

# 2008 River Management Program Annual Report to the Vermont legislature

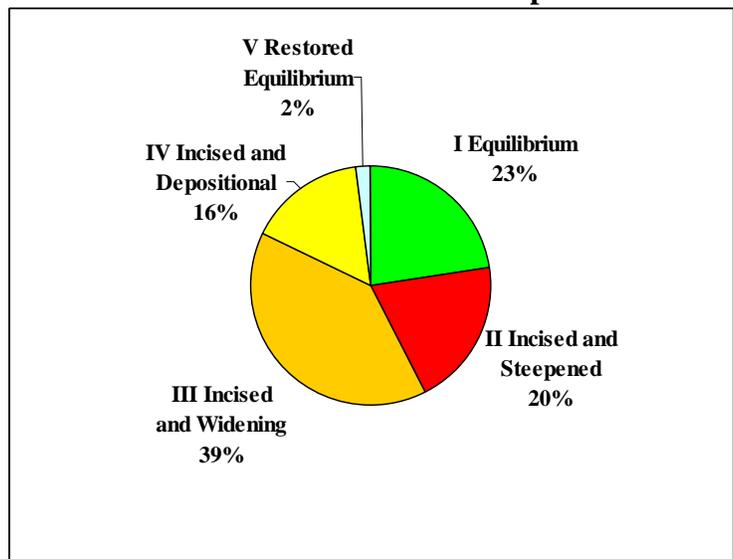
## The Problem

Since European settlement, repeated watershed and stream channel modification (i.e., deforestation, ditching, dredging and armoring) has led to a widespread loss of floodplain function throughout Vermont. Rivers, now confined to deeper, straighter channels, do not have access to their historic floodplains. The increased power of larger floods, contained within the channel, has led to higher rates of bed and bank erosion. With erosion hazards and flood losses increasing, methods to keep rivers disconnected from their floodplains and static in the landscape have become unsustainable. Aside from the financial impact of erosion hazards and flood losses, another significant consequence of stream alterations and encroachments has been a profound loss of sediment, nutrient storage, and attenuation capacity within the State's river corridors. If phosphorus is not retained within the river channels and flood plains throughout the watershed, it is transported downstream to receiving waters like Lake Champlain. Alternatively, if the phosphorus is captured and retained on floodplains, it can feed vegetation in open spaces and agricultural meadows rather than in the bays of Lake Champlain.

The extent and scale of the historic physical manipulation and constraint of rivers is almost incomprehensible because these changes are so pervasive, began over 200 years ago, and are only now being documented scientifically. The profound loss, due to channelization, drainage works, and flood plain encroachments, of sediment and nutrient storage functions at a watershed scale has resulted in an increase in fluvial erosion hazards (i.e., flood and erosion damage), and an upward trend in sediment, soil, and nutrient export from Vermont watersheds. River management has become a vicious cycle where flood recovery and structural constraints (i.e., channel straightening, berming and rip-rapping) have led to developments along rivers where they formerly meandered and flooded. Inevitably, and often decades later, a large flood occurs, structures fail, and the cycle repeats itself. As the economic, social and environmental costs increase, the adoption of sound, science-based river management practices will be imperative. This requires an increased level of public understanding about river processes and changes in individual and community relationships with fluvial systems.

Rivers that have down cut and lost access to their floodplains will erode their banks until new floodplains are formed. During the early stages of this channel evolution process, floods remain within deepened channels, and have much more power to erode and carry

**75% of Assessed Streams Lack Floodplain Access**



*VT DEC Stream Geomorphic Assessment Results (2002-2008) explain the State of Vermont Rivers. Channel Evolution Stages II through IV represent departures from equilibrium where floodplain access and attenuation functions are reduced.*

away anything that enters them. Without floodplains and meanders, it is often the lakes and reservoirs that are the first quiet waters into which rivers deposit eroded soil and nutrients. This process helps to explain the increasing enrichment and algae along the shores and bays of Lake Champlain. 75% of the field stream miles assessed by the RMP are in unstable condition (Stages II through IV) of the evolution process. Lacking floodplain access, they do not provide the sediment and nutrient storage function that they would if in equilibrium. The Clean and Clear goal of achieving stream stability to benefit the lake is now being aggressively pursued through landowner and municipal incentives to protect and restore stream equilibrium. Protection and restoration of floodplains are essential to stable streams and sustainable water quality management.

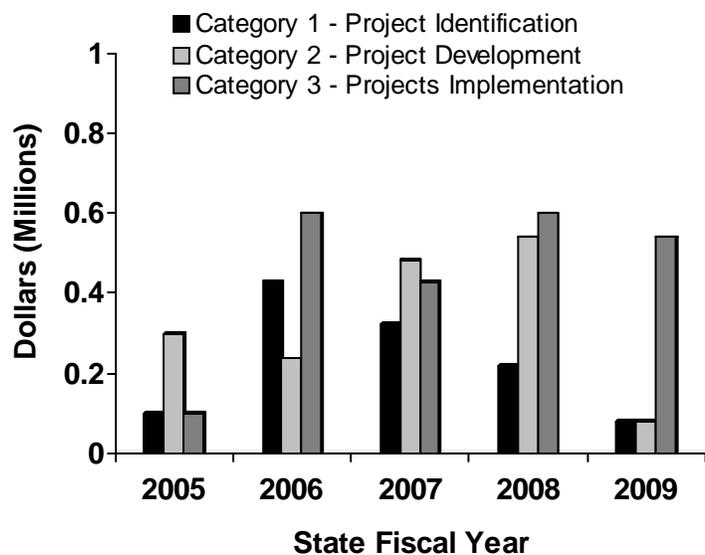
## Program Accomplishments

The goal of river management in Vermont is to protect and restore our streams and riparian corridors based on the science of fluvial geomorphology. This science-based river management approach involves elements of technical assistance, river corridor protections, management of existing human conflicts with river processes, restoration of unstable reaches, and education of landowners and public officials about these principles. The great majority of this work is achieved by supporting partners through River Corridor Grants.

The River Management Program (RMP) provides technical assistance and grants to a variety of watershed organizations to pursue a sequence of (1) river assessment and project identification, (2) project development, and (3) project implementation (Category 1, 2 and 3 River Corridor Grants respectively), all based on fluvial geomorphic principles. River Corridor Grants also provide assistance and incentives for communities to adopt and support local actions such as growth and development decisions that take into account the geomorphic processes of surrounding streams. Through technical assistance grants, the RMP is building partnerships to work toward restoration and protection of floodplain function and channel equilibrium.

Category 1 grants support river assessments conducted through a two-phase stream geomorphic assessment process in order to understand observed problems and identify remediation opportunities within a larger watershed context. This is done using nationally recognized and peer-reviewed protocols developed by the Vermont River Management Program. Category 2 grants support the creation of: river corridor

**Funds Granted for Projects**



management plans, fluvial erosion hazard maps and corridor restoration and protection project designs to address channel instability in a holistic, technically sound and socially feasible manner. Category 3 grants fund project implementation. Project categories include: river corridor protection through zoning or conservation easements, river and/or floodplain restoration to restore hydrologic, sediment and nutrient attenuation capacity, and encroachment removal to eliminate existing sediment transport barriers such as undersized culverts.

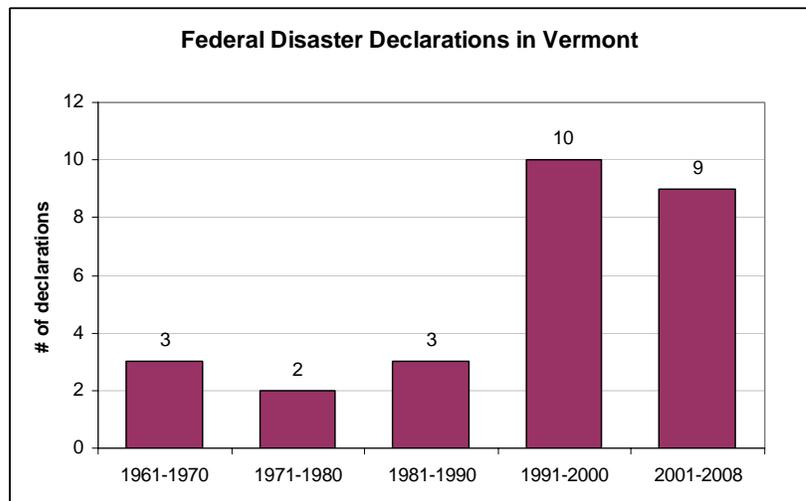
### Bridge and Culvert Assessment

Recent significant improvements to the Bridge and Culvert Assessment Tool provide more resolution in identification of structures causing channel instability and/or presenting a barrier to aquatic organism passage (AOP). The new Geomorphic Compatibility Screen ranks individual structures on the extent to which they: impede sediment and debris transport, affect channel hydraulics and exacerbate channel instability. The new Aquatic Organism Passage Screen (culverts only) ranks individual culverts according to: the extent to which they impede aquatic organism passage (AOP), their potential for being retrofitted to reduce the degree to which they impede AOP, and determines the potential extent of habitat that would be made accessible by removing or retrofitting culverts that act as barriers to migration. The Geomorphic Compatibility and AOP screen reports are accessible via the Stream Geomorphic Assessment Data Management System.

### Floodplain Management Program

Regulation of development in flood plains is the responsibility of municipalities enrolled in the National Flood Insurance Program (NFIP) and overseen by the office of the Vermont NFIP Coordinator within the River Management Program. Most local government land use regulations do not exceed the minimum standards of the NFIP and therefore are generally not consistent with or supportive of Clean and Clear Action Plan objectives. This is because the minimum standards allow flood plains to be filled and encroached upon, creating the opportunity for human investments to come into conflict with fluvial processes. For example, these regulations allow people to build a house or other structure in a flood plain that will eventually be flooded. The history of NFIP has proven that the federal minimum standards do not adequately reduce flood risk, do not promote sustainable community relationships with their water resources, and are devoid of protections to ecosystem services including water quality. Loss of floodplain function resulting from NFIP minimum standards has been, and will continue to be, exacerbated by increased frequency and intensity of severe storms brought on by climate destabilization. The number of federally declared flood disasters has increased substantially in the last 2 decades. 2008 marks the first time that Vermont experienced 3 declared disasters in one year.

In 2008, the Floodplain Management Section took a major step toward enhanced flood plain and river corridor protection. A suite of model flood hazard bylaws was developed and released with the goal of encouraging NFIP



communities to shift away from federal minimum standards. The model flood hazard bylaws integrate Fluvial Erosion Hazard Overlay District text along with numerous other enhancements and either highly discourage or prohibit new structures in the Federal Emergency Management Agency (FEMA) mapped floodplain and the ANR-designated Fluvial Erosion Hazard corridor. Communities adopting one of the enhanced model bylaws will better protect the sediment and nutrient attenuation capacity of flood plains in their communities and decrease their exposure to inundation and erosion related flood hazards.

The Floodplain Management Section continues to provide a tremendous amount of technical assistance and outreach to Vermont communities by providing floodplain and Act 250 development reviews, conducting site visits and workshops, and attending Planning Commission and Selectboard meetings. The section continues to be engaged with a myriad of stakeholders including landowners, local, regional, state, and federal officials, numerous NGOs, and consultants.

### **River Corridor Protection and the Fluvial Erosion Hazard Program**

The RMP is working with partners including the Regional Planning Commissions (RPC), the League of Cities and Towns, municipalities, conservation districts, and watershed groups to resolve water quality degradation, loss of floodplain function, and erosion conflicts by promoting river corridor protection.

River corridors consist of lands adjacent to and including the present channel of the river. Their delineations are based primarily on the lateral extent of stable meanders (the meander belt; also referred to as the fluvial erosion hazard (FEH) area) and a riparian buffer to provide streambank stability. River corridors provide the area necessary to restore and maintain stable equilibrium processes, allow for the re-development of floodplains, and the achievement of the socio-economic benefits and ecosystem services that healthy stable streams provide their communities.

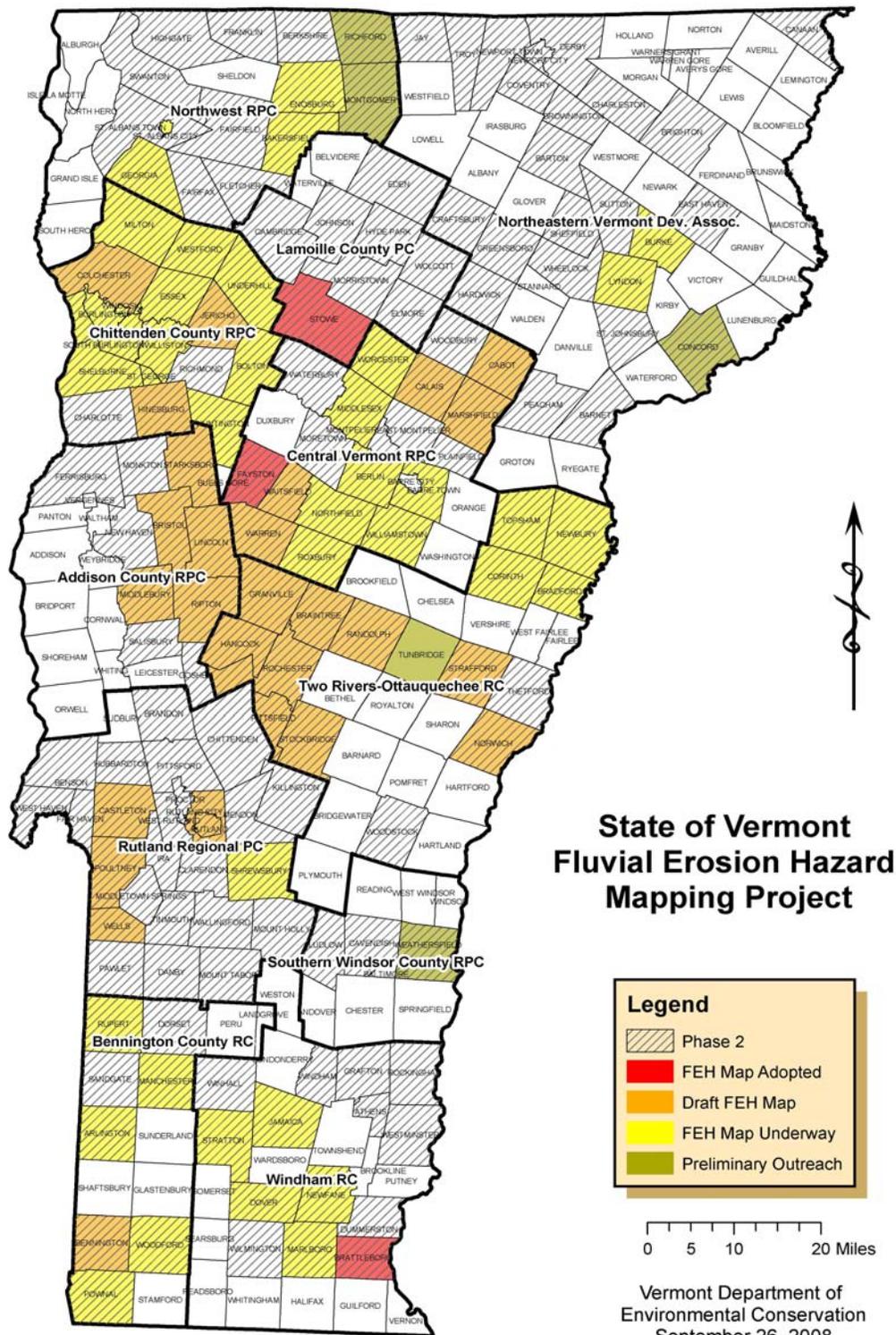
Where feasible, the RMP continues to pursue floodplain restoration projects and demonstrate their nutrient capture functions. However, the scale of the problem demands a long-term perspective. Unlike other causes of nutrient loading, there may be no quick or feasible engineered solutions to the loss of wetland and floodplain function. But nature will do the job for us, if, to the greatest extent possible, the space for stream equilibrium is set aside. To that end, the RMP has developed two primary mechanisms to promote river corridor protection: (1) municipal land use restrictions on development within defined river corridors; and (2) the use of river corridor easements to support the purchase of development and channel management rights.

The RMP, in collaboration with most of the state's RPCs, leveraged Clean and Clear funding to attract nearly \$1,026,000 in FEMA Pre-Disaster Mitigation Program planning grants to support corridor protection. The work involved developing Phase 2 geomorphic assessment data, generating FEH maps, working with communities to educate them about fluvial erosion hazards, and encouraging and supporting their adoption and implementation of fluvial erosion hazard zoning bylaws including provision of maps and model by-laws. New fluvial erosion hazard data represented by the assessments and the maps are being incorporated into the Regional Hazard Mitigation Plans (RHMP). The RMP has technically supported the work by the RPCs and their consultants and recently provided the RPCs with a suite of Enhanced Model Flood Hazard Area Regulations including fluvial erosion hazard area protection.

**Pre-Disaster Mitigation (PDM-C) Grant Program**

PDM Year Grant Funding	Regional Planning Commission	Geomorphic Assessment Underway or Completed	Fluvial Erosion Hazard Assessment Underway or Completed
<b>2003</b> \$76,800	Addison Northwest Two Rivers- Ottauquechee	X X X	X Preliminary Discussion X
<b>2005</b> \$337,500	Lamoille Central Vermont Chittenden Rutland	X X X X	X X X X
<b>2007</b> \$469,600	Lamoille So. Windsor Windham Bennington	X X X X	X  X X
<b>2008</b> \$141,920	Chittenden (Submitted proposal Jan. 2008)	X	X

Below are a map and a supporting data table to summarize the Clean and Clear work to date by Vermont municipality. The Program is helping towns across the state enhance their resiliency in mitigating flood damages and taking proactive steps towards regaining and maintaining healthy water quality and habitat conditions for future generations to enjoy.



<b>Total number of communities targeted</b>	<b>160</b>
<b>FEH maps adopted as an ordinance</b>	<b>3</b>
<b>Draft FEH maps completed</b>	<b>29</b>
<b>FEH projects underway or completed as part of town corridor plans</b>	<b>39</b>
<b>Phase 2 geomorphic assessment underway – prerequisite for FEH map development</b>	<b>51</b>
<b>Phase 1 geomorphic assessment underway or completed (pre-requisite for P2 assessment)</b>	<b>34</b>
<b>Conducted preliminary outreach only</b>	<b>2</b>
<b>No interest at this time</b>	<b>2</b>

## **Stream Alteration Regulation Activities, Technical Assistance and Flood Recovery**

33% of the Stream Alteration Engineering staff resources of the River Management Program statewide are funded through Clean & Clear. The work of the Stream Alteration Engineers is absolutely critical to achieving a meaningful reduction of the dredging, armoring, and straightening of Vermont's rivers and streams that all too frequently follow floods in the name of protecting poorly planned and sited public and private investments that are vulnerable to flood inundation and fluvial erosion. These channel management activities reduce the watershed and fluvial system capacity to retain and attenuate sediment and nutrients within the riparian corridor.

The key strategy that the Stream Alteration Engineers aggressively pursue, promote and educate in their work, particularly following flood events, is to identify river management alternatives that accommodate to the greatest extent feasible, the natural, stabilizing tendencies of the river, in the context of the specific location, and assist in the implementation of these alternatives.



*Pond Brook, Salisbury. August, 2008*

A river, given the space it needs to achieve equilibrium conditions, represents the lowest level of flood hazard, most efficiently attenuates the discharge of sediment and nutrients, and provides the highest potential level of social, economic and ecological attributes. Under this strategy, these functions can be sustained by the fluvial system with minimal external energy inputs.

## **Indicators of Progress; Vermont Watersheds**

### **Northern Vermont**

**Lamoille River:** Within the Lamoille watershed, the RMP is partnering with the Lamoille County Regional Planning Commission (LCRPC) on several assessment and corridor planning projects within Lamoille County. The LCRPC is striving to develop River Corridor Plans (RCP) and FEH strategies for the towns of Hyde Park, Elmore, and Wolcott; encompassing the rivers of Lamoille main-stem, Centerville Brook, Rodman Brook, Green River, Gihon, Elmore Branch, Elmore Pond Brook, and the Wild Branch. These plans will be utilized in the 2009 season to begin working with the towns to look at planning opportunities for FEH and corridor management.

In the Upper Lamoille, the RMP is collaborating with the Caledonia Natural Resource Conservation District (CNRCD) to develop a RCP along the main-stem of the Lamoille from Hardwick to Greensboro Bend. This project has assisted in the identification of opportunities for conservation and restoration projects along the main-stem. Several tree planting projects have already occurred and the RCP data will be utilized to develop opportunities with the towns of Hardwick and Greensboro Bend for further corridor management planning and future FEH considerations.

Within the Browns River, the RMP is working with the Winooski Natural Resource Conservation District (WNRCD) to develop a RCP along the main-stem of the Browns and the major tributaries in the towns of Underhill, Westford, Jericho and Essex. Data from the RCP will be used by the WNRCD to develop corridor restoration and protection projects. Landowners have been approached through several public meetings and now the “kitchen table” one on one meetings are starting with individual landowners to develop specific projects. The plans will also be used to help develop FEH within various communities. The towns of Jericho and Underhill have started to utilize the data and work with RMP to incorporate FEH in their town plans.

The RMP has partnered with the Lamoille Natural Resource Conservation District (LNRCD), WNRCD, and CNRCD to develop and utilize assessment data, which has resulted in several tree planting projects. These Districts have developed a protocol and criteria to use river assessment data for choosing locations to work with various types of landowners in the implementation of tree planting projects.

***Missisquoi River:*** The RMP is working with the Northwest Regional Planning Commission (NRPC) to develop multiple projects within the basin. The work has lead to a river corridor plan being developed for the Hungerford Brook; project development for implementation work on the Rock River, and project development for implementation work on the lower Mill River and Rugg Brook. From the project development work on the Rock River one site is moving forward to design for next season construction; and on the Mill / Rugg Brook 2 sites are moving forward this fall with fencing and tree planting. The NRPC is also sponsoring work for the Tyler Branch to further develop data for the towns of Bakersfield and Enosburg, which are both interested in FEH. Project development continues within the Tyler Branch, and the RMP is working on project design for implementation in the 2009 season.

The Missisquoi River Basin Association (MRBA) continues to be a sponsor of projects within the basin. The RMP is currently working on assessment work in the Black Creek. This data will be used to develop a RCP and work with the communities to look at options for FEH and other opportunities for conservation/restoration. The MRBA’s work has also helped to develop data and RCP for the upper Missisquoi basins of Mud Creek and Jay Branch, Trout River, and the main-stem of Missisquoi from Richford to the Canadian boarder.

***Upper Lake Champlain Tributaries:*** The RMP is working with the NRPC to look at opportunities for FEH work with the town of Georgia and the city of St. Albans. This would include the rivers of Stevens Brook, Rugg Brook, Mill River, Stonebridge Brook and Deer Brook (Lamoille tributary).

The Chittenden County Regional Planning Commission (CCRPC) has been working on several of the direct drains; Trout Brook, Smith Creek, and Pond Creek to look at opportunities for FEH development with the towns of Milton and Colchester.

***Memphremagog Rivers:*** With Clean and Clear funding the Northwoods Stewardship Center completed a Phase 2 assessment and developed a River Corridor Plan for the portion of the Johns River south of the US Canadian border. Overall the geomorphic condition of the river is good but several opportunities for river restoration have been identified in the Johns River Corridor Plan and

further investigation into the feasibility and benefits of implementing those projects will occur in 2009.

With Clean and Clear funding the Northwoods Stewardship Center completed a Phase 2 assessment and developed a RCP for the Barton and Willoughby Rivers. Many restoration needs were identified through the assessment and planning process. Many fluvial erosion hazards exist along the mostly unconfined Barton River and the lower reaches of the Willoughby River. With assessment data and the River Corridor reports in hand, RMP and Northwoods Stewardship Center staff met with the Towns of Brownington and Barton to discuss the state of the rivers and the FEH zoning concept. More meetings are being scheduled for 2009.

***Passumpsic River:*** After years of work and funding from Clean and Clear, the Caledonia County Natural Resources Conservation District (CCNRCD) completed a Phase 2 assessment on the East Branch, West Branch and Miller's Run and used the data to develop a RCP for this flood prone region of the state. Many opportunities to reduce both inundation and erosion hazards have been identified and a 2009 Clean and Clear grant will enable the CCNRCD to begin working with both individual landowners and the towns within the Upper Passumpsic watershed to develop hazard mitigation and corridor protection projects.

The Essex County Natural Resources Conservation District has built upon a previously conducted Phase 1 assessment of the Moose River to complete a Phase 2 assessment on several reaches of the river in the Town of Concord. The assessed reaches run through a broad valley and are surrounded by agricultural and residential land uses making them important reaches for FEH zoning consideration. A RCP was developed and will be presented at a meeting with the Town of Concord to discuss corridor protection and restoration including fluvial erosion hazard zoning.



*Highly incised and bermed reach of Beecher Hill Brook in Hinesburg. Due to the extreme incision and dominance of course substrates, a passive restoration approach is recommended for this reach.*

## **Central Vermont**

***Winooski River:*** In the Winooski watershed, Phase 1 and 2 SGA as well as Corridor Planning was initiated on the Huntington River, Kingsbury Branch, Stevens Branch, and Dog River. The Dog River assessment is also serving as a pilot project for a new habitat assessment protocol, providing data on habitat quality that will be a valuable asset to municipal planning and restoration project development. A Phase 2 SGA on Joiner Brook in Bolton is being conducted to help the community incorporate erosion hazards into their town zoning regulations. Corridor conservation projects are under development in Huntington and Marshfield, and this type of work as well as working with communities to address FEH concerns is anticipated to continue in the newly assessed sub watersheds of the upper Winooski as these efforts move into the project development phase.

The Friends of the Mad River (FMR), the RMP, and the Towns of Waitsfield and Warren are working to the possible adoption of Fluvial Erosion Hazard Zoning. The RMP developed and presented maps of the proposed Fluvial Erosion Hazard Overlay district to both towns. The FEH concept was well received by both towns and encouraged by this initial success the FMR and the Mad River Valley Planning District have applied for a 2009 Clean and Clear grant to continue to work with Waitsfield and Warren to adopt Fluvial Erosion Hazard overlays.

With technical guidance provided by the Upper Mad River Corridor Plan (Fitzgerald and Godfry, 2008) the Friends of the Mad River worked with other local organizations, including the Vermont Land Trust, to purchase, conserve, and sell the Kingsbury Dairy Farm to the Vermont Food Bank. The Kingsbury Farm is on the Mainstem of the Mad River in the Town of Warren and the riparian buffer that was incorporated into the easement was only possible because of the sound scientific data contained in the Upper Mad River Corridor Plan.

**LaPlatte River:** In the LaPlatte watershed, river corridor planning and project development efforts continue, with a RCP now existing for the majority of the main stem LaPlatte from Shelburne to Hinesburg. A highly incised reach of Beecher Hill Brook in Hinesburg received a restoration alternatives analysis, and river corridor easements are being pursued on lower reaches of this brook. Guided by RCP recommendations, corridor conservation efforts are anticipated to continue on the LaPlatte as well as some of the smaller direct drainages to Lake Champlain in Charlotte where some Phase 2 SGA has occurred.

**White River:** In the White River watershed, RCPs on the upper White River, Tweed River, and Ayers Brook are guiding river corridor conservation project development efforts. Currently two corridor easements have been secured on the highly unstable Ayers Brook (see case study below), one is pending on a very sensitive reach of the upper White River in Rochester, and many more are planned for pursual in the near future.

**Mid-Connecticut River Tributaries:** In the smaller direct drainages to the Connecticut River, Phase 1 and 2 SGA and corridor planning was initiated on the Wells, Waits and Black Rivers, as well as a Phase 1 assessment on the Ompompanoosuc. As RCPs are completed on these rivers, it is anticipated that work to develop corridor conservation and restoration projects, as well as working with communities to address FEH through municipal planning, will continue as it has in other watersheds in central Vermont.

## Southern Vermont

**Middlebury River:** The Addison County Regional Planning Commission applied for and received funding from Clean and Clear to complete a RCP for the



*River Corridor Easement in development in Rochester. This reach of the upper White River has been historically straightened and is very sensitive to channel adjustment. The easement will encompass approximately 16 acres within which the river will be allowed to redevelop meanders and a state of dynamic equilibrium.*

Middlebury River. They have convened a diverse steering committee of local residents and officials who are working their way through identifying and prioritizing projects for restoration within the watershed. This project is especially timely given the latest flash flooding in Ripton. Local officials plan to use the RCP as guidance for post-flood restoration and mitigation of future floods.

The towns of Ripton and Middlebury have both expressed an interest in adopting proactive zoning to improve water quality and reduce flooding hazards. They invited state staff to come talk and present maps of recommended limited development areas.

The Middlebury Area Land Trust received Clean and Clear funds to pursue conservation of a critical flood attenuation property in East Middlebury. They have worked with the Town of Middlebury to match Clean and Clear funds and purchased a 12 acre floodplain parcel on the Northern side of the river. They are continuing the effort on the South side of the river and plan to acquire an easement on a 100' buffer zone on the southern steep slope where massive mass failures are continuing to contribute sediment and nutrients due to miss management of the river corridor. For more detail on this project go to:

<http://www.maltvt.org/index.cfm?fuseaction=page.viewPage&pageID=506&nodeID=1>

**Upper Otter Creek:** The Rutland Natural Resources Conservation District received Clean and Clear funds to match an existing United States Department of Agriculture (USDA) project to remove a manure storage pit that was built within the river corridor on a tributary to the Mill River in Danby, VT. The stream was starting to erode the Pit's banks, threatening to expose the nutrient rich manure to the river and cause a direct discharge of manure. The Department of Environmental Conservation (DEC) and USDA team worked to design a project to remove the liquid manure and spread it on fields according to a Nutrient Management Plan. They excavated the non-contaminated material and created a new floodplain for the river. This project was an example of stretching Clean and Clear funds by matching federal programs and meeting multiple objectives at once.

The Rutland Natural Resources Conservation District continued work on the Mill River Corridor Planning. They have held public meeting and met with numerous landowners who are interested in restoration projects. They have worked to coordinate with both the wetland program and the USDA to match Clean and Clear dollars with federal funding sources where appropriate. The Plan will be presented to the towns of Clarendon, Wallingford, and Shrewsbury.

**Batten Kill River:** Partners: Batten Kill Watershed Alliance, Bennington County Natural Resources Conservation District, Bennington Regional Planning Commission, Vermont Fish and Wildlife, USDA Fish and Wildlife, Trout Unlimited and Vermont Land Trust

The Bennington RPC has worked diligently on the Batten Kill RCP. Using Clean and Clear funds, they have selected a multitude of local, state and federal experts to work together on the Batten Kill RCP Implementation. The group collaborated to come up with projects on the Batten Kill that would benefit both the water quality and habitat improvement. They continue to meet with landowners and identify high priority restoration projects in the watershed.

The number one project identified in the Batten Kill Plan was a large berm removal project at the confluence of the Roaring Branch and Batten Kill River in Arlington, VT. This project is currently in the study and design phase. The landowner has expressed interest in participating in a restoration project. Construction is expected to begin in Spring of 2009.

Another high priority project is conserving existing floodplain areas within the watershed. One high priority area, the Green River, has been targeted for easements and the steering committee has identified a willing landowner to complete the easement pilot project for the Batten Kill River.

**West River:** Corridor Planning continues on the Rock River. The group continues to make progress toward implementing high priority projects in the watershed to improve water quality. Corridor Planning also continues on the Ball Mountain Brook. The group continues to make progress toward implementing high priority projects in the watershed to improve water quality.

**Lower Connecticut River Tributaries:** The Windham Natural Resources Conservation District received Clean and Clear funds to complete a Phase 1, 2 and River Corridor Plan on the sediment impaired Crosby Brook in Brattleboro, VT. A contractor was hired and has completed the assessment and come up with a draft project list to restore the watershed and prevent further water quality degradation. The steering committee composed of VT DEC staff, Windham Regional Planning Commission and a private consultant have been touring potential project sites and meeting with landowners to determine which restoration projects to move forward.

One high priority project is moving forward to restore an incised reach along Black Mountain Road. The town of Brattleboro worked with the Basin Planning Section staff to secure federal transportation funds to complete the engineering, design and construction of the restoration project.

The RMP continues to work very closely with the Town of Brattleboro, Windham Natural Resources Conservation District and local partners and consultants on the Whetstone Brook River Corridor Plan implementation. The group continues to make progress toward implementing high priority projects in the watershed to improve water quality.

## **Indicators of Progress; Restoration and Protection Case Studies**

### **Lamoille Valley Rail Trail Flood Plain Restoration One Year Monitoring Results**

One year after removing nearly 6 miles of flood plain encroachments along the Lamoille River and Black Creek represented by the former Lamoille Valley Railroad embankment, and reconnecting river access to over 200 acres of historic flood plain, field sampling and monitoring results on 3 flood plain restoration sites in Franklin County were conducted by the Agency of Natural Resources.

Two field sampling investigations were conducted. One immediately following spring run-off, and the second immediately following a summer flood. The three monitored sites involved 21 acres of reconnected flood plain representing approximately 10% of the total flood plain area restored by the overall project.

Restored floodplains in Bakersfield and Fairfield were surveyed for surface area and depth of deposited sediment. These data allowed for a calculation of the estimated volume of sediment retained during spring runoff and a summer flood on the recently re-connected floodplains. Samples were collected from deposited sediment and combined for laboratory testing for total phosphorus concentration. A calculation of the amount of phosphorus captured and stored on the floodplains was made from the measured volume of sediment and the measured concentration of total phosphorus.



*Spring flooding over the former rail bed along Black Creek in Fairfield. Restored flood plain is between the rail bed and VT 36 at the top of the photo.*

Over 1100 cubic yards of sediment and nearly 1.2 tons of total phosphorus were deposited and stored on the three sampled floodplains combined less than one year after project completion.

<b>Site</b>	<b>Volume (yd<sup>3</sup>)</b>	<b>Phosphorus (ton)</b>
Bakersfield_1	330	0.22
Fairfield_3	52	0.11
Fairfield_4	735	0.85
<b>TOTALS</b>	<b>1117</b>	<b>1.18</b>

The removal of the former railroad embankment and reconnection of natural floodplain has led to observable sediment deposition and measurable phosphorus storage. In a year with a smaller than typical spring flood due to the absence of rain during peak snow-melt, nearly 100 dump truck loads of sediment were captured on three restored floodplain locations rather than transported downstream. Associated with these sediments was just under 1.2 tons of phosphorus that would previously have been more likely to make its way into Lake Champlain via the Missisquoi River. It is likely that the benefits of this project are even greater than portrayed here as this evaluation only considers 3 of the 11 floodplain reconnection sites. Furthermore, larger floods and multiple floods each year are possible that could increase the potential for sediment and nutrient storage on the reconnected floodplains. More importantly, this project will continue to effectively attenuate sediment and nutrient loads without additional investment for the foreseeable future. One additional flood plain restoration site in on Black Creek is scheduled for construction in late 2008.

### Conserving 45 acres of River Corridor Along the White River's Ayers Brook

Ayers Brook is a major tributary to the White River's Third Branch, flowing from its headwaters in Brookfield to its confluence in Randolph. Most of Ayers Brook is listed on the State of Vermont's Impaired Waters List for sediment due to geomorphological instability. A 2001 erosion study, conducted by the Natural Resources Conservation Service, reports that the Third Branch delivers over 14,000 tons of sediment annually, and the Ayers Brook is a leading source of that sediment.



Many landowners along Ayers Brook have been struggling for years to control the dynamic nature of the Brook with traditional river management practices. The geomorphic assessment found that the Brook's chronically unstable condition, depicted by significant and accelerated bank erosion, is a function of the degradation of the stream bed and subsequent loss of floodplain access, channel widening, and planform changes from channelization practices, floodplain encroachment, and poor condition of riparian vegetation.

The Clean and Clear Program funded the Ayers Brook RCP in 2007 to better understand the stressors contributing to the instability and to identify options to restore the Brook. The Plan recommended, "Given the highly unstable nature of Ayers Brook, river corridor protection is the most important type of project that could be implemented." In 2008, with \$74,122 of funding from the Clean and Clear Program, the White River Partnership worked with the Vermont Land Trust and the Vermont River Conservancy to secure river corridor easements at two farms. Approximately 45 acres of river corridor were conserved, allowing over 3 miles of river to adjust naturally toward a more stable equilibrium condition. Nearly 10 acres of the conserved river corridor will be planted as part of the Conservation Reserve Enhancement Program (CREP), administered jointly by the VT Agency of Agriculture and the Farm Services Agency.



*River Corridor Easements along Ayers Brook in Randolph and Braintree. The protected corridor is in orange, the acres enrolled in CREP are in yellow, and the land targeted for a conservation easement in 2009 is in blue.*

The White River Partnership is now working with a landowner to acquire another easement to protect the 8 acres of river corridor between these two farms. CREP will also be part of this project, re-vegetating nearly 3 acres of the river corridor.