strongly consider removing those dams that no longer serve a purpose and cost more to fix than the benefits they offer or dams that pose a threat to areas downstream. Springfield should seek state assistance for removing the Springfield Reservoir Dam.
Developers	• Ensure that their developments keep natural drainage patterns and use swales and depressions ("rain gardens")to reduce runoff and recharge groundwater. • Ensure that septic systems are properly engineered and designed. • Avoid constructing new roads near rivers and streams. • Obey the law against filling wetlands.
Farmers	• Work with conservation districts and Cooperative Extension Service to prepare a total nutrient management plan for their land, to make best use of available nutrients, reduce potential for water quality impacts, save farm money by reducing cost of fertilizer purchases, and determine where and when biosolid application could benefit the farm operation; employ best management practices. • Inquire about how VT's Conservation Reserve Enhancement Program could help with water quality protection on the farm. • Stabilize irrigation hoses so they cannot vibrate and create a channel for erosion. • Ensure that livestock watering does not unduly affect streambanks and water quality. • Retain and encourage 50-100 foot riparian buffers to help minimize erosion of valuable soils.
Forest Landowners	• Discourage logging on steep slopes near the river, and in the riparian buffer. Use best management practices and be sure forest management plans include riparian buffers.
Waterfront Landowners	• Learn about the proper use and disposal of fertilizers, pesticides, and toxic materials; refrain from using fertilizer within 250′ of rivers, and consider alternatives to chemical fertilizers, herbicides, and pesticides. Consult CRJC's *Homeowner's Guide to Nonpoint Source Pollution in the Connecticut River Valley.* • Make use of CRJC's *Riparian Buffers for the Connecticut River Valley* to learn how to plant and enhance riparian buffers on their property with attractive landscape plantings that help control erosion and provide food and cover for wildlife. • Encourage native plants on their riverbanks, resist the temptation to cut and mow to the water's edge, and remove invasive plants. Understand and obey state and local protection of riverbanks and buffers. • Include more vegetative and bio-technical components in designs for streambank stabilization and contact the county conservation district office for advice.
All landowners	• Know the location of and regularly maintain on-site septic systems. • Obey the ban on barrel burning of trash.

Appendix D. Water & Sediment Quality

Water Quality

Results of 2004 water quality assessment by the New Hampshire Department of Environmental Services, with support from CRJC and US EPA Region I.

Connecticut River mainstem segment	Sampling Location	Towns	Miles	Assessment - 2004
Confluence of Mascoma River to confluence of Blow Me Down Brook, Cornish	Sumner Falls, Hartland	Lebanon Plainfield Hartland Cornish Windsor	12.5 miles	**Unsafe for swimming due to combined sewer overflows in Lebanon and Hartford** Safe for boating, fishing Meets state standards for supporting aquatic life **Fish consumption unsafe -mercury**
Confluence of Blow Me Down Brook to confluence of Sugar River	North Star Canoe Launch, Cornish	Cornish Windsor	6.7 miles	Safe for swimming, boating, fishing Meets state standards for supporting aquatic life **Fish consumption unsafe -mercury**
Confluence of Blow Me Down Brook to confluence of Sugar River	Ascutney Bridge	Claremont Weathersfield Charlestown Springfield	6.7 miles	Safe for swimming, boating, fishing Meets state standards for supporting aquatic life **Fish consumption unsafe -mercury**
Confluence of Sugar River to 1/4 mile below Cheshire Bridge	Cheshire Bridge	Claremont Weathersfield Charlestown Springfield	13 miles	Safe for swimming, boating, fishing **Does not meet state standards for supporting aquatic life - non-native species** **Fish consumption unsafe - mercury**
1/4 mile below Cheshire Bridge to Bellows Falls Dam	Arch St. Bridge	Charlestown Springfield Walpole Rockingham	9 miles	Safe for swimming, boating, fishing Meets state standards for supporting aquatic life **Fish consumption unsafe - mercury**

Swimming, fishing, and boating - determined by measurements of bacteria *(E. coli)*
Aquatic habitat - determined by measurements of dissolved oxygen, pH, specific conductance, and temperature
Fish consumption advisories: Information is available on the web at: www.wildlife.state.nh.us/Fishing/fish_consumption.htm.

Sediment Quality

Sampling Location	Town	Contaminants that Exceeded Screening Level	Source
Inside mouth of Ottauquechee River	Hartland, VT	• phenanthrene • fluoranthene • pyrene • chrysene • benzo(a)pyrene	2000 Upper Connecticut River Valley Sediment Study, US EPA, Region 1. Study of 100 locations on the mainstem and inside mouths of tributaries from Pittsburg NH to Hartland VT.
Sampling Location	**Town**	**Contaminants identified**	**Source**
Connecticut River mainstem downstream of the Sugar River confluence	Claremont, NH	***Levels above those expected to have ecological effects*** • benzo(ghi)perylene • chrysene • dibenzo(a,h)anthracene • indeno(1,2,3-cd)pyrene ***Levels below those expected to have ecological effects*** • dieldrin (pesticide) - low concentrations • PAHs (polyaromatic hydrocarbons) - highest levels found • cadmium, chromium, copper, nickel, lead, zinc, mercury	1998 Upper Connecticut River Sediment/Water Quality Analysis, US EPA, Region 1. Study of 10 locations on the mainstem from Stewartstown to Hinsdale NH.

Appendix E. Invasive Aquatic Species

Invasive Aquatic Species* (may not be a complete list)*		New Hampshire		Vermont		Present in CT River mainstem	Present in Mt. Ascutney Region?*
		present	prohibited	present	prohibited		
Floating Plants	European Naiad - *Najas minor*	X	X	X		X	
	Water Chestnut - *Trapa natans*	X	X	X			X
	Yellow Floating Heart - *Nymphoides peltata*		X	X			
Submerged Plants	Rock Snot - *Didymosphenia geminata*	X		X		X	
	Variable Milfoil - *Myriophyllum heterophyllum*	X	X				
	Fanwort - *Cabomba caroliniana*	X	X		X		
	Eurasian Water-Milfoil - *Myriophyllum spicatum*	X	X	X		X	X
	Brazilian Elodea - *Egeria densa*	X	X		X		
	Curly-leaf Pondweed - *Potamogeton crispus*	X	X	X		X	X
	Parrot Feather - Myriophyllum aquaticum		X				
	Hydrilla - *Hydrilla verticillata*		X		X		
	European Frogbit - *Hydrocharis morsus-ranae*		X	X	X		
	Indian Water Star - *Hygrophila polysperma*				X		
	Giant Salvinia - *Salvinia auriculata*				X		
	Giant Salvinia - *Salvinia herzogii*				X		
	Giant Salvinia - *Salvinia molesta*				X		
	Giant Salvinia - *Salvinia biloba*				X		
	Great Water Cress - *Rorippa amphibia*			X			

Appendix E. Continued

Emergent Plants	Purple Loosestrife - *Lythrum salicaria*	X	X	X		X	X
	Common Reed - *Phragmites australis*	X	X	X		X	X
	Flowering Rush - *Butomus umbellatus*		X	X			
	Japanese Knotweed - *Fallopia japonica*	X		X		X	X
	Yellow Flag Iris - *Iris pseudoacorus*	X		X		X	X
	True forget-me-not - *Myosotis scorpioides*	X		X		X	
Animals	Zebra Mussel - *Dreissena polymorpha*			X			
	Faucet Snail - *Bithynia tentaculata*			X			
	Chinese mystery snail - *Cipangopaludina chinensis*			X			
	Common Carp - *Cyprinus carpio*			X			
	Gizzard Shad - *Dorosoma cepedianum*			X			
	White Perch - *Morone americana*			X			
	Rusty Crayfish - *Orconectes rusticus*		X	X			
	European Rudd - *Scardinius erythrophthalmus*		X	X			
	Walking Catfish - *Clarias batrachus*		X				
	Grass carp - *Ctenopharyngodon idella*		X				
	Round goby - *Neogobius monachus*		X				

*Please note: this list is the result of informal observations by CRJC staff and more formal observations taken during a 2006 Connecticut River Aquatic Invasive Plants Outreach & Survey Project, funded by the Connecticut River Joint Commissions' Partnership Program. This survey took place at 21 mainstem sites in New Hampshire and Vermont, from Hinsdale to Pittsburg. Because the entire region was not surveyed intensively, and because invasive species may have established colonies since these observations were made, it is likely that this list is not complete.

Appendix F. Local Shoreland and Water Quality Protection

New Hampshire Towns

Town Tools	Plainfield	Cornish	Claremont	Charlestown
1. Master Plan is in effect	Yes (1987)	Yes (1989)	Yes (1991)	Yes
2. River is mentioned in master plan	Yes	Yes	Yes	Yes
3. Scenic or historic resources mentioned in master plan/ zoning	Yes	Yes	Yes	Yes
4. Zoning is in effect	Yes (2005)	Yes (2000)	Yes (1997)	Yes (2002)
5. Subdivision Regulations are in effect	Yes (1987)	Yes (1993)	Yes (1993)	Yes (2003)
6. Site Plan Review is in effect	Yes (2001)	Yes (1993)	Yes (2000)	Yes (1999)
7. Excavation Regulations are in effect	Yes (2005)	Yes	Yes (1994)	Yes (1990)
8. Shoreland Protection Regulations	Yes	Yes	Yes	Yes
a. Building setback required from waterways? *(50′ setback on CT River - state law)*	Yes - 100′	Yes - 100′	Yes - 50′	Yes - 50′ or 25′
b. Development prohibited in flood hazard area? *(100 year floodplain = 1% chance of flood each year)*	No	Yes	No	No
c. Riparian buffer protected? *(150′ buffer on CT River where the buffer exists-state law)*	Yes - 150′	Yes - 100′	No	Yes - 50′ or 25
d. Overlay district for rivers & streams?	Yes	Yes	Yes	No
e. Minimum frontage required for shore lots? *(150′ min. on CT. River if no sewer-state law)*	No	No	No	No
f. Local regulation of docks in effect?	No	No	No	No
9. Wetlands Regulations	Yes	Yes	No	No
a. Uses regulated in wetlands?	Yes	Yes	No	No
b. Activities regulated in a buffer zone around wetlands?	No	No	No	No
10. Groundwater Protection Regulations	No	No	No	Yes
a. Uses regulated over aquifers ?	No	No	No	Yes
b. Well-head protection area defined?	No	No	No	Yes
c. On-site sewage disposal buffer around water supplies?	No	Yes - 100′	No	No
11. Agricultural Soils Protection Regulations	No	No	No	No
12. Steep Slopes Regulations	No	No	No	No
13. Town has a conservation commission	Yes	Yes	Yes	Yes

Source: Upper Valley Lake Sunapee Regional Planning Commission, 2005.

Appendix F. Continued

Vermont Towns

Town Tools	Hartland	Windsor	Weathersfield	Springfield	Rockingham
1. Town Plan is in effect*	Yes (2002)	Yes (2004)	Yes (2004)	Yes (2004)	Yes (2005)
2. River mentioned in master plan	No	Yes	Yes	Yes	Yes
3. Scenic or historic resources mentioned in master plan and/or zoning	Yes	Yes	Yes	Yes	Yes
4. Zoning is in effect	No	Yes (2001)	Yes (2002)	Yes (1997)	Yes (2005)
5. Subdivision Regulations in effect	No	Yes (2003)	Yes (1988)	Yes (1999)	Yes (1987)
6. Site Plan Review in effect	No	Yes	Yes	Yes	Yes
7. Excavation Regulations in effect	No	No	No	No	Yes
8. Shoreland Protection Regulations	No	Yes	Yes	Yes	No
a. Building setback required from waterways? *(No state requirement)*	No	Yes - 50', all waters	Yes - 100' from Connecticut R.	Yes - 50', CT & Black Rivers	No
b. Development prohibited in flood hazard area? *(100 year floodplain)*	Yes	Subject to DRB review	No	No	No
c. Riparian buffer protected?	No	Yes - 50'	Yes	Yes	Yes
d. Overlay district for rivers & streams?	No	No	No	Yes - CT & Black Rivers	Yes - limited area of CT R.
e. Minimum frontage for shore lots?	No	No	No	No	No
f. Local regulation of docks?	No	No	Yes	Yes - one dock	No
9. Wetlands Regulations	No	Yes	Yes	No	No
a. Uses regulated in wetlands?	No	Yes	Yes	No	No
b. Activities regulated in a buffer zone around wetlands?	No	Yes - 50'	Yes	No	No
10. Groundwater Protection Regulations	No	Yes	No	Yes	No
a. Uses regulated over aquifers ?	No	No	No	Yes	No
b. Well-head protection area defined?	No	No	Defined on Town Plan map, not regs	Town Plan only	Yes - public water supplies
c. On-site sewage disposal buffer around water supplies?	No	No	Yes	No	Yes
11. Agricultural Soils Protection Regulations	No	No	Yes, 10+ contiguous acres in ag	No	No
12. Steep Slopes Regulations	No	No	Yes	No	No
13. Conservation commission	Yes	No	Yes	No	No

Sources:
Hartland: Research by Deborah Noble Associates, April 2005
Windsor, Weathersfield, Springfield: Southern Windsor County Regional Planning Commission, October, 2005
Rockingham: Town of Rockingham, March, 2005

Note: Vermont town plans expire after five years. Date given is date of last update.

Appendix G. Water Withdrawals in the Mount Ascutney Region – N.H.

(note: Vermont does not require registration of water withdrawals except for snowmaking)

Name	Facility	Town	Source Type	Source Name
Meriden Village Water District	Water Works	Plainfield	Groundwater	Newton/bloods Brook Well
Edgewater Farm	Edgewater Farm	Plainfield	Surface Water	Connecticut River
BG&A Corporation	Hy on a Hill Trout Farm	Plainfield	Groundwater	Wells
Claremont City	Water Works	Claremont	Surface Water	Sugar River
Lower Village Hydro Corp	Lower Village Water Power	Claremont	Surface Water	Sugar River
Claremont Country Club	Claremont Country Club	Claremont	Surface Water	Pond 1
Sweetwater Hydroelectric Inc	Sweetwater Hydroelectric Project	Claremont	Surface Water	Sugar River
APC Paper Company Inc	APC Paper Company Inc	Claremont	Surface Water	Sugar River
Windy Acres Coop Inc	Windy Acres Mobile Home Park	Charlestown	Groundwater	Well #3
N Charlestown Water Works	N Charlestown Water Works	Charlestown	Groundwater	Gravel Pack Well 2
Charlestown Water Works	Charlestown Water Works	Charlestown	Groundwater	Gravel Pack Well Clay Bk

Appendix H. Rivers Covered by NH Comprehensive Shoreland Protection Act – Mount Ascutney Region

The New Hampshire shore of the Connecticut River, from the river's source at Fourth Connecticut Lake, is covered by this law. The law also applies to lakes and ponds of 10 acres or more, and to other rivers and streams in New Hampshire's Headwaters Region that are fourth order and larger:

City/ Town	River/ Stream	Stream Order	Beginning of Fourth Order or Higher Segment
Plainfield	Connecticut River	7	(all)
	Bloods Brook	4	Juncture of Newton Brook
Cornish	Connecticut River	7	(all)
	Mill Brook	4	Juncture of Blow-Me-Down Brook
	Blow-Me-Down Brook	4	Juncture of two unnamed 3rd order streams
Claremont	Connecticut River	7	(all)
	Sugar River	6	Outflow of Lake Sunapee
Charlestown	Connecticut River	7	(all)
	Beaver Brook	4	Juncture of unnamed 3rd order stream
	Clay Brook	4	Juncture of unnamed 3rd order stream
	Jabes Hackett Brook	4	Juncture of Meadows Brook
	Little Sugar River	4	Juncture of Meadow Brook in Unity

Appendix H. Continued

Environmental Services

RSA 483-B
Comprehensive Shoreland Protection Act (CSPA)
A Summary of the Standards

Effective July 1, 2008, **A STATE SHORELAND PERMIT is required for many construction, excavation or filling activities within the Protected Shoreland.** Forest management not associated with shoreland development or land conversion and conducted in compliance with RSA 227-J:9 or under the direction of a water supplier for the purpose of managing a water supply watershed, and agriculture conducted in accordance with best management practices as required by RSA 483-B, III is exempted from the provisions of the CSPA. Projects that receive a permit under RSA 482-A, e.g., beaches, do not require a shoreland permit. A complete list of activities that do not require a shoreland permit can be found in the Shoreland Administrative Rules, Env-Wq 1406.

250 feet from Reference Line—THE PROTECTED SHORELAND:

Impervious Surface Area Allowance. Twenty percent of the area within the protected shoreland may be impervious surface. This may be increased up to 30 percent if there are 50 points of tree coverage in each 50 foot x 50 foot grid segment in the waterfront buffer (WB), and a storm water management plan is submitted and approved by DES.

Other Restrictions:

- No establishment/expansion of salt storage yards, auto junk yards, solid waste and hazardous waste facilities.
- All new lots, including those in excess of 5 acres are subject to subdivision approval by DES.
- Setback requirements for all new septic systems are determined by soil characteristics.
  - 75 feet for rivers and areas where the there is no restrictive layer within 18 inches and where the soil down gradient is not porous sand and gravel (perc>2 min.).
  - 100 feet for soils with a restrictive layer within 18 inches of the natural soil surface.
  - 125 feet where the soil down gradient of the leachfield is porous sand and gravel (perc rate equal to or faster than 2min/in.).
- Minimum lot size in areas dependent on septic systems determined by soil type.
- Alteration of Terrain Permit standards reduced from 100,000 square feet to 50,000 square feet.
- For new lots with on-site septic, the number of dwelling units per lot shall not exceed 1 unit per 150 feet of shoreland frontage.

150 feet from Reference Line—NATURAL WOODLAND BUFFER (NWB) RESTRICTIONS:

- For lots that contain ½ acre or more within the NWB, between 50 feet and 150 feet of the reference line, the vegetation within at least 50 percent of the area, exclusive of impervious surfaces, shall be maintained in an unaltered state.
- For lots that contain less than ½ acre within the NWB, between 50 feet and 150 feet of the reference line, the vegetation within at least 25 percent of the area shall be maintained in an unaltered state.

50 feet from Reference Line—WATERFRONT BUFFER and PRIMARY BUILDING SETBACK:

- Effective April 1, 2008, all primary structures must be set back at least 50 feet from the reference line. Towns may maintain or enact their own setback only if it is greater than 50 feet.
- Within 50 feet, a waterfront buffer must be maintained. Within the waterfront buffer, tree coverage is managed with a 50-foot x 50-foot grid and points system. Tree coverage must total 50 points in each grid. Trees and saplings may be cut as long as the sum of the scores for the remaining trees and saplings in the grid segment is at least 50 points.
- No natural ground cover shall be removed except for a footpath to the water that does not exceed 6 feet in width and does not concentrate stormwater or contribute to erosion.
- Natural ground cover, including the duff layer, shall remain intact. No cutting or removal of vegetation below 3 feet in height (excluding lawns) except for the allowable footpath. Stumps, roots, and rocks must remain intact in and on the ground.
- Pesticide or herbicide applications must be by a licensed applicator only.
- Low phosphorus, slow release nitrogen fertilizer may be used for the area that is beyond 25 feet from the reference line. No fertilizer, except limestone, shall be used between the reference line and 25 feet.

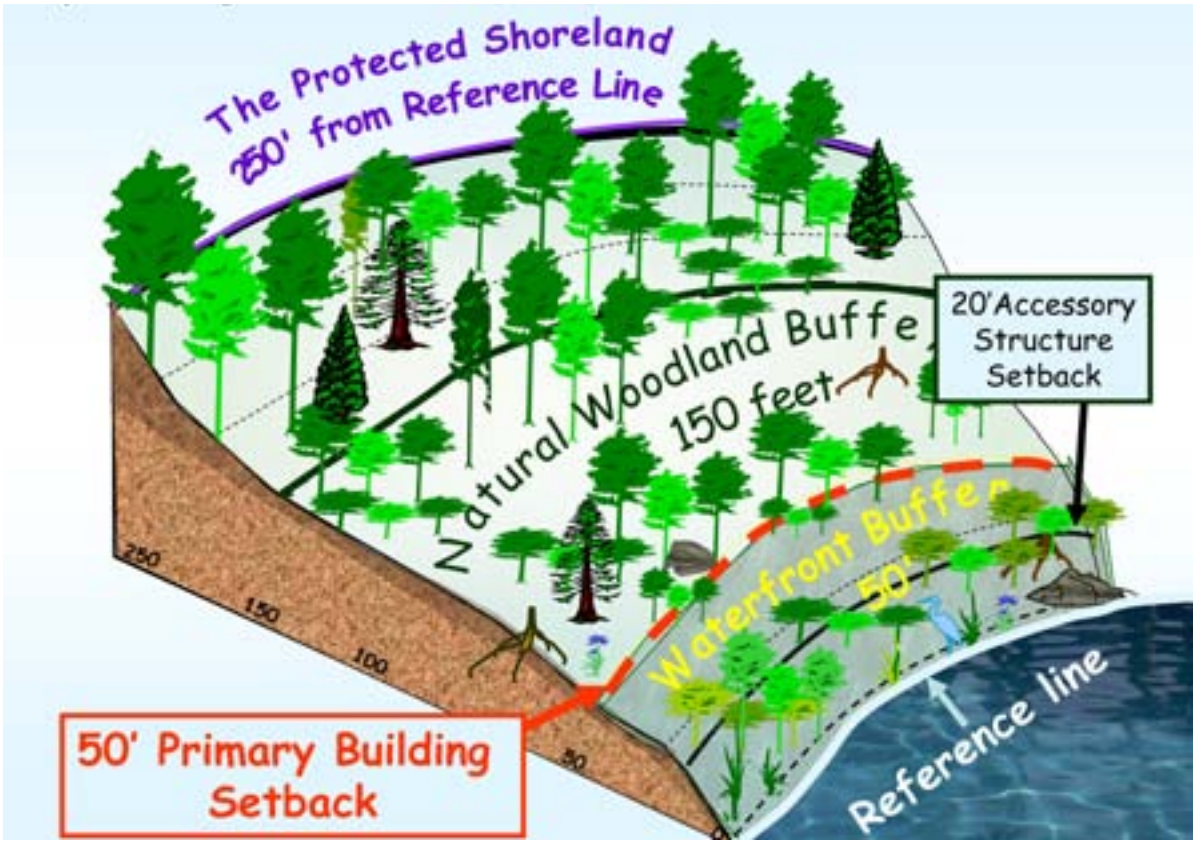
REFERENCE LINE: For ***coastal waters*** it is the highest observable tide line; for ***rivers*** it is the ordinary high water mark; for ***natural fresh waterbodies*** it is the natural mean high water level; and for ***artificially impounded fresh waterbodies*** it is the elevation at the spillway crest or, if there are flowage rights, the elevation of the flowage rights.

NON-CONFORMING STRUCTURES Are structures that, either individually or when viewed in combination with other structures on the property, do not conform to the provisions of the CSPA, including but not limited to the impervious surface limits of RSA 483-B:9V(g). They may be repaired, renovated, or replaced in kind using modern technologies, provided the result is a functionally equivalent use. Such repair or replacement may alter the interior design or existing foundation, but shall result in no expansion of the existing footprint except as authorized by the department pursuant to paragraph II of RSA 483-B.

A SITE ASSESSMENT is required prior to executing a purchase and sale agreement for any "developed waterfront property" using a septic disposal system and which is contiguous to or within 200 feet of a great pond (a public water of more than 10 acres) as defined in RSA 4:40-a and upon which stands a structure suitable for either seasonal or year-round human occupancy.

For more information, please visit the DES Shoreland Website at www.des.nh.gov/cspa

Appendix H. Continued



Source: NH DES

Appendix I. Tributaries to the Connecticut River

New Hampshire

Tributary	State Assessment Draft 2008 Section 303(d) List of Impaired Surface Waters	Local Observations
Town where tributary enters Connecticut River: Lebanon - (most of tributary located in Plainfield)		
Bloods Brook (also known as Willow Brook and True's Brook)	not assessed	3d order stream. Watershed land use varies from dispersed to urban development, with roads, agriculture, roads, a cemetery, and conserved land. Significant parking lot runoff, erosion, recreational use, and lawns. Some livestock access. Bottom varies from cobbles and gravel to sandy/silty. Some erosion. Tends to be flashy during heavy rains. Trash and paint on ledges, E. side of Meriden swimming hole, under covered bridge. Popular swimming hole on Lebanon line with conservation easement. Stocked trout fishery. Scenic. Some wetlands violations. Town plans to reduce road runoff into brook. Large cobble and gravel deposit at mouth following heavy rains in 2006, has raised river bend 2 feet above previous level.
Town where tributary enters Connecticut River: Plainfield		
Hibbard Brook	safe for swimming, boating, fishing	
Hanchett Brook	not assessed	
Town where tributary enters Connecticut River: Cornish		
Blow Me Down Brook	not assessed except for 0.36 mile segment, where it is safe for swimming but impaired for aquatic life due to aluminum	3d order stream. Most of tributary located in Plainfield, before it enters the forested and protected Saint-Gaudens National Historic Site in Cornish. Watershed land use in Plainfield is largely agriculture and dispersed development, some forest, and minor concentrated development. Some problems with intensive grazing, lack of buffer, lawns. Bottom type is largely sandy with some gravel, and some erosion. Used for irrigation. Flow tends to be consistent. Coldwater fishery, hiking and snowmobile trails nearby. Road salt storage close to brook. Slides along steep banks. Need for sound manure management at fish hatchery. Unauthorized dredging of brook for irrigation. Large infestation of Japanese knotweed at Daniels Meadow area.
unnamed brook	not assessed	1st order. Passes through forested ledges south of Saint-Gaudens. Some erosion, many small waterfalls. No evident WQ problems.
unnamed brook	not assessed	1st order. Enters CT R. at Cornish boat landing. Upper watershed steep and largely forested, lower is in corn production. No evident WQ problems Some erosion, purple loosestrife present.
Dingleton Brook	not assessed	
Mill Brook	not assessed	
unnamed brooks	not assessed	

Appendix I. Continued

Tributary	State Assessment Draft 2008 Section 303(d) List of Impaired Surface Waters	Local Observations
Town where tributary enters Connecticut River: Claremont		
unnamed brook	not assessed	Runs by Lambert's bike shop, past Silver's junkyard, and parking lot of Lambert used auto. Once had culverts made of old hot water heaters. Silver's junkyard has no fence, and state has been trying to follow up with capping, but owner has moved to Florida and not responded.
North Branch Sugar River	many miles of tributaries to the Sunapee Lakes and to the North Branch exhibit low pH. The North Branch itself is impaired by *E. coli* for 7.98 miles and by low pH for 13.21 miles. Lake Sunapee is on NH's list of acid ponds.	
South Branch Sugar River	-safe for swimming from Blood Br. to Trow Br. -8.24 miles not safe for swimming (*E. coli*); 17.02 miles impaired for aquatic life due to low pH	
Sugar River *** primary drinking water source for Claremont, after treatment*	-unsafe for swimming (*E. coli*) for 19.03 miles in Newport and Claremont. Aluminum impairs 15.91 miles. Aquatic life impaired by low pH in 20.14 miles and by low dissolved oxygen in 1.3 miles, partly due to municipal and industrial discharges in Newport and Sunapee.	
Town where tributary enters Connecticut River: Charlestown		
Little Sugar River	not assessed in most places; safe for swimming in 7 miles above Chase Brook	One of the few wild trout tribs to the Connecticut in this region. Intensively used Arabian horse farm near its mouth, then a couple of fairly pristine miles upstream, then the Unity Stage Road runs parallel to it for another couple of miles. Because of the bridge washout in October 2005, that road is getting a lot less traffic. (The detour is a Class 6 road through the woods). It is a beautiful little river. Watershed largely forested, with dispersed development and good riparian buffer. Bottom is mostly cobbles and gravel. No evident water quality problems. Popular swimming hole at Rt. 12 RR bridge. Scenic. Japanese knotweed. Salmon fry released here. Natural Heritage Bureau identified several rare plant species in the floodplain.
Meadow Brook	not assessed	
Gully Brook	not assessed	
Ox Brook	not assessed	Watershed partly forested, some agriculture. Good riparian buffer. Sandy/silty bottom, waterfall, some erosion, some riprap. No evident WQ problems. History of wetlands violations in area.
Beaver Brook	not assessed	
Clay Brook	safe for swimming in lowest mile; fish bio-assessments indicate 1.11 miles impaired for aquatic life use	Watershed partly forested, some agriculture and dispersed development. Bottom largely small boulders, cobbles, gravel; some silt. Waterfall, some erosion, some riprap. Hall's Pond and old reservoirs on Hemlock Road. Nearby well. No evident WQ problems. Trash on bank. Some intensive cropping.
Dickerson Brook	not assessed	Watershed largely in agriculture, some forest, and some development. Bottom largely silty. Waterfall, 25-50% eroded banks, WQ problems include turbidity and odor. Concern about cattle trampling and contaminating the brook. Lower course of brook is denuded. Water milfoil at mouth of brook, purple loosestrife along banks near mouth.
Hackett Brook	not assessed	mostly forested

Appendix I. Continued

Vermont

Tributary	State Assessment Draft 2008 Section 303(d) List of Impaired Surface Waters and 2002 VT Surface Water Quality Assessment Report	Local Observations
Town where tributary enters Connecticut River: Hartland		
Ottauquechee River	Controlled by the U.S. Army Corps of Engineers flood control dam at North Hartland. 86% forested watershed. Phosphorus levels high in N. Hartland reservoir 1997; CSOs and golf course in Quechee. 0.9 miles below N. Hartland dam, pathogens from failing septic systems, fertilized turf, and horse farms, fluctuating flows, and warm, turbid water releases from dam result in "partial support" of river uses and values. Roaring Brook, a tributary of the Ottauquechee River, is affected by stormwater runoff, land development, and erosion. Leachate from the Bridgewater landfill is entering the river via a wetland. Several other tributaries are affected by sediment from road runoff, nutrients from horse recreation activity and golf course runoff, and sediment. EPA 2000 Sediment Study - sampled just above confluence with CT R., site # SD-090L, found 5 polyaromatic hydrocarbons (PAHs) exceeded low effects levels: phenanthrene, fluoranthene, pyrene, chrysene, benzo(a)pyrene	
Lull's Brook	First 8 miles from the mouth have threats to aquatic biota/habitat, contact recreation, and aesthetics due to nutrients, pathogens, sediment from horse pasture with no buffers, horse manure on streambanks, gravel road runoff (1999). Wild brook trout.	
Town where tributary enters Connecticut River: Windsor		
Mill Brook	From Mill Pond Dam to CT River, partial support of aesthetics, aquatic biota/habitat, secondary contact recreation due to sedimentation, nutrients, and flow and habitat alteration caused by upstream impoundment and its desilting, urban and road runoff, and land development. Geomorphic assessment underway by State of VT .WQ monitoring by RPC and Mill Brook Association beginning 1997; also bank erosion survey 2000. From Reading through Brownsville to Mill Pond, stream may be polluted by *E. coli*, temperature, and sediment, and needs further assessment.	
Town where tributary enters Connecticut River: Weathersfield		
Spencer Brook	Loss of riparian vegetation is a threat, cows have access to stream. A lot of algae observed in stream (1999).	
Mill, Blood, Barkmill Brooks	No WQ problems seen; wild brook trout; water clarity excellent, water temps in 60sF (1999).	
Town where tributary enters Connecticut River: Springfield		
Black River	From mouth to 2.8 miles upstream, unsafe for contact recreation, poor aesthetics; polluted by *E. coli* and thick algal growth from CSOs, municipal WWTF, and road runoff. Threats from suspended solids, pH and toxic compounds from CSOs, urban and road runoff and a hazardous waste site. CSO abatement being phased. Roof drain disconnection work done in 2006. Partially controlled by N. Springfield Flood Control dam. Watershed 75% forested. Aquatic community rated "good." Some toxic urban impact suspected. Jones & Lamson site had contaminants of concern including PCBs, VOC, lead, #6 fuel on its 2 sites in Springfield. Some cleanup work done but it is not clear if flood drains from one of the plants have been cleaned and sealed. The drains (presumably connected to outfall pipes) are one of potential sources of pollution to the Black River. Town has achieved compliance with phosphorus effluent limit North Branch above Stoughton Pond is eroding and may be polluted by sediment, nutrients, and *E. coli*. Jewell Brook, a tributary in Ludlow, may be contaminated with arsenic in sediment from a former mill, and needs further assessment.	The CSO work is split up into six phases. All CSOs were eliminated by 2008.

Appendix I. Continued

Vermont

Tributary	State Assessment Draft 2008 Section 303(d) List of Impaired Surface Waters and 2002 VT Surface Water Quality Assessment Report	Local Observations
Town where tributary enters Connecticut River: Rockingham		
Commissary Brook	Habitat degradation due to sedimentation & turbidity from channel modification, logging, discharges and erosion. Needs further assessment.	Subject of strong local concern. VT and NH agencies appear to believe the problem may be too difficult to be solved. EPA should look at the site. Head cuts may be forming that could threaten other properties.
Williams River	From 2007 Draft Watershed Plan: The Williams River is 25 miles long and drains 117 square miles. Much of the upper basin is rugged, hilly land with steep slopes and poor drainage. At its lower end in Rockingham is an 80-foot gorge with pools, potholes, and small cascades. The Brockways Mills hydro dam has downstream fish passage. The upper portions of the mainstem Williams River and Middle Branch, as well as most of the smaller tributaries support healthy populations of wild native brook trout, and in some cases, wild brown trout. However, high summer water temperatures limit trout populations in the lower mainstem. Salmon have been stocked in the Williams River since 1993. One returning adult salmon entered the Williams River in 1999. The macro-invertebrate populations are considered good to very good. The lower Williams River (Mouth Upstream to Middle Branch Confluence) is compromised by sediments, nutrients, and temperature problems due to encroachments, poor riparian condition, and runoff from agriculture and development.	

2008 VT draft 303(d) List of Impaired Surface Waters and 2008 draft VT List of Priority Surface Waters Outside the Scope of Clean Water Act Section 303(d).

Appendix J. List of Acronyms

BMP = best management practices
CFS = cubic feet per second
CREP = Conservation Reserve Enhancement Program
CRJC = Connecticut River Joint Commissions
CSO = combined sewer overflow
EPA = United States Environmental Protection Agency
FEMA = Federal Emergency Management Administration
NH DES = New Hampshire Department of Environmental Services
NPDES = National Pollutant Discharge Elimination System
NRCS = Natural Resources Conservation Service of USDA
TMDL = total maximum daily load
USDA = United States Department of Agriculture
USGS = United States Geological Survey
UST= underground storage tank
UVLT = Upper Valley Land Trust
VRAP = Volunteer River Assessment Program
VT DEC = Vermont Department of Environmental Conservation of ANR
VT ANR = Vermont Agency of Natural Resources
WWTF = wastewater treatment facility

Appendix K: River Designations Chart

ENVIRONMENTAL
Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

29 Hazen Drive, Concord, New Hampshire 03301 • (603) 271-3503 • www.des.nh.gov

R&L-14 2009

River Classifications and State Regulated Protection Measures As They Apply To Each Classification

	RIVER CLASSIFICATIONS			
	Natural	**Rural**	**Rural-Community**	**Community**
Activities Allowed				
Dams & Encroachments				
Construction of New Dams	No	No	No	Yes
Reconstruction of Breached Dams	No	Yes (within six years)	Yes (within six years)	Yes
Channel Alterations	No (excluding repair)	Yes (with conditions)	Yes (with conditions)	Yes (with conditions)
Water Quality/ Water Quantity				
Water Quality	Class A or B	Class B	Class B	Class B
Interbasin Transfers	No	No	No	No
Protected Instream Flow	Yes	Yes	Yes	Yes
Waste Disposal				
New Landfills	No (within 250 ft.)	No (within 250 ft.)	No (within 250 ft.)	No (within 250 ft.)
New Hazardous Waste Facilities	No (within 250 ft.)	No (within 250 ft.)	No (within 250 ft.)	No (within 250 ft.)
Other New Solid Waste Facilities	No (within 250 ft.)	No (within 250 ft.)	No (within 250 ft.)	No (within 250 ft.)
New Septic Systems	No (within 75 ft.)	No (within 75 ft.)	No (within 75 ft.)	No (within 75 ft.)
New Auto Junk Yards	No (within 250 ft.)	No (within 250 ft.)	No (within 250 ft.)	No (within 250 ft.)
Fertilizer				
Limestone	Yes	Yes	Yes	Yes
Sludge and Septage	No (within 250 ft.) Conditions apply	No (within 250 ft.) Conditions apply	No (within 250 ft.) Conditions apply	No (within 250 ft.) Conditions apply
Low Phosphorus, Slow Release Nitrogen	No (within 25 ft.)	No (within 25 ft.)	No (within 25 ft.)	No (within 25 ft.)

Appendix K. Continued

All Other Fertilizers	No (within 25 ft.)	No (within 25 ft.)	No (within 25 ft.)	No (within 25 ft.)
Pesticides and Herbicides				
All pesticides and herbicides	Yes (with conditions)	Yes (with conditions)	Yes (with conditions)	Yes (with conditions)
Recreation Use				
Motorized Watercraft	No	Yes (within 150 ft. of shoreline, only "headway" speed)	Yes (within 150 ft. of shoreline, only "headway" speed)	Yes (within 150 ft. of shoreline, only "headway" speed)
New Building				
Primary Structure	No (within 50 ft.)	No (within 50 ft.)	No (within 50 ft.)	No (within 50 ft.)
Multiple Dwellings	Yes (with conditions)	Yes (with conditions)	Yes (with conditions)	Yes (with conditions)
Impervious Surface Cover	Yes (with conditions)	Yes (with conditions)	Yes (with conditions)	Yes (with conditions)
Subdivision	Yes (with approval)	Yes (with approval)	Yes (with approval)	Yes (with approval)l
Buffer Removal				
Natural Ground Cover	No (within 50 ft., except for 6 ft. path)	No (within 50 ft., except for 6 ft. path)	No (within 50 ft., except for 6 ft. path)	No (within 50 ft., except for 6 ft. path)
Stumps, Roots and Rocks	No (within 50 ft.)	No (within 50 ft.)	No (within 50 ft.)	No (within 50 ft.)

For further information about the N.H. Rivers Management and Protection Program visit the DES website at www.des.nh.gov/organization/divisions/water/wmb/rivers/index.htm or contact Steve Couture, Rivers Coordinator, 29 Hazen Drive, PO Box 95, Concord, NH 03302-0095; (603) 271-8801; steven.couture@des.nh.gov.

Appendix L. Water Resources Maps

Data Sources:
NH base map features, including roads and railways, from 1:24,000 Digital Line Graph (DLG) data supplied by Complex Systems Research Center, UNH (CSRC). VT base map features from 1:5,000 orthophotos distributed by VT Center for Geographic Information (VCGI). VT roads from Enhanced 911 Board, distributed by VCGI. VT railway from USGS 1:100,000 DLG data, distributed by VCGI, 1987.

NH watershed boundaries by US Department of Agriculture (USDA) Natural Resource Conservation Service (NRCS) and NH Department of Environmental Services (NHDES), 1:24,000 scale, distributed by CSRC, 1983. VT watershed boundaries by USDA NRCS, 1:24,000 scale, from USGS DLG's and Digital Raster Graphics (DRG), distributed by VCGI.

Wetlands data provided by the US Fish & Wildlife Service, National Wetlands Inventory (NWI). NH wetlands distributed by CSRC, 1:24,000 scale. VT wetlands distributed by VCGI, 1:80,000 scale.

Aquifers mapped by US Geological Survey (USGS) in cooperation with NHDES, 1:24,000 scale, distributed by CSRC, 2000. For detailed information, see Geohydrology and Water Quality of Stratified-Drift Aquifers in the Middle Connecticut River Basin, West-Central NH, USGS Water-Resources Investigations Report 94-4181 or Geohydrology and Water Quality of Stratified-Drift Aquifers in the Lower Connecticut River Basin, Southwestern NH, USGS Water-Resources Investigations Report 92-4013. No digitized aquifers available in the state of VT.

NH public drinking water supply sources from NHDES, 1:24,000 scale, distributed by NHDES, 1997. VT public drinking water sources by Halliburton NUS Corporation, funded by US Environmental Protection Agency (EPA), distributed by Vermont Agency of Natural Resources (VTANR), 1994.

Sediment locations from Weston Solutions, Inc., 2000, distributed by US Environmental Protection Agency--New England, funded in cooperation with NHDES and VTANR. See Upper Connecticut River Valley Sediment Study from Weston Solutions, Inc. for detailed information on sediment samples. This study sampled river sediments in 100 locations along the mainstem and inside the mouths of tributaries between Fourth Connecticut Lake in Pittsburg, NH and the confluence of the Ottauquechee River in Hartland, VT. Sediments were analyzed for the presence of 159 possible contaminants. "High risk priority" means that the concentration of the pollutant(s) found in the sediment suggests a strong likelihood of impacts to aquatic life. "Moderate risk priority" means that the concentration of the pollutant(s) found in the sediment suggests a moderate likelihood of impacts to aquatic life.

Sediment locations from US Environmental Protection Agency--New England, 1999, Office of Environmental Management and Evaluation Ecosystem Assessment Unit. This study sampled river sediments in 10 locations along the mainstem between Pittsburg, NH and the confluence of the Ashuelot River in Hinsdale, NH. Sediments were analyzed for the presence of heavy metals, pesticides/PCBs, polyaromatic hydrocarbons, total petroleum hydrocarbons, and total organic carbon. "High risk priority" means that the concentration of the pollutant(s) found in the sediment suggests a strong likelihood of impacts to aquatic life. "Moderate risk priority" means that the concentration of the pollutant(s) found in the sediment suggests a moderate likelihood of impacts to aquatic life.

Potential water quality threats in NH distributed by NHDES include the following:
- Underground Storage Tank Facilities, 2004.
- Automobile Salvage Yards, 1991.
- Point/Non-point Potential Pollution Sources**
- Groundwater Hazard Inventory, 2003 **

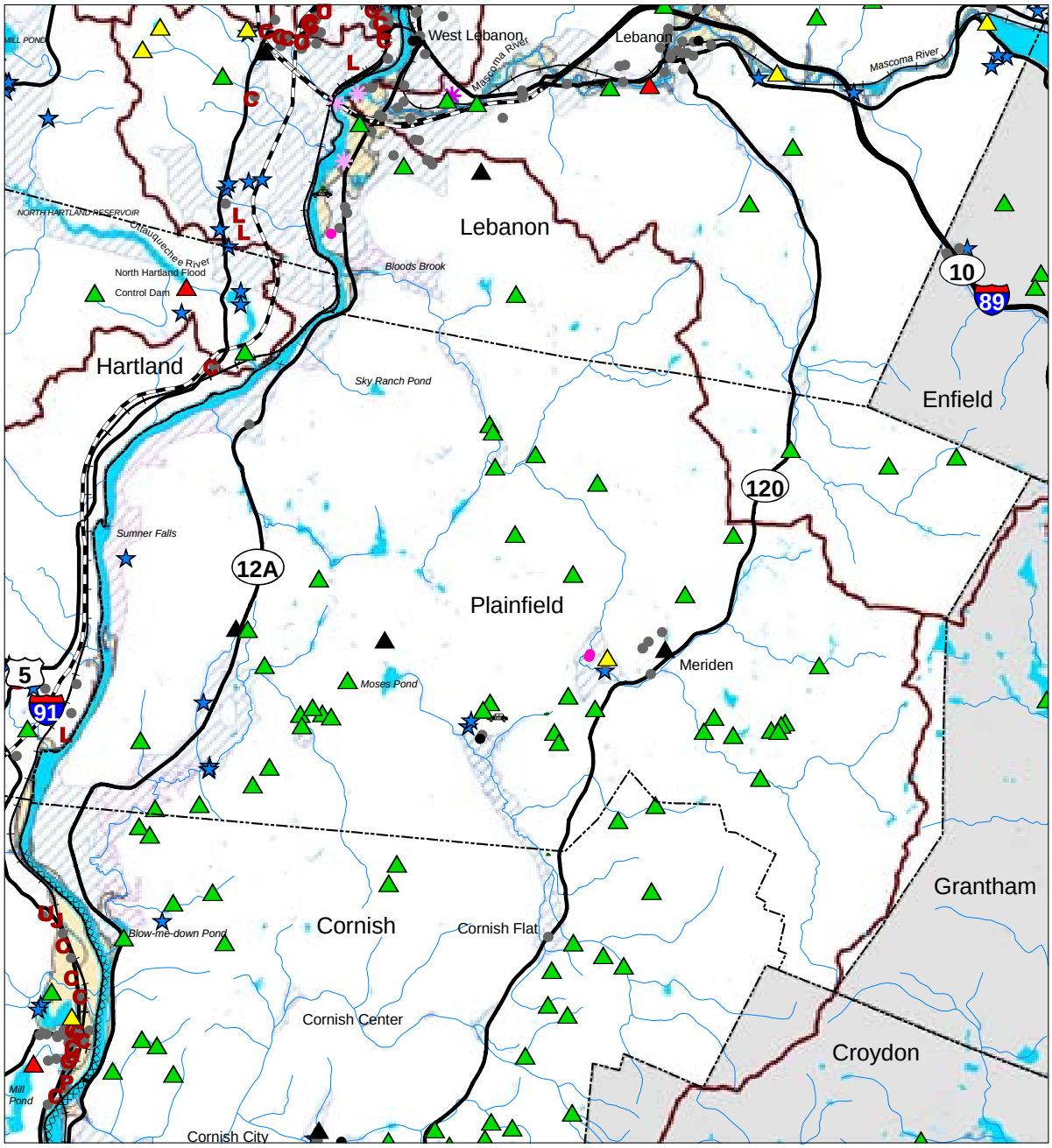
**Refer to written report for more detailed information on each potential water quality threat categories.

Potential Water Quality Threats in VT from VTANR distributed by VCGI include Underground Storage Tank Facilities and the Pollution Source Inventory of 1980.

Floodplains for Windsor, VT/Plainfield, NH and points south from ENSR International, Westford, MA, funded by Federal Emergency Management Agency (FEMA), 2003.

The impoundment zone, or upstream extent of impoundments, generated by MicroData, 1994, based on source data provided by Connecticut River Joint Commissions.

Maps created by Upper Valley Lake Sunapee Regional Planning Commission, by R. Ruppel, GIS Analyst.



Water Resources - Plainfield, NH

Mt. Ascutney Subcommittee

- Political Boundary
- Watershed Boundaries
- Interstate
- State or Local Highway
- Railway
- Major Water Bodies
- Wetlands

Aquifers

- Stratified-Drift Aquifers
- Glacial Lake Bottom Deposits
- 100-Year Floodplain
- Public Water Supply

Sediment Locations

- High Risk Priority
- Moderate Risk Priority

Dams

- Low Hazard Potential
- Significant Hazard Potential
- High Hazard Potential
- Hazard Potential Not Assigned
- Impoundment Zone

N W E S

1 0 1 2 Miles

1:100,000

Water Quality Threats

VT Pollution Source Inventory of 1980

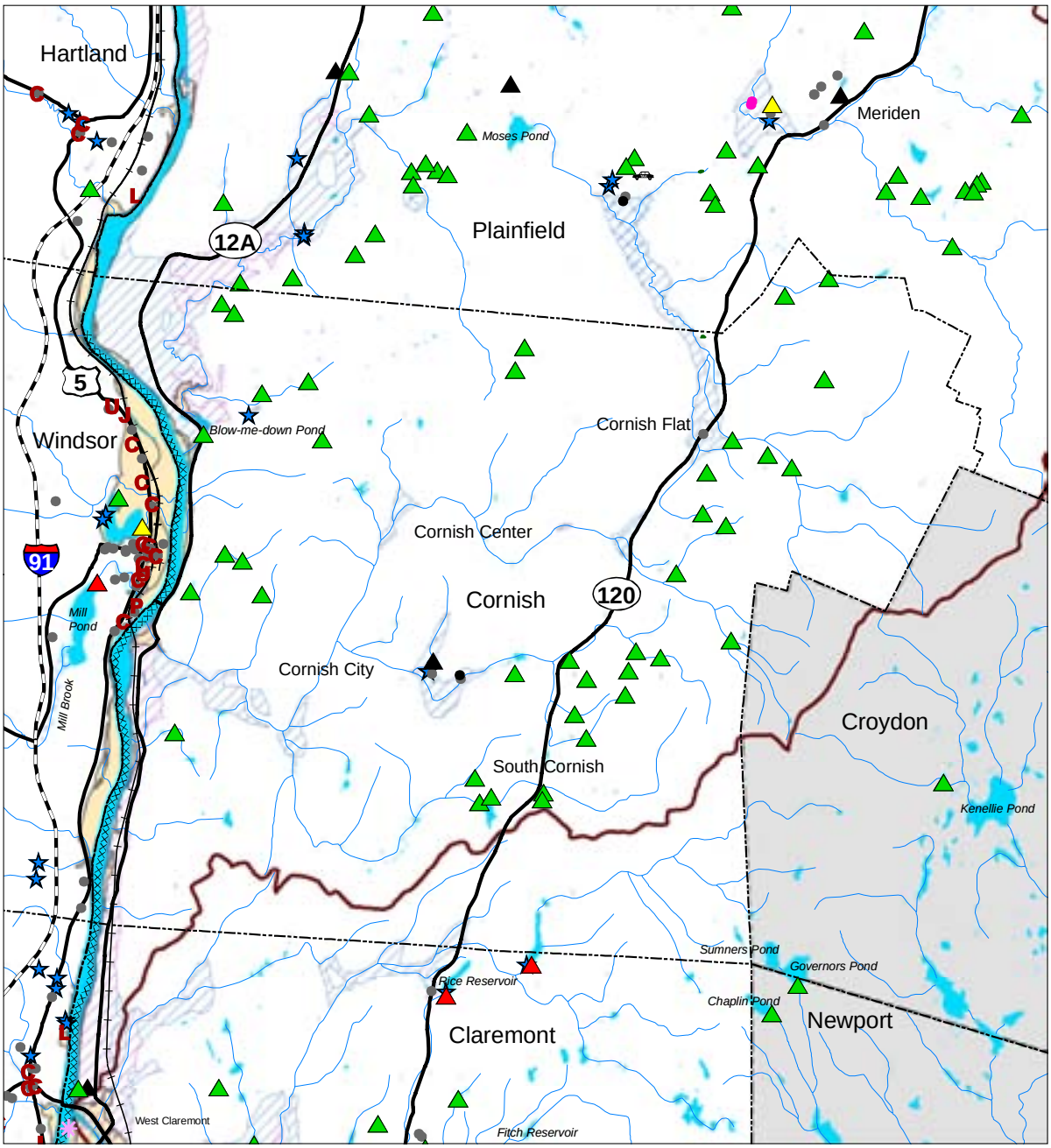
- C Petrochemicals
- J Junk Yard/Salvage Yard
- K Liquid Waste to Land Surface/Subsurface
- L Landfilll/Dump
- P Lagoon-Municipal
- U Salt/Salted Sand
- Underground Storage Tank Facilities

NH Water Quality Threat Inventories

- Snow Dump/Salt Storage
- Automobile Salvage Yard
- Lagoon
- Landfill/Dump

Map created by
Upper Valley Lake Sunapee Regional Planning Commission
for the Connecticut River Joint Commissions, January 2008.

Funding provided by CRJC and US Gen New England.



Water Resources - Cornish, NH

Mt. Ascutney Subcommittee

- Political Boundary
- Watershed Boundaries
- Interstate
- State or Local Highway
- Railway
- Major Water Bodies
- Wetlands

Aquifers

- Stratified-Drift Aquifers
- Glacial Lake Bottom Deposits
- 100-Year Floodplain
- Public Water Supply

Sediment Locations

- High Risk Priority
- Moderate Risk Priority

Dams

- Low Hazard Potential
- Significant Hazard Potential
- High Hazard Potential
- Hazard Potential Not Assigned
- Impoundment Zone

N W E S

1 0 1 2 Miles

1:85,000

Water Quality Threats

VT Pollution Source Inventory of 1980

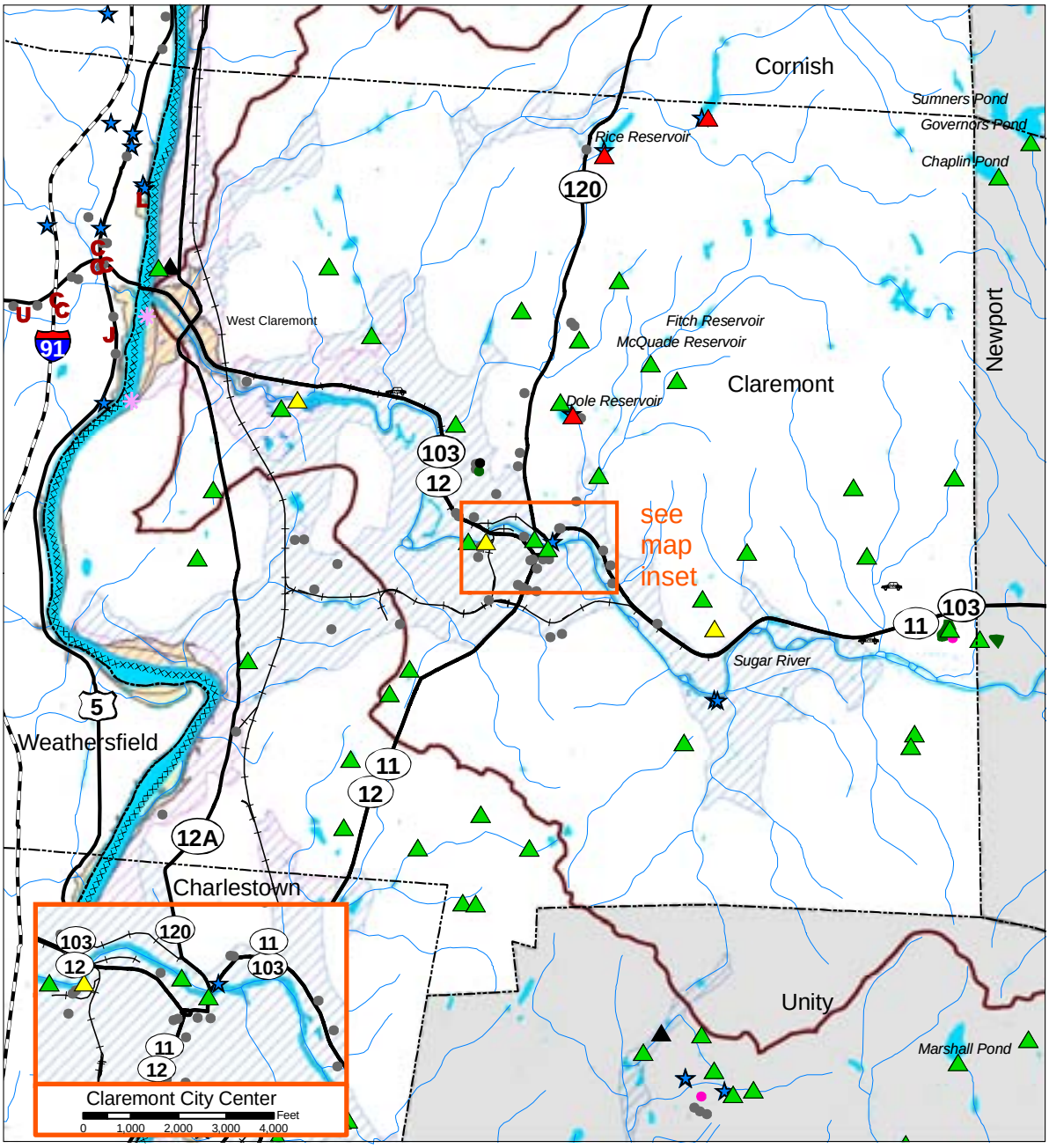
- C Petrochemicals
- J Junk Yard/Salvage Yard
- K Liquid Waste to Land Surface/Subsurface
- L Landfilll/Dump
- P Lagoon-Municipal
- U Salt/Salted Sand
- Underground Storage Tank Facilities

NH Water Quality Threat Inventories

- Snow Dump/Salt Storage
- Automobile Salvage Yard
- Lagoon
- Landfill/Dump

Map created by
Upper Valley Lake Sunapee Regional Planning Commission
for the Connecticut River Joint Commissions, January 2008.

Funding provided by CRJC and US Gen New England.



Water Resources - Claremont, NH

Mt. Ascutney Subcommittee

Political Boundary
Watershed Boundaries
Interstate
State or Local Highway
Railway

Major Water Bodies
Wetlands

Aquifers
Stratified-Drift Aquifers
Glacial Lake Bottom Deposits

100-Year Floodplain
Public Water Supply

Sediment Locations
High Risk Priority
Moderate Risk Priority

Dams
Low Hazard Potential
Significant Hazard Potential
High Hazard Potential
Hazard Potential Not Assigned
Impoundment Zone

N
W E
S

0.5 0 0.5 1 Miles
1:70,000

Water Quality Threats

VT Pollution Source Inventory of 1980

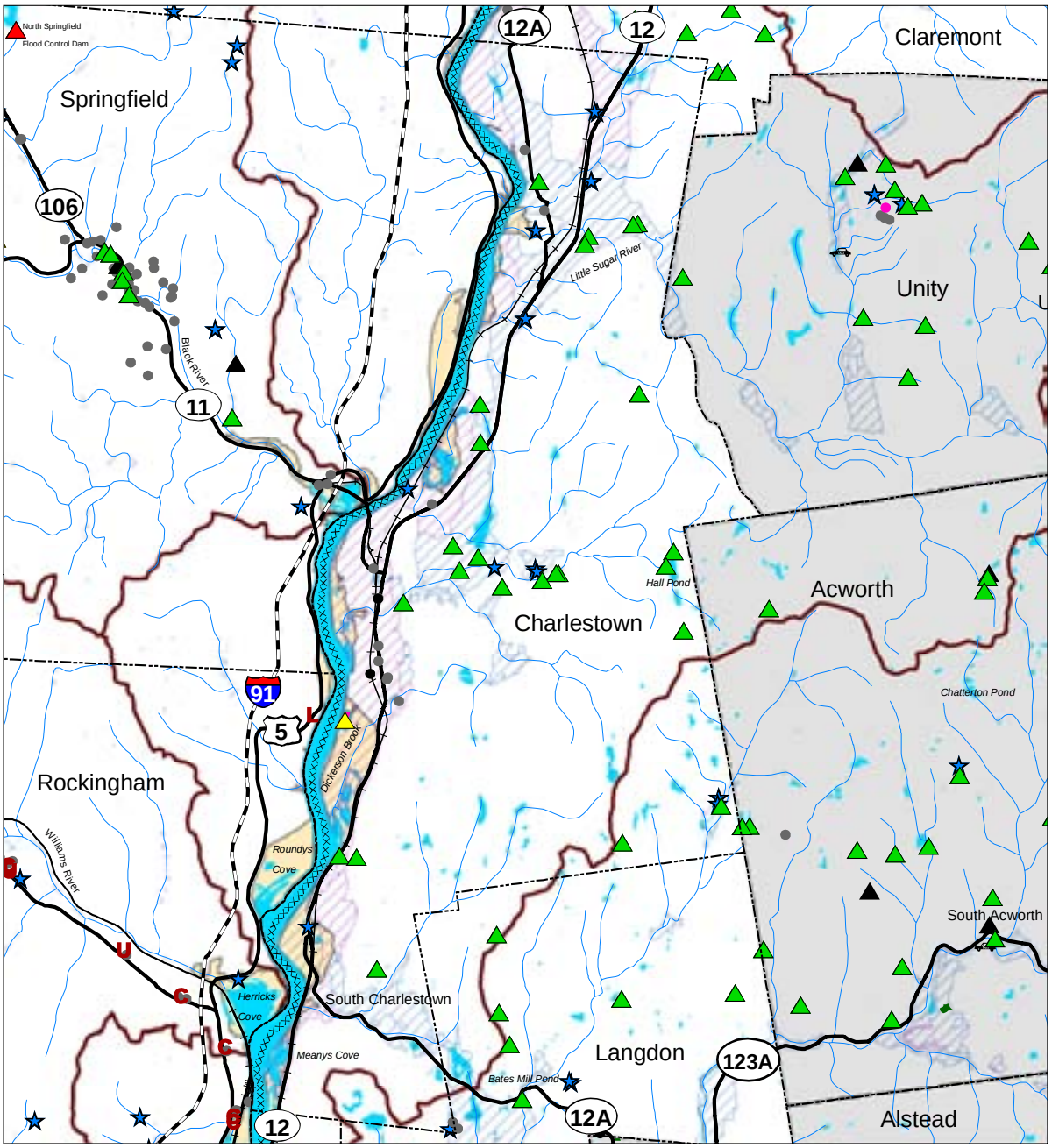
- C Petrochemicals
- J Junk Yard/Salvage Yard
- K Liquid Waste to Land Surface/Subsurface
- L Landfill/Dump
- P Lagoon-Municipal
- U Salt/Salted Sand
- Underground Storage Tank Facilities

NH Water Quality Threat Inventories

- Snow Dump/Salt Storage
- Automobile Salvage Yard
- Lagoon
- Landfill/Dump

Map created by
Upper Valley Lake Sunapee Regional Planning Commission
for the Connecticut River Joint Commissions, December 2007.

Funding provided by CRJC and US Gen New England.



Water Resources - Charlestown, NH

Mt. Ascutney Subcommittee

- Political Boundary
- Watershed Boundaries
- Interstate
- State or Local Highway
- Railway
- Major Water Bodies
- Wetlands

Aquifers

- Stratified-Drift Aquifers
- Glacial Lake Bottom Deposits
- 100-Year Floodplain
- Public Water Supply

Sediment Locations

- High Risk Priority
- Moderate Risk Priority

Dams

- Low Hazard Potential
- Significant Hazard Potential
- High Hazard Potential
- Hazard Potential Not Assigned
- Impoundment Zone

N W E S

1 0 1 2 Miles

1:100,000

Water Quality Threats

VT Pollution Source Inventory of 1980

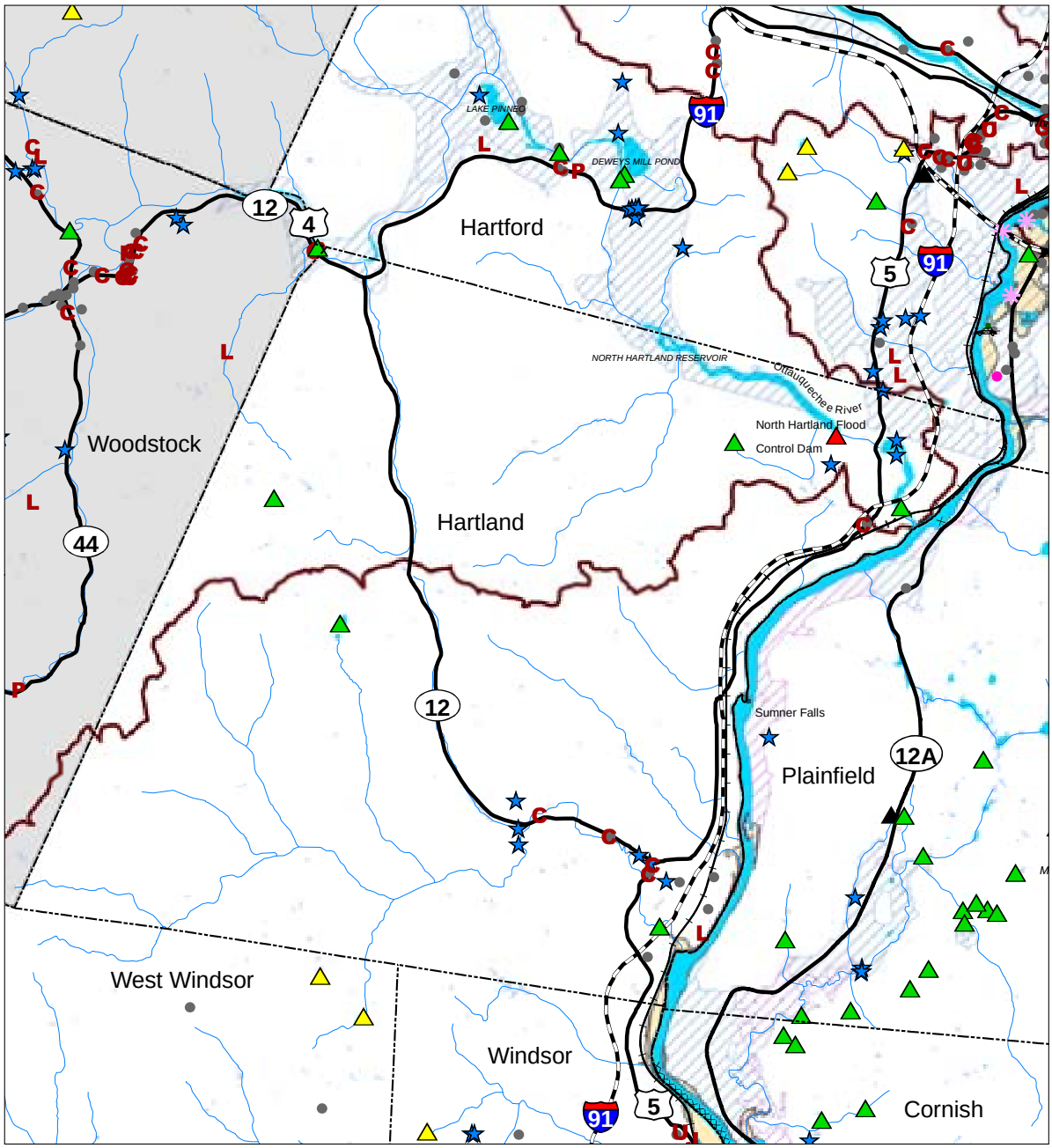
- C Petrochemicals
- J Junk Yard/Salvage Yard
- K Liquid Waste to Land Surface/Subsurface
- L Landfill/Dump
- P Lagoon-Municipal
- U Salt/Salted Sand
- Underground Storage Tank Facilities

NH Water Quality Threat Inventories

- Snow Dump/Salt Storage
- Automobile Salvage Yard
- Lagoon
- Landfill/Dump

Map created by
Upper Valley Lake Sunapee Regional Planning Commission
for the Connecticut River Joint Commissions, January 2008.

Funding provided by CRJC and US Gen New England.



Water Resources - Hartland, VT

Mt. Ascutney Subcommittee

- Political Boundary
- Watershed Boundaries
- Interstate
- State or Local Highway
- Railway
- Major Water Bodies
- Wetlands

Aquifers

- Stratified-Drift Aquifers
- Glacial Lake Bottom Deposits
- 100-Year Floodplain
- Public Water Supply

Sediment Locations

- High Risk Priority
- Moderate Risk Priority

Dams

- Low Hazard Potential
- Significant Hazard Potential
- High Hazard Potential
- Hazard Potential Not Assigned
- Impoundment Zone

Water Quality Threats

VT Pollution Source Inventory of 1980

- C Petrochemicals
- J Junk Yard/Salvage Yard
- K Liquid Waste to Land Surface/Subsurface
- L Landfill/Dump
- P Lagoon-Municipal
- U Salt/Salted Sand
- Underground Storage Tank Facilities

NH Water Quality Threat Inventories

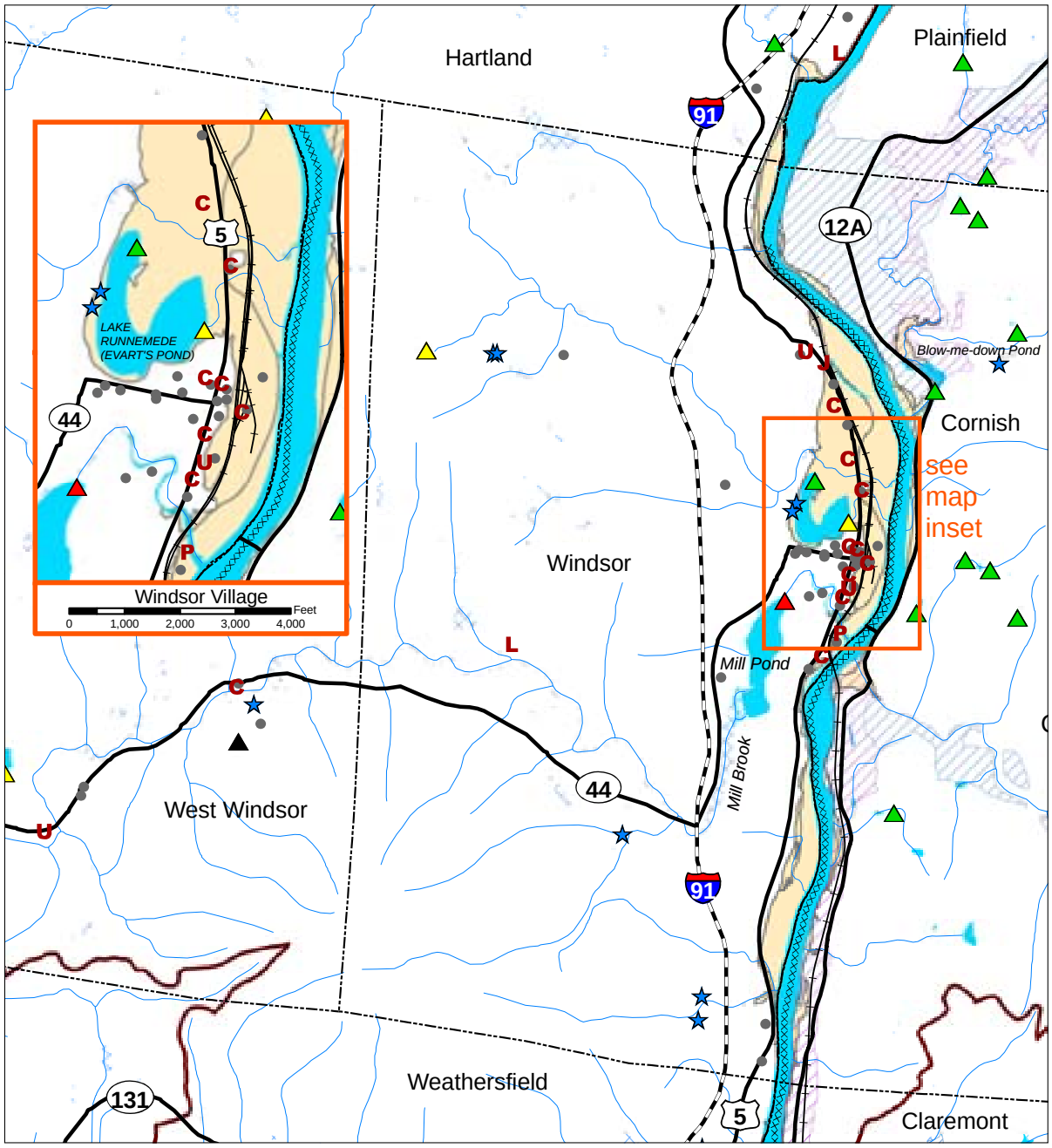
- Snow Dump/Salt Storage
- Automobile Salvage Yard
- Lagoon
- Landfill/Dump

1 0 1 2 Miles

1:90,000

Map created by
Upper Valley Lake Sunapee Regional Planning Commission
for the Connecticut River Joint Commissions, January 2008.

Funding provided by CRJC and US Gen New England.



Water Resources - Windsor, VT

Mt. Ascutney Subcommittee

- Political Boundary
- Watershed Boundaries
- Interstate
- State or Local Highway
- Railway
- Major Water Bodies
- Wetlands

Aquifers

- Stratified-Drift Aquifers
- Glacial Lake Bottom Deposits
- 100-Year Floodplain
- Public Water Supply

Sediment Locations

- High Risk Priority
- Moderate Risk Priority

Dams

- Low Hazard Potential
- Significant Hazard Potential
- High Hazard Potential
- Hazard Potential Not Assigned
- Impoundment Zone

Water Quality Threats

VT Pollution Source Inventory of 1980

- C Petrochemicals
- J Junk Yard/Salvage Yard
- K Liquid Waste to Land Surface/Subsurface
- L Landfill/Dump
- P Lagoon-Municipal
- U Salt/Salted Sand
- Underground Storage Tank Facilities

NH Water Quality Threat Inventories

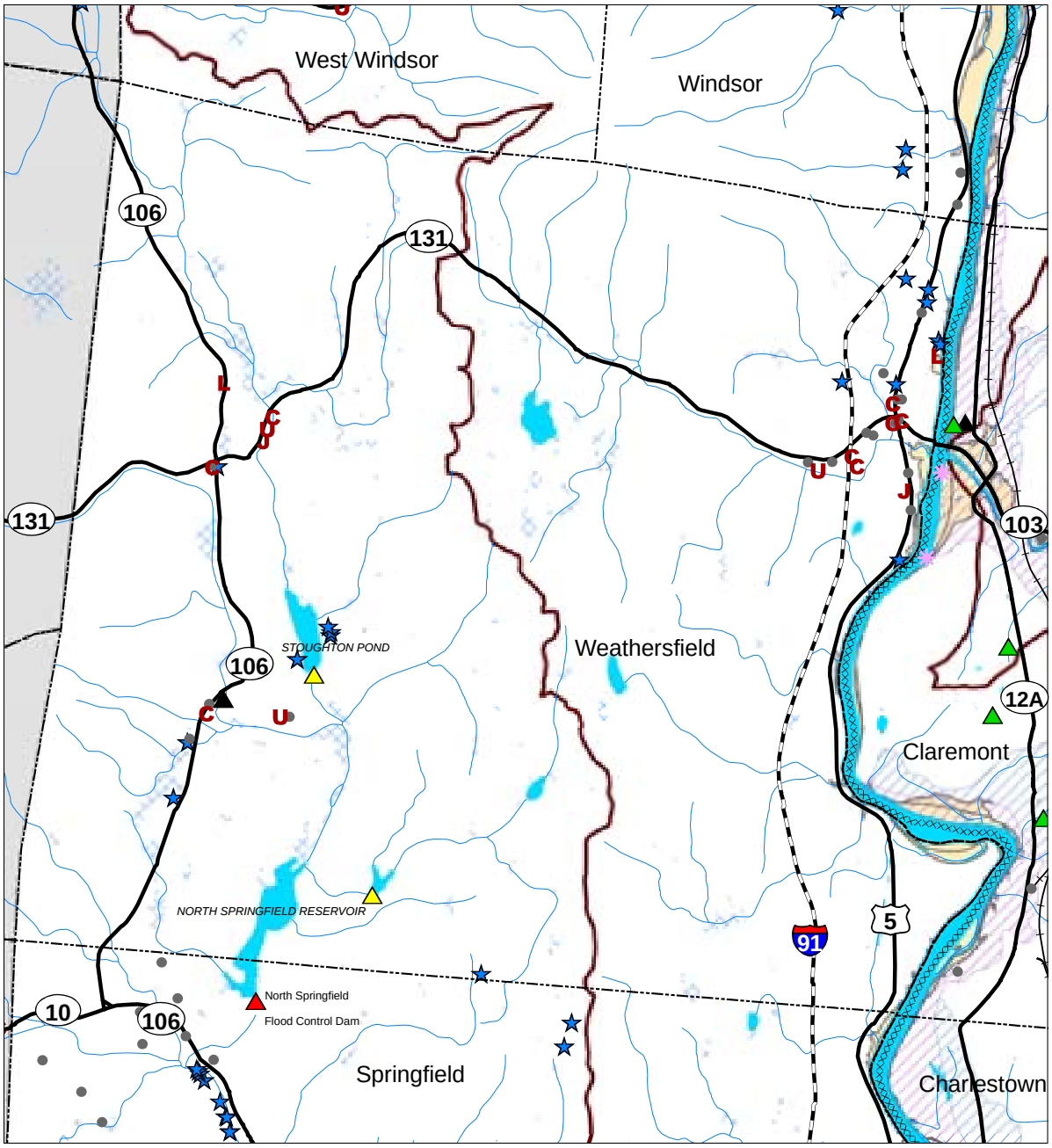
- Snow Dump/Salt Storage
- Automobile Salvage Yard
- Lagoon
- Landfill/Dump

0.7 0 0.7 1.4 Miles

1:60,000

Map created by
Upper Valley Lake Sunapee Regional Planning Commission for the Connecticut River Joint Commissions, January 2008.

Funding provided by CRJC and US Gen New England.



Water Resources - Weathersfield, VT

Mt. Ascutney Subcommittee

Political Boundary
Watershed Boundaries
Interstate
State or Local Highway
Railway

Major Water Bodies
Wetlands

Aquifers
Stratified-Drift Aquifers
Glacial Lake Bottom Deposits

100-Year Floodplain
Public Water Supply

Sediment Locations
High Risk Priority
Moderate Risk Priority

Dams
Low Hazard Potential
Significant Hazard Potential
High Hazard Potential
Hazard Potential Not Assigned
Impoundment Zone

N
W E
S

Water Quality Threats

VT Pollution Source Inventory of 1980

- C Petrochemicals
- J Junk Yard/Salvage Yard
- K Liquid Waste to Land Surface/Subsurface
- L Landfilll/Dump
- P Lagoon-Municipal
- U Salt/Salted Sand

Underground Storage Tank Facilities

NH Water Quality Threat Inventories

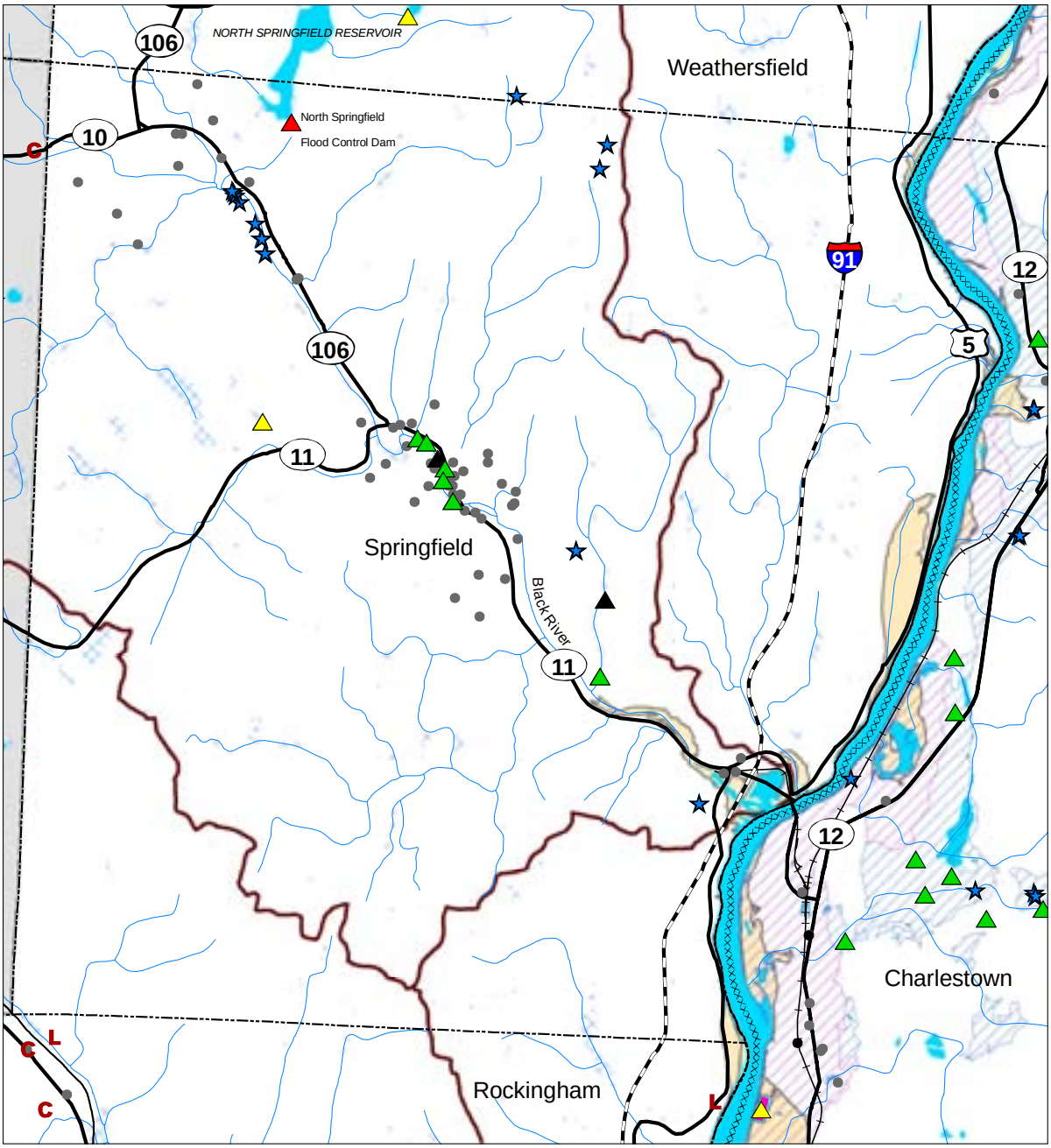
- Snow Dump/Salt Storage
- Automobile Salvage Yard
- Lagoon
- Landfill/Dump

0.75 0 0.75 1.5 Miles

1:70,000

Map created by
Upper Valley Lake Sunapee Regional Planning Commission for the Connecticut River Joint Commissions, January 2008.

Funding provided by CRJC and US Gen New England.



Water Resources - Springfield, VT

Mt. Ascutney Subcommittee

- Political Boundary
- Watershed Boundaries
- Interstate
- State or Local Highway
- Railway
- Major Water Bodies
- Wetlands

Aquifers
- Stratified-Drift Aquifers
- Glacial Lake Bottom Deposits

- 100-Year Floodplain
- Public Water Supply

Sediment Locations
- High Risk Priority
- Moderate Risk Priority

Dams
- Low Hazard Potential
- Significant Hazard Potential
- High Hazard Potential
- Hazard Potential Not Assigned
- Impoundment Zone

N W E S

Water Quality Threats

VT Pollution Source Inventory of 1980
- C Petrochemicals
- J Junk Yard/Salvage Yard
- K Liquid Waste to Land Surface/Subsurface
- L Landfilll/Dump
- P Lagoon-Municipal
- U Salt/Salted Sand
- Underground Storage Tank Facilities

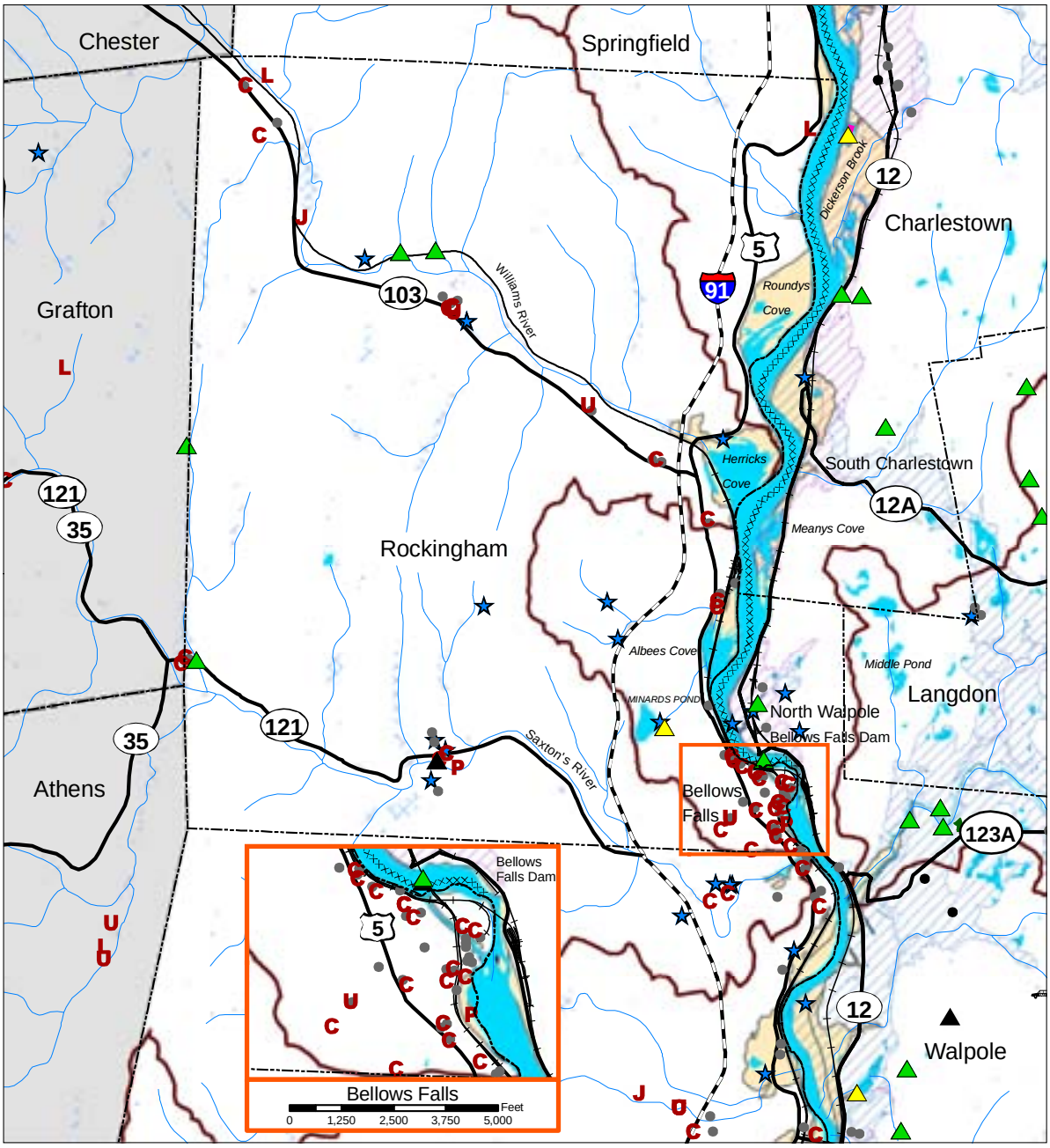
NH Water Quality Threat Inventories
- Snow Dump/Salt Storage
- Automobile Salvage Yard
- Lagoon
- Landfill/Dump

0.75 0 0.75 1.5 Miles

1:70,000

Map created by
Upper Valley Lake Sunapee Regional Planning Commission
for the Connecticut River Joint Commissions, January 2008.

Funding provided by CRJC and US Gen New England.



Water Resources - Rockingham, VT

Mt. Ascutney Subcommittee

- Political Boundary
- Watershed Boundaries
- Interstate
- State or Local Highway
- Railway
- Major Water Bodies
- Wetlands

Aquifers
- Stratified-Drift Aquifers
- Glacial Lake Bottom Deposits

- 100-Year Floodplain
- Public Water Supply

Sediment Locations
- High Risk Priority
- Moderate Risk Priority

Dams
- Low Hazard Potential
- Significant Hazard Potential
- High Hazard Potential
- Hazard Potential Not Assigned
- Impoundment Zone

N W E S

1 0 1 2 Miles

1:85,000

Water Quality Threats

VT Pollution Source Inventory of 1980
- C Petrochemicals
- J Junk Yard/Salvage Yard
- K Liquid Waste to Land Surface/Subsurface
- L Landfilll/Dump
- P Lagoon-Municipal
- U Salt/Salted Sand
- Underground Storage Tank Facilities

NH Water Quality Threat Inventories
- Snow Dump/Salt Storage
- Automobile Salvage Yard
- Lagoon
- Landfill/Dump

Map created by
Upper Valley Lake Sunapee Regional Planning Commission for the Connecticut River Joint Commissions, January 2008.

Funding provided by CRJC and US Gen New England.

Notes

Connecticut River
Joint Commissions
PO Box 1182
Charlestown, N.H. 03603
www.crjc.org
603-826-4800