River, River Corridor, & Floodplain Management Programs

Biennial Report to the General Assembly Pursuant to Act 110

Vermont Department of Environmental Conservation

January 2013

SDMS Doc ID 567912

River, River Corridor, & Floodplain Management Programs

Biennial Report to the General Assembly Pursuant to Act 110

Vermont Department of Environmental Conservation

Contents

Executive Summary 3

A. Introduction 5

B. River and River Corridor Management Programs 6

C. Floodplain Management 11

D. Best Management Practices for River Corridors and Buffers 14

E. Incentives for Municipalities to Adopt River Corridor and Shoreland Protection Bylaws 16

Table 1: Municipal Incentives for River Corridor, Floodplain and Shoreland Protection 18

F. ANR Recommendations to Improve River, River Corridor, and Floodplain Management Programs ... 20

Appendix 1a: Municipally Adopted River Corridor and Floodplain Protection Bylaws 23

Appendix 1b: Status of River Corridor Assessment, Outreach, Planning and Mapping 26

Appendix 2: 2011- 2012 River Corridor Activity Summary 27

Appendix 3: Municipally Adopted Buffer Bylaws, As of 2007 48

Act 110

River, River Corridor, & Floodplain Management Programs

Biennial Report to the General Assembly Pursuant to Act 110

Vermont Department of Environmental Conservation

Executive Summary

Act 110 directed the Secretary of Natural Resources to establish a river corridor management program and a shoreland management program, effective February 1, 2011, to provide municipalities with maps of designated river corridors and develop recommended best management practices for the management of river corridors, shorelands, and buffers. In 2012, on the heels of the record statewide flooding in 2011, the Legislature passed Act 138 (S.202), which expanded the state's regulatory and technical assistance programs with respect to management of rivers, river corridors, and floodplains. The 2013 Act 110 report includes relevant updates in response to Act 138. The Lake Shoreland update is contained in the report entitled *Lake Shoreland Protection and Restoration Management Options* soon to be available from the Lakes and Ponds Management and Protection Section. This report to the House Committee on Fish, Wildlife and Water Resources and the Senate Committee on Natural Resources and Energy describes the status of river, river corridor, and floodplain management in Vermont.

River & River Corridor Management

Based on lessons learned during Irene disaster recovery, and as directed by the passage of Act 138, the following initiatives are being undertaken to improve river and river corridor management:

- Limitation of stream alterations during post-flood emergencies to those necessary to address imminent threats to public safety, reduce vulnerability, and mitigate hazards associated with public infrastructure;
- Restoration and protection of river and riparian habitat to the greatest extent possible within the authority, timing, funding, and physical constraints that exist after a disaster;
- Greater operational preparedness within the ANR for flood disasters, including trained staff, coordinated technical guidance, established inter-agency agreements, and enhanced communications;
- Guidance of post-disaster river management activities by river corridor plans, where protecting and restoring floodplains is an integral component of flood recovery operations; and
- Increased river corridor and floodplain protection in order to decrease post-flood river channelization.

Floodplain Management

In response to Act 110, the Rivers Program of the Department of Environmental Conservation (DEC) reorganized, effective November, 22, 2010, to create a River Corridor and Floodplain Management Program (RCFMP). This new program integrates floodplain management under the FEMA National Flood Insurance Program (NFIP) with fluvial erosion hazard avoidance, river corridor and buffer protection, and river science. The Rivers Program can now more effectively and efficiently provide technical assistance to municipalities, landowners, and the regulated community, with enhanced

alignment of efforts to minimize flood hazards, improve water quality, reduce risks to public safety, and promote ecological integrity of rivers statewide.

Act 138 legislation requires ANR to implement additional changes with respect to floodplain management, as follows:

- Create new state floodplain rules for activities exempt from municipal regulation;
- Increase the regulatory and technical assistance capacity for floodplain protection (2 new positions were provided to the VT Rivers Program to help meet this objective);
- Increase outreach to communities on the importance of floodplain protection; and
- Develop improved floodplain mapping.

Further, the Rivers Program identifies three Best Management Practices (BMPs) to restore and protect the equilibrium condition of rivers, minimize flood damages, and achieve water quality and habitat objectives: (a) Minimizing or Removing Stream Channel Constraints; (b) Restoring and Maintaining Riparian Buffer Vegetation; and, (c) Protecting River Corridors and Floodplains. This report describes existing programs and guidance documents used to implement these BMPs.

