



# WATER RESOURCES - Executive Summary

## Wantastiquet Region River Subcommittee

**This Water Resources Chapter** is an updated and expanded edition of the Water Quality chapter originally published by the Connecticut River Joint Commissions as part of the *1997 Connecticut River Corridor Management Plan, Volume VI, Wantastiquet Region*. This plan is a requirement of the New Hampshire Rivers Management and Protection Act. It was prepared by CRJC's Riverbend Subcommittee in 2005-7 by volunteer representatives of the riverfront towns from Walpole to Hinsdale, NH and Westminster to Brattleboro, VT, assisted by CRJC's Conservation Director. Planning boards and commissions can review its recommendations and integrate them into their local master plan, and select recommendations to bring to townspeople for adoption into their zoning ordinances.

**The Wantastiquet Region** - The Wantastiquet Region River Subcommittee's segment covers 40 miles of the Connecticut River as it runs from the Bellows Falls Dam and the northern boundaries of Walpole, New Hampshire and Westminster, Vermont, south to the Massachusetts border in Hinsdale, New Hampshire, and Vernon, Vermont. Within the river corridor are the busy town of Brattleboro and nearby clusters of residential, commercial, and industrial development. In the upper ten miles of this segment, water moves with a perceptible current and there is an opportunity for flushing of nutrients and sediment. A short set of rapids below the Bellows Falls Dam and other quickwater sections return oxygen to waters that may have acquired pollutants from upstream sources. The Vernon Dam, just downstream from the Vermont Yankee Nuclear Power plant, creates a 26 mile long impoundment on the mainstem. Major tributaries to this section of the Connecticut are the Saxtons and West Rivers and Sackett's Brook in Vermont, and the Cold and Ashuelot Rivers and Partridge Brook in New Hampshire.

**Clean Water Has Clear Economic Value** - Good water quality is important economically for the Wantastiquet region. Studies in New Hampshire have found that its rivers and lakes annually contribute an estimated \$1.5 billion in total sales and \$247 million in property taxes to its economy (2002 dollars). Statewide, fishing, boating, and swimming have the same economic impact as snowmobiling, ice-fishing, downhill skiing, and cross-country skiing combined. Overall, water-based recreation in New Hampshire's Monadnock Region, of which the Wantastiquet area is a part, generates over 120 jobs and almost \$3 million in personal income and almost \$8 million in business sales, totaling about 4% of the recreational revenue generated state-wide by anglers, boaters and swimmers. A perceived decline in water clarity and purity would cause a loss of approximately one-half million in business sales, 9 jobs, about \$180,000 in personal income.

### CONDITION OF THE CONNECTICUT RIVER TODAY

**Water Quality** - Results from testing in 2004 indicated that the river's quality fully supports swimming and other forms of recreation, although it found elevated aluminum and copper levels create poor aquatic habitat below Vernon Dam. Ten miles of the West River have elevated temperatures and degraded aquatic habitat from sediment releases from flood control dams. A number of tributaries in both states have low pH or bacteria problems. Sackett's Brook suffers from fish habitat degradation from undefined pollutants. Some New Hampshire segments have problems with dissolved oxygen or aluminum. At a mill site in Hinsdale, there is contamination by organic chemicals as well as aluminum and copper. The entire Connecticut River is considered contaminated by polychlorinated biphenyls (PCBs) from atmospheric deposition.

Volunteer water quality monitoring is occurring on the Cold and Ashuelot Rivers and on parts of the West and Saxtons Rivers. Vermont Yankee has a long record of water quality data since 1967 for 26 miles of the Connecticut River from the West River to Northfield, Massachusetts. Otherwise, there is currently no regular, on-going water quality monitoring program on the Connecticut River mainstem or lesser tributaries in the Wantastiquet region.

**Sediment Quality** - Studies of sediment by EPA showed that in general, sediments looked relatively clean, although results indicate that road runoff probably has an effect upon aquatic life. An exception is chrysene near Sackett's Brook, which exceeded the level at which ecological effects might occur. Copper and nickel exceeded this level here and below the West River. Breakdown products of the pesticide DDT were detected in low concentrations downstream of Sackett's Brook.

**Toxins in Fish Tissue** - In 2000, EPA and the four Connecticut River states conducted the first river-wide study of fish tissue in the nation. Wantastiquet Region fish were sampled as part of Reach 5 (Wilder Dam to Vernon Dam). In this reach, mercury in fish is a threat to fish-eating birds and mammals, but not to recreational or subsistence fishers. Dioxin-like PCBs pose a risk to recreational and subsistence fishers and to fish-eating mammals and fish-eating birds, but not to fish-eating fish. DDT and related breakdown products pose a risk to 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. Dioxins and furans are a threat to subsistence fishermen, and a slight threat to fish-eating mammals, but not to recreational fishermen.

**Key recommendations for river quality**

- State water quality agencies should sponsor increased water quality monitoring activities in the region and make use of data collected by Vermont Yankee. Train and equip a team of roving volunteer monitors to track down sources of pollutants for which monitoring data suggest problems, such as elevated levels of phosphorus or copper.
- Congress and the states should continue to reduce sources of mercury contamination and carbon dioxide emissions. States should consider regulations for outdoor furnaces. Citizens should obey the ban on barrel burning of trash. All should pursue increased energy efficiency to reduce pollutants, including carbon dioxide that contributes to climate change.

## **RIVER FLOW**

**Instream Flow** - Except in very high water conditions, the flow of the Connecticut River is controlled almost completely by operations at Bellows Falls and Vernon Dams, and is also affected by Northeast Utilities' dam at Turners Falls and pump storage at Northfield Mountain. The Connecticut River here typically exhibits heavy flows with spring ice-out and snowmelt. Flooding is now controlled to some extent by four U.S. Army Corps dams on the West and Ashuelot Rivers, and on the Ottauquechee, Black, and Ompompanoosuc Rivers upstream. Together, these dams control less than 15 percent of the flow from the 6266 square mile watershed that drains through Vernon Dam. Sudden releases from Ball Mountain and Townsend Dams for whitewater recreation contribute to sedimentation in the West River, affecting the fish habitat downstream, although a more natural flow increase has recently been instituted to help minimize these problems.

In the Wantastiquet Region, the effect of flow upon temperature is especially important for fish habitat and migration and also for waste assimilation. The river must accept and disperse heated water from Vermont Yankee and warmed runoff from pavement. There is one gaging station on the Connecticut River in the Wantastiquet region, and eight on tributaries in this area. The Drewsville gage on the Cold River, inactive at the time of the October, 2005 flood, is currently recommended for reinstatement.

**Extreme storms and Floods** - The Wantastiquet Region has suffered from a number of sudden, severe rainstorms in the last five years. Two isolated heavy rainstorms in the Westmoreland, NH area in 2003 caused severe erosion in Mill Brook, sending enough debris into the Connecticut River to alter the river's flow and erode the opposite Vermont bank. Brattleboro's Whetstone and Crosby Brooks tend toward flash flooding, with their steep, high watersheds and stormwater from concentrated development.

In October, 2005, the Cold River watershed experienced a 500+ year storm, and received 11 inches of rain in 24 hours, reaching a total of 17 inches during the ensuing week. Flooding caused over \$4 million in damage in New Hampshire, and seven deaths, four of them in the Cold River watershed. A confluence of conditions on the ground, including an undersized culvert which caused a road washout resulting in a devastating loss of lives and homes, led to declaration of a federal disaster area. In addition to buildings, a number of septic systems were washed away during the Cold River flood, probably contaminating the Cold and Connecticut Rivers for many miles. During this same month, flows in the nearby Ashuelot River exceeded the largest flow since construction of the Surry Mountain and Otter Brook Flood Control Dams.

Road and streambank repair work after such a flood must be consistent with good river science. Key decisions about working in the streams (extent of debris removal, need for clear-cutting banks, placement of rip-rap, backfilling of flood channels, earth-moving to protect homes, the use of streams as highways for equipment) requires clear oversight by the state and can benefit from the involvement of the local river watershed group and conservation commission.

**Key recommendations for flow and flood control**

- Ensure a coordinated, inclusive, and efficient response to floods and other river-related disasters that is based in good river science. NH DES and VT ANR should each develop a coordinated approach to such disasters, and assign an agency staff person to ensure communication between the state environmental and transportation agencies, town officials, conservation commissions, and local river advisory committees or watershed groups. Town officials should meet regularly to discuss emergency planning, and include local watershed groups for river-related issues.

## **WORKING RIVER**

**Hydro Dams** - Two major hydro power dams influence the Wantastiquet segment of the Connecticut River mainstem: Bellows Falls and Vernon Stations. Their federal operating licenses expire in 2018 with that of Wilder Dam. Both are daily peaking generation plants, storing and releasing water during periods of the day. Both are controlled remotely by an operator at Wilder Dam upstream. In 2006, a project began to install four new units at Vernon Dam, replacing four that were so unreliable and difficult to run that they were not being used. Because Bellows Falls and Vernon 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 either dam. Questions remain about possible further inundation of the shoreline since hydraulic flash boards were installed at Vernon Dam in 1991. Since that time, four culverts built in the 1800s in Hinsdale are inundated, and now have to be regularly cleared of silt.

### **Key recommendations for dams**

- The Federal Energy Regulatory Commission should include best management practices such as a slower, more natural raising and lowering for the ramping rate in the 2018 license for Bellows Falls and Vernon Dams. Include a provision for emergency gate operation, such as in the context of a “black start” when the dam is needed to provide immediate power in case of a blackout. Local citizen groups should participate in the relicensing process.

## **USING THE WATER**

**Water withdrawals** - As a designated river in New Hampshire’s Rivers Management and Protection Program, the Connecticut River’s water is protected from being diverted outside of the watershed. The state requires registration of water withdrawals over a certain size, which helps identify future problems of well interference, declining water tables and/or diminished streamflows, but does not limit withdrawals. Vermont has no system for tracking withdrawals and the amount of water that would otherwise have flowed in the river from Vermont is unknown.

**Groundwater and drinking water supplies** - New Hampshire has mapped stratified drift aquifers and regulates new groundwater withdrawals for public community water systems and large withdrawals to prevent harm to existing water users and nearby streams and rivers. Vermont has not mapped aquifers as comprehensively and does not regulate groundwater withdrawals. Surficial geology maps have been completed by NH for Walpole, Westmoreland, Chesterfield, and Hinsdale, covering parts of Putney, Dummerston, Brattleboro, and Vernon. However, these maps need to be converted to Arc-GIS, which would make them much more useful to land use planners. 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. Leaking underground fuel storage tanks remain a problem in many of the villages in the Wantastiquet region. Salt above a certain level in groundwater makes the water unhealthy for drinking, since it can lead to high blood pressure and other diseases. MtBE contamination has been discovered near the Main Street Service Center in the town of Putney. It may also be present elsewhere in the region, but has not yet been picked up.

### **Key recommendations for water use**

- Towns should protect groundwater recharge areas and consider a wellhead protection program such as Hinsdale’s to save money in sampling costs; provide information on wellhead protection to new property owners.

## **LAND USE & WATER RESOURCES**

**Wastewater discharges** - Careful management of wastewater discharges is important for public safety and for the health of the streams that receive these discharges. Phosphorus readings in the Ashuelot River increase downstream of Keene. Keene has funds to improve its phosphorus removal but is awaiting an updated discharge permit from EPA which will dictate the level of phosphorus to be discharged, and the WWTF is prepared to upgrade to meet the limit. The Wantastiquet region is fortunate that the long-urbanized communities in the area, Brattleboro and Keene, have always had separate stormwater drainage and sewerage systems.

**Vermont Yankee Nuclear Power Station** - This nuclear power plant, producing electricity since 1972, is situated on the banks of the Connecticut River in Vernon, Vermont, 3/4 mile upstream of Vernon Dam. The plant was constructed with cooling towers. Shortly after it went on line, plant managers received a permit to discharge heated water to the Connecticut River to avoid the costs of using the cooling towers for this purpose. Warmer water is discharged when there is enough flow to mix it. There is an upstream ambient river monitoring station and another ½ mile below Vernon Dam.

Since Entergy’s application to increase production by 20% beyond that for which it was originally designed, cooling tower motors have been increased in size to handle the upgrade. An agreement reached with the State of Vermont includes a \$20 million payment to Vermont that the state intends to apply not to the Connecticut River, where the discharge takes place, but to benefit the Lake Champlain watershed on the opposite side of the state. For lack of a better solution, current plants call for storage of radioactive waste in “dry casks” on the banks of the river. Entergy has also applied to increase the temperature of its discharge by 2 degrees F to the Connecticut River. Legal challenges to the Vermont decision to issue a permit for this thermal discharge have not yet been resolved. Temperatures sometimes reach high levels even without discharge from Vermont Yankee. The Vernon impoundment also increases the temperature of the river, as slower river flow heats up in the sun, and tributaries draining urbanized areas deliver warmed water. At times, there is not sufficient flow in the river to adequately dilute the warm water discharge. The Subcommittee is concerned about the biological effects on migrating salmon, shad, and other aquatic life if thermal criteria are relaxed. The Vernon pool has limited ability to accept more wastewater, since warmer water holds less oxygen.

### **Key recommendations for wastewater discharges**

- Ensure that wastewater discharges are as clean as possible. The U.S. Environmental Protection Agency should decide upon standards for phosphorus in wastewater treatment plant effluent so that Keene can plan effective phosphorus removal. EPA should update standards for disposing of unused and out-dated medicines, and assist area solid waste districts in educating consumers about proper disposal to reduce the pharmaceuticals that enter wastewater.

**Stormwater runoff** - Runoff from impervious or deforested surfaces has altered the effects of stormwater in many parts of the Wantastiquet Region. Towns may become concerned how such clearing can affect the roads and culverts they are responsible for maintaining. Experience in Hinsdale shows that there is more runoff after heavy clearing. Stormwater may be washing pet waste into the river and contributing to the higher bacteria levels found here.

**Key recommendations for stormwater management**

- Towns should minimize addition of impervious cover because of its effects on storm water runoff and harm to aquatic systems. Look at ways to include “low impact development” ideas to reduce runoff and promote stormwater infiltration for groundwater recharge. Towns should require additional treatment to remove oil for new discharges to surface waters and dry wells, and treatment to remove toxic metals for redevelopment projects.

**Solid Waste**- The Wantastiquet Subcommittee is concerned about soil and water contamination from old junkyards and capped but unlined landfills within the floodplain, including Putney Paper Company discharge from unlined lagoons. Leachate from the Brattleboro landfill is entering groundwater, with potential water quality impacts from metals, organics and inorganics, although nearby groundwater was reclassified so it would not require remediation. The Hinsdale landfill at the end of River Road, located on a steep bank next to the water, could be a continuing source of pollution, although it was capped in the 1970s. The fast growth of “ReNew Salvage” in Brattleboro reflects demand for its service of deconstructing buildings and reselling the materials.

Vermont Yankee plans to store radioactive waste from its operations in dry casks on its Connecticut River front site. This appears to be the only alternative, since the federal government, which is responsible for solving the problem of nuclear waste, has not provided a better solution. Reprocessing of nuclear waste was practiced until the 1970s but is no longer done.

**Key recommendations for solid waste**

- NH DES should investigate whether the Hinsdale Landfill at the end of River Road was adequately capped and whether it is leaching into the river. The federal Nuclear Regulatory Commission should address the storage problem of spent fuel and nuclear waste, to prevent the necessity of storing Vermont Yankee’s radioactive waste near the Connecticut River.

**Shoreline & Floodplain Development** - The Connecticut River shoreline in the Wantastiquet Region is under heavy development pressure for riverfront homes. While New Hampshire has a state shoreland protection law, it has been largely unable to monitor or enforce it, and violations have occurred. Vermont has no such law, although all Vermont towns in the Wantastiquet region, except for Vernon, have their own shoreland protection for the Connecticut River and other streams which is comparable to or more protective than the New Hampshire law. 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. Septic systems within the floodplain have also proved to be a source of contamination, as during the Cold River flood of October, 2005.

Knowledge of varves, or glacial clay deposits, is important for land use planning, because they behave differently from other kinds of soils. Siting landfills, bridges, large buildings, and other important structures on varved deposits is risky. Reconstruction of the Route 9 bridge, for example, was a special challenge because of the presence of varves.

This part of the upper Connecticut River has the most marina development north of Massachusetts. The Subcommittee suggests that sufficient marina service now exists, and discourages development of further marinas elsewhere in the segment which could threaten pollution and create more boat traffic congestion leading to boating conflicts and bank erosion.

**Key recommendations for shoreland and floodplain development**

- Towns should evaluate their rules regarding shoreland protection and floodplain development, and consider if there are areas that need more protection. The New Hampshire legislature should apply the Comprehensive Shoreland Protection Act to smaller streams. Vermont should adopt statewide shoreland protection

**Roads and railroads** - An active rail line follows the Connecticut River on the Vermont side. In many places, the railroad has removed riparian buffer vegetation between the tracks and the river, removing a source of protection for the bank and for water quality. The integrity of the rail bed is vulnerable to uneven drainage patterns, such as those created by varved soils. The resulting instability has led to at least one disaster: a train derailment in April, 2001 spilled six cars and a locomotive into a thaw-swollen Connecticut River. The cars were carrying thousands of gallons of diesel fuel, as well as road salt and limestone slurry, all toxic to river life. An unknown quantity of road salt also seeped into surrounding wetlands. Such washouts can be caused by beaver activity or by rerouting drainage. It appears to be a problem endemic to soft soils on steep old river terraces.

There are problems with inadequately sized or located road culverts, inadequate drainage ditch construction, and disruption of fish habitat by perched culverts. Good information about the adequacy and safety of culverts and bridge crossings is missing in the New Hampshire towns of the region, except for the Ashuelot River watershed, where The Nature Conservancy has enlisted volunteers to survey 1400 crossings to see if they are interrupting fish movement.

**Key recommendations for roads and railroads**

- Town road agents should ensure that culverts are regularly cleared of debris to prevent blocking during storms. Ensure that culverts are properly sized when replacing them during road work. New Hampshire should aggressively promote

bridge and culvert surveys, by providing funds to the regional planning commissions to identify those that are undersized. Note if they block fish passage and seek grants for replacing them where necessary.

**Home landscapes** - Residential development pressure is significant in the Wantastiquet Region, and much of the riverfront, especially in Chesterfield, Brattleboro, Dummerston, and Westmoreland, features homes that display views of the river. A number of them have lawns extending to the river's edge. Development has taken place over many years, and sometimes, in the case of New Hampshire, in violation of state shoreland protection laws. Some of this change has occurred on prime agricultural soils after farm landowners decided not to keep the land in production, and sold it for subdivision and development. Little if any of this development is served by municipal wastewater collection systems, and the homes rely upon on-site septic systems.

**Key recommendations for home landscapes**

- Expand education for landowners and real estate agents about best management practices for waterfront land and applicable shoreland regulations. Town conservation commissions should provide information to every new riverfront landowner to explain the special challenges of owning and managing riverfront land, including the benefits of riparian buffers and the requirements of state shoreland protection laws. CRJC could assist by preparing a publication for this purpose. State agencies should provide similar information to real estate agents

**Cultivated lands and rivers** - Prime agricultural soils distinguish much of the floodplain in the Wantastiquet region. Land use along both sides of the river still speaks of a long-time lively agricultural economy and way of life in the river valley. Farms, golf courses, and home landscapes can all be sources of unwanted nutrients that can reach streams and rivers in the region. Choosing good sites for winter field stockpiling of manure has been a struggle with the weather changes in the last several years. The US Department of Agriculture offers cost-sharing programs for farm projects that improve water quality, but some farmers consider the requirements too complicated and the cost-share too expensive for structures they consider over-built. In the past, some designs have brought their own water quality problems, such as runoff from earth storage manure pits and pits that collect too much water.

**Brownfields** - Historic industrial areas such as Keene and Brattleboro have properties where contamination may linger in the soil and prevent it from contributing once again to the tax rolls and economic vitality of the community. The regional planning commissions have assessed brownfields in the region, and can assist property owners and prospective purchasers of brownfields with environmental site assessments, grants and loans for cleanup.

## **RIVERBANK EROSION**

Streambank erosion and removal of riparian vegetation are difficult problems in the Wantastiquet region, not only on the mainstem but particularly on the West and Saxtons Rivers in Vermont, and on tributaries affected by recent sudden heavy storms. Towns sometimes riprap along streambanks without consulting the state or local conservation commissions.

**Causes of Erosion** - Causes of erosion are many and complex on the Connecticut River. The U.S. Army Corps of Engineers concluded that the primary cause on the Connecticut River is shear stress of high-velocity flows, especially on banks composed of non-cohesive material. 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. Later studies by the County Conservation Districts found that most of the reaches with moderate or severe erosion had moderate to high banks and slopes greater than 60%. Low banks with gentle slopes were generally stable. Recreation-related foot and motor boat traffic have also led to erosion.

**Riparian Buffers** - Vegetation along streams and rivers is probably the simplest, least expensive, and most effective way to slow erosion and protect these waters from pollution and overheating. 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, a significant problem in the lower third of Walpole and throughout Westmoreland. In many of these reaches, undercutting is occurring at a slow but persistent rate.

**Key recommendations for erosion and riparian buffers**

- Ensure that development does not contribute to erosion on the river. Towns should require developers to follow best management practices for erosion and sedimentation control, and ensure that riverside construction activities do not impact riverbanks and riparian buffers.
- Encourage wide understanding of the value of riparian buffers. State water quality agencies should take an active role in encouraging waterfront homeowners to plant and maintain buffers of natural vegetation along the riverbank, and encourage the use of vegetative bank stabilization techniques, in combination with riprap only where necessary, to control erosion. County conservation districts should supply landowners with information about sources of assistance including nurseries offering buffer plant material.