Incentives

Acts 110 and 138 hinge upon the offering of municipal incentives. Table 1 on pages 18-19 of the report presents the potential suite of financial and programmatic incentives that state agencies could offer municipalities through the Flood Resilient Communities Program to encourage adoption and implementation of zoning bylaws that protect shorelands, river corridors, floodplains, and buffers. This report provides the status of developing model municipal river corridor and shoreland protection ordinances, as well as describes the process for municipalities to qualify for the incentives.

Act 110

River, River Corridor, & Floodplain Management Programs

Report to the General Assembly

Vermont Department of Environmental Conservation

A. Introduction

Acts 110 and 138 amended 10 V.S.A. § 1427 such that the Secretary of Natural Resources shall establish a river corridor and floodplain management program and a shoreland management program, effective February 1, 2011, to provide municipalities with maps of designated river corridors and develop recommended best management practices for the management of river corridors, shorelands and buffers. Beginning January 15, 2011 and biennially thereafter, the Agency of Natural Resources shall report to the House Committee on Fish, Wildlife and Water Resources and the Senate Committee on Natural Resources and Energy regarding the status of river corridor, shoreland, and buffer zoning within Vermont. The report shall include:

(1) The priority schedule for providing river corridor and buffer maps required by 10 V.S.A. § 1427 and a summary of the implementation of the priority schedule;

(2) A summary of the status of best management practices required under 10 V.S.A. §§ 1425 and 1427 for management of river corridors, shorelands, and buffers;

(3) A summary of the municipalities that have adopted river corridor, shoreland, or buffer zoning bylaws and a summary of the content of such bylaws;

(4) A description of the financial incentives that have been established according to the requirements of 10 V.S.A. §§ 1425 and 1427 for municipal adoption and implementation of zoning bylaws that protect and preserve river corridors, shorelands, and buffers; and

(5) The Agency of Natural Resources' recommendations for statutory changes, regulatory changes, or additional practices that, based on information available to the Agency of Natural Resources, will improve the efficacy of the river corridor management and shoreland management programs and improve the quality of the waters of the state.

B. River and River Corridor Management Programs

The following initiatives are being undertaken to improve river and river corridor management, based on lessons learned during Irene disaster recovery and as directed by the passage of Act 138:

I. ***Establish technical standards and rules for conducting in-stream work and emergency protective measures.***

a. *Develop a set of Standard River Management Practices* that can be used by ANR disaster response staff, external partners, professional consultants, and other trained operatives to guide different types of river management work. These Standard Practices would extend Vermont river corridor planning into a design phase and include information on the normal constraints, regulatory requirements, and the state and federal funding eligibility of different practices.

   At the time of this report: The DEC has applied for and received a Hazard Mitigation Grant from FEMA which includes funding to secure the contractual services to research and propose a set of cost effective and environmentally sound in-stream practices . The Rivers Program has requested proposals from qualified consultants and formed an oversight committee comprised of staff from VTrans and ANR to select a technical consultant. A firm with in-state offices and extensive river engineering and restoration work was selected and is now under contract. A detailed outline of the deliverables for this Standard River Practices project is available from the DEC Rivers Program. The project is under an accelerated timeframe, because ANR and VTrans prefer to use these standard river practices to inform other procedures and rules under development and within the cross-training programs also under development.

b. *Enhance ANR authority to regulate stream alterations during emergencies*. Adopt rules and general permits for stream alterations and emergency in-stream work (as per 10 V.S.A. § 1027). Stream alteration rules will ease permitting for activities conducted using standard operating procedures and consistent with river corridor plans. VTrans and ANR should create an MOU for the regulation of emergency in-stream work on local, state, and federal highways in coordination with the USCOE and other federal agencies.

   At the time of this report: ANR is finishing an internal review of a draft set of Stream Alteration Rules and a draft revision of the Stream Alteration General Permit (GP). Both the draft rules and GP contain substantial sections pertaining to the regulation of Emergency Protective Measures. These sections contain the requirements spelled out in 10 V.S.A. §1027, i.e., defining what qualifies as an emergency protective measure, the criteria for coverage (authorization) under the GP, interagency coordination, and public notice. The ANR anticipates a lengthy public participation and hearing process in adopting the rules and revised GP, but hopes to have them adopted by the 2013 runoff and construction season.

II. ***Maximize public assistance funding for flood hazard mitigation.***

a. *Adopt codes and standards to maximize the availability of federal funding.* State-adopted technical standards, rules, and procedures for conducting emergency protective measures, replacing or protecting infrastructure, and implementing local flood hazard mitigation plans should be submitted to all applicable federal funding programs (e.g., those of FEMA, FHWA, and USDA). Transmittals should specify the State's intent to satisfy the eligibility criteria specified for different funding programs and request a formal confirmation.

At the time of this report: The Standard River Management Practices are under development. The ANR is consulting with the Attorney General's Office and sister agencies to ensure that language supporting the Stream Alteration Rules, GP, and Standard Practices will address the qualifying criteria of FEMA and other federal funding sources.

b. *Ensure that state, regional, and local hazard mitigation plans are updated and approved by FEMA* to meet State environmental, infrastructure, and hazard mitigation standards. Towns and regions should reference all or parts of their river corridor plans to increase FEMA funding eligibility and competitiveness.

At the time of this report: The State Hazard Mitigation Plan (HMP) is being updated by Vermont Emergency Management and will be submitted to FEMA for approval during the 2013 calendar year. The interagency committee advising VEM has agreed that the Standard River Management Practices (currently under development as described under task I.A above) will be incorporated into the State HMP by reference to ensure that FEMA acknowledges them as emergency protective measures and hazard mitigation practices. The specific objective is a FEMA acknowledgement that where these practices are used and authorized by the state in post-flood response and recovery efforts, municipalities will satisfy eligibility codes and standards criteria for FEMA Public Assistance and Hazard Mitigation Funding.

c. *Establish the "Flood Resilient Communities Program,"* as now required in 10 V.S.A. §1428, to increase state and federal mitigation funding for eligible Vermont communities. Municipalities that have adopted river corridor and floodplain protections and are actively working to implement their river corridor plans will become increasing competitive for pre- and post-disaster mitigation funding through a flood resilient community scoring system.

At the time of this report: The DEC applied for and received a FEMA Hazard Mitigation Grant to coordinate the development of a "Focus on Floods" web page that will serve as the primary portal for communities to learn about their progress in river corridor planning, hazards mapping, and floodplain protection. Incentives for river corridor and floodplain protection are being compiled, and communities will become eligible based on a rating system that considers a suite of mitigation activities, including implementation of Standard River Management Practices. Revised Emergency Relief and Assistance (ERAF) rules are the latest example of a state funding formula that will now recognize towns that have increased river corridor and floodplain protection through an increased state cost share for emergency relief funding. Focus on Floods will include testimonials, success stories, videos, and training opportunities for local and regional organizations to learn about best practices and how other communities are benefitting from their application.

III. ***Develop ANR emergency operations in coordination with other local, state, and federal agencies***.

a. *Create a cadre of "flood response regulators"* within the ANR who would be trained to assist the River Management Engineers during larger disasters. These staff would be technically trained and selected to serve as regulators, authorizing and coordinating emergency protection measures and other stream alteration activities within an assigned region.

At the time of this report: When Super Storm Sandy was bearing down on the Mid-Atlantic and New England States in October 2012, the DEC prepared a list of flood response regulators and prepared to mobilize them. The Rivers Program was prepared to immediately issue a set of emergency river management practices and the authorization process that would be used in working with municipalities to address true imminent threats. This first test was a definite improvement over the preparations made prior to TS Irene. However, a larger and more

formalized response system will be required to ensure the state can provide regulatory and technical assistance for emergency measures during major disasters, without increasing vulnerability or unduly impacting river environments.

The Agency has engaged consultants to train staff in Incident Command Systems (ICS). Within a one year time period (end of calendar year 2013), the ANR will develop ICS and begin training staff to activate and carry out duties as may be required to deal with disasters of different magnitudes. Coordination with VEM and VTrans incident command systems will be critical to the success of an ANR ICS. One of the key Operational Sections for a flood-disaster ICS will be "flood response regulators." ANR must establish a ratio of regulator/affected town (e.g., one river management engineer for every five flood-stricken towns) and be prepared to mobilize pre-trained people once an assessment of damage has been made. Initiative IV.B below describes the training program that will be used to prepare flood response regulators. The State may also need to identify contractors who can serve in this capacity and, within the ICS Finance and Admin Section, be prepared to rapidly activate those contractors during emergency situations.

b. *Establish a network of river scientists and engineers and habitat restoration specialists* from within the Agency, other natural resource agencies (i.e., US Fish and Wildlife Service), private consultant companies, RPCs, and non-profit organizations who can be brought in or called upon to assist VTrans and municipalities as resident experts on larger construction sites. Agency staff and consultants within this network would assist and take direction from River Engineers and Flood Response Regulators by providing services related to regional coordination, corridor mapping, geomorphic assessments, in-stream surveys, alternatives analyses, "quick" equilibrium-based restoration designs, and construction oversight.

   At the time of this report: During Super Storm Sandy preparations, the DEC listed a network of scientists, engineers, and habitat restoration specialists and prepared to mobilize. This first test was a definite improvement over the preparations made prior to TS Irene, but a larger and more formalized organization is needed. The State must create a defined set of operational procedures and preset contracts to achieve the desired outcome of emergency measures that do not increase our vulnerability or unduly impact river environments.

   River scientists and restoration specialists will be working within the Operational Section of the ANR ICS in the coming year. Preliminarily, the Rivers Program is designing an organizational structure that would prepare and assign staff, including river geomorphologists and biologists, to work under the direction of a River Engineer or flood response regulator. The Engineer will review and condition approval of emergency protection measures. They will use river assessment data provided by scientists and, where beneficial, assign a restoration specialist to act as a construction supervisor to ensure hazard mitigation and habitat protection/restoration are conducted to the greatest extent possible during emergency response and recovery operations. Initiative IV.B below describes the training program that will be used to prepare river scientists and restoration specialists to work within the ANR ICS.

c. *Coordinate ANR emergency operations with other agencies*, particularly with the emergency operations of Vermont Emergency Management and VTrans. Emergency planning and training should be conducted on a regular basis so that ANR disaster response staff, local emergency officers, and VTrans incident commanders are cross-trained on their respective roles and responsibilities.

   At the time of this report: DEC staff are participating in Incident Command System training. Within the calendar year 2013, the ANR ICS will be developed in coordination with VEM and

VTrans ICS. Mock disaster training exercises will be important to familiarize ANR staff with the emergency operations and staff of sister agencies.

IV. ***Create and maintain a three-tiered river management training program.***

a. *For VTrans district staff, local road foremen, equipment operators, and emergency coordinators,* to give them a working knowledge of how to restore flood-damaged infrastructure, minimize the vulnerability of infrastructure, and reduce the environmental damage caused by channelization and encroachment. This two-day training will be designed to help people problem-solve and apply practices that promote natural stream stability and reduce the risk of project failure.

   At the time of this report: A DEC Rivers Program staff scientist has been assigned the responsibility of developing and carrying out a three-tiered training program. The Tier 1 training will be an on-line program (scheduled to be on-line by early spring 2013) and will be used by VTrans and other agencies to expose employees to the basics of river science and engineering. A Tier 2 training module has been developed and piloted with a mix of VTrans staff. The training entails a combination of short lectures, river simulator ("flume") demonstrations, and field trips, with a heavy emphasis on problem-solving by participants. The Tier 2 training course will be offered on at least three occasions to VTrans field operations staff during 2013, as well as piloted to town road and emergency officials. The Tier 2 course is held over a three-day period and will have the primary objective, over time, of preparing State District staff and towns to take emergency river management measures. The Tier 3 training will consist of a set of modules that prepare state agency staff and consultants to undertake more technical river management practices. One or two of the modules will be piloted during 2013, with a more complete set of scheduled offerings starting in 2014.

b. *For flood response regulators, river designers, and engineering contractors,* to give them the technical skills for river corridor and floodplain mapping, geomorphic assessments, in-stream surveys, alternatives analyses, "quick" equilibrium-based restoration designs, and the construction oversight necessary during flood emergency operations. This training program is intended to greatly expand the State's capacity during disaster recovery operations and provide coordination and technical assistance on as many sites as possible.

   At the time of this report: The three-tiered training program described above, in combination with development and training associated with the ANR ICS, will be used to prepare these Operational staff for actual flood response and recovery operations. The courses will be focused on separate categories of Standard River Engineering Practice (developed under task I.A above). For example, a Tier 3 class will be developed that covers bridge and culvert practices and debris clearance practices. The smaller, less extensive flood disasters (which typically occur once a year in Vermont) will provide additional opportunities to train "flood response regulators" and others who may be critically involved in larger flood disaster response.

V. Enhance Rivers Program Operations

a. *Create mobile offices for the river management engineers* to access data and issue authorizations (with drawings) from the field. The engineers should have access to state vehicles, IT support, and the technology for communicating authorizations to a central map-based data system that can be accessed by Agency staff and the public over the internet.

   At the time of this report: The River Management Engineers now have smart phones in the field which support a greater transfer of information and data where they have cell service. Ideally, the mobile office will consist of hardware to draw up conceptual designs, fill out and print

standard authorizations with supporting documentation, transmit field-generated information to a central office and to other regional partners and agencies, and receive transmitted information. These communication systems, and the IT support necessary to effectively carrying them out, will be developed as part of the Department's strategic business transformation initiative. This is a very high priority for DEC in carrying out the new Stream Alteration Rules and revised GP, especially with respect to the inter-agency coordination requirements anticipated for emergency protective measures during post-flood operations.

b. *Obtain administrative assistance for river management engineers within each regional office* during disasters, to ensure that authorizations are accessible electronically and to assist with office correspondence and other communication needs such as switchboard operations during larger disaster recovery operations.

   At the time of this report: The DEC has identified administrative assistance for the field engineers as a critical need. With the development of the mobile office and IT systems envisioned above, it is anticipated that the Watershed Management Division will hire or assign a single nine-month seasonal employee to provide service to all five regional river management engineers. The ANR ICS structure will provide the full range of ICS functions (operations, logistics, planning, and administration/finance) to ensure administrative support during emergency response periods.

c. *Strengthen the Rivers Data Management and Map Serve Systems.* Create systems for statewide geo-spatial analysis of geomorphic data. Create web-accessible geo-databases for river corridor plans and projects.

   At the time of this report: Partnerships with UVM and other non-profit organizations (e.g., the Vermont Land Trust) are enhancing ANR's capabilities for analyzing statewide data, using remote sensing techniques to identify sensitive river reaches and opportunities for targeting river corridors and floodplain protection efforts. The ANR recently moved the Rivers data into the on-line Natural Resource Atlas, which allows an analyst to view floodplain and geomorphic data with other ANR data layers and maps. In addition, ANR is partnering with the Agency of Commerce and Community Development and VTrans to conduct analyses that overlay sensitive river corridors with critical infrastructure and areas of vital economic activity, pilot different hydraulic modeling techniques in order to better understand vulnerable areas, and ultimately help Vermont communities create flood resiliency plans that have specific hazard mitigation projects and practices ready to implement.

d. *Develop a flood disaster outreach program within the ANR* to better prepare the public and watershed groups for what occurs during and after a flood. The public should have access to information explaining in-stream work. Ideally, a professional outreach coordinator, working out of the State Emergency Operations Center, would prepare press releases and organize media events as necessary during disaster recovery periods.

   At the time of this report: Several projects described above will be brought together in carrying out this objective. The Standard River Management Practices (task I.A) will be developed into guidance written at the lay-person level. This information will be prominently displayed on the "Focus on Flood" web page (task II.C). The Tier 1 and 2 training courses will be made available to the broader public and serve as an outreach and education center for emergency in-stream work and, to the greatest extent feasible, river scientists will work with watershed coordinators and other watershed organizations to provide hands-on experiences for lay audiences.

VI. ***Create tools and incentives for the protection of river corridors and floodplains*.**

a. *Create ANR River Corridor Procedures* comprised of mapping protocols and best management practices to guide municipal and state river corridor, floodplain, and riparian buffer protection. Mapping protocols should include methods for developing and using unstudied corridors (i.e., by non-experts) to expedite certain hazard planning and environmental permitting. Revise the River Corridor Planning Guide to incorporate techniques, ranging from simple to complex, for developing and utilizing "local flood hazard analyses." These analyses will be prioritized based on stream geomorphic sensitivity (as now required in 10 V.S.A. §1427), and used to design larger-scale flood recovery, hazard mitigation, and river restoration projects that maintain public infrastructure within otherwise protected river corridors and floodplains.

   At the time of this report: The DEC Rivers Program has developed a work plan for developing a river corridor data layer for all stream lines in the state. Prior to this time, river corridors were only created where Phase 1 and Phase 2 stream geomorphic data had been obtained. This remote sensing and quality-assured exercise will create the opportunity for every municipality to have maps that show both provisional and final inundation and erosion hazard information. The DEC has begun outlining the documentation for this process, how the state will use the data in its regulatory programs, and recommendations for municipal use, including model bylaws, ordinances, and best practices. Detailed procedures for map updating and revisions will also be provided. Best practices will include those identified in DEC's River Corridor Plans, e.g., riparian buffer and river management practices as they relate to river corridor and floodplain management. Many elements for a set of ANR River Corridor Procedures have already been published by the Rivers Program and therefore this set of procedures should come together quickly as an updated compendium.

b. *Outreach to landowners and communities to strategically protect critical flood attenuation assets.* Work with other State agencies, RPCs, municipalities, watershed and land conservation organizations to complete river corridor mapping statewide and promote the importance of river corridor planning to protect and restore the flow and sediment attenuation within river corridors. Increase the role of land conservation in river corridor protection by pursuing a statewide strategy for river corridor easements and buyouts.

   At the time of this report: The ANR and the Vermont Land Trust cosponsored a workshop during the fall of 2012 which focused on the role of land conservation in local and state flood resiliency programs. Attended by over 50 conservation leaders from statewide and regional agencies and organizations, this workshop resulted in three ongoing work groups: a governance workgroup to create state-level policy and funding mechanisms; a mapping and priority-setting workgroup; and a procedural workgroup to help agencies and organizations in retooling existing programs for incorporating flood resiliency objectives and mechanisms. As discussed above, the Rivers Program has created a work plan for developing a statewide river corridor layer by the end of 2013. A statewide river corridor layer will better facilitate the work of the mapping and priority-setting workgroup.

C. Floodplain Management

DEC's river corridor protection began with the initiation of its Fluvial Erosion Hazard (FEH) program, which was established in response to Act 137 (passed by the 1997-98 General Assembly). Act 137 required the State to develop appropriate flood hazard mitigation and avoidance measures. Acts 110 and 138 go a step further by encouraging river corridor, floodplain, and lake and river buffer protections at the municipal level. Acts 110 and 138 promote the use of incentives to encourage

municipalities to adopt corridor protection strategies. Since most land use decisions occur on the local level, incentives are effective at raising public awareness about river corridor and floodplain functions and motivating landowners and municipalities to take proactive steps to reduce property loss, protect water quality, and build greater resilience to future flood damages.

Floodplain management is an important component of the rivers program, since the restoration and maintenance of floodplain function are essential for stable streams, reductions in nutrient pollution loading to Lake Champlain and other receiving waters, and the long-term insurance against future flood hazards. The RCFMP's floodplain management staff will continue to provide technical support to communities participating in the NFIP program and agencies of state government. Greater municipal participation achieves the State's water resource objectives of avoiding flood hazards, protecting beneficial floodplain functions, restoring natural stability of rivers, and securing greater NFIP compliance.

The following floodplain management initiatives are being undertaken as directed by the passage of Act 138:

I. Enhance State and municipal floodplain regulation.

a. *Establish enhanced State floodplain regulations.* Establish rules and general permits for any development exempt from municipal regulation by July 1, 2014 (as per 10 V.S.A. §754), creating standards that exceed the minimum requirements of the National Flood Insurance Program (NFIP). Notify all State agencies about the required transition period in which all municipally-exempt development must meet the NFIP minimum requirements. Establish MOUs with state agencies that agree to regulate developments within their purview consistent with the State Floodplain Rules.

   At the time of this report: The Rivers program has had discussions both internally, and with Division and DEC leadership, on the overarching goals of the new rules. RCFMP plans to do outreach on the new rules with sister agencies (e.g. AOT, ACCD, AAFM, BGS) and establish draft rules and a general permit by July 1, 2013. To ensure compliance with NFIP minimum criteria, the program will also solicit review and input from FEMA.

b. *Increase the regulatory and technical assistance capacity for floodplain protection.* Create northern, central, and southern state floodplain offices to issue floodplain permits and provide technical reviews for municipalities and other state agencies. Establish a Certified Floodplain Technician Program whereby Regional Planning and municipal staff may become certified to review development proposals requiring municipal permits under the NFIP.

   At the time of this report: The two new floodplain manager positions have been created, filled, and the northern, central, and southern regions have been created (http://watershedmanagement.vt.gov/rivers/docs/rv_floodplain_regions.pdf). The new staff will allow the program to provide the level of technical assistance required to fully implement Act 138. RCFMP plans on establishing a Certified Floodplain Technician program during the 2013-2014 reporting period. Delegating floodplain development reviews to qualified floodplain management professionals around the state will increase efficiency at the state level and broaden expertise and engagement with outside partners. In December 2012, RCFMP met with a group of Vermont Certified Floodplain Managers to discuss the prospect of starting a Vermont Chapter of the Association of State Floodplain Managers. A Vermont chapter may be an effective framework for ANR to deliver training and certification.

c. *Increase outreach to communities on the importance of active floodplain protection.* Work with VLCT, RPCs, Vermont Planners Association, and other watershed organizations to promote the importance of natural floodplain functions and increase participation in the NFIP. Develop and promote enhanced model bylaws and ordinances that exceed the minimum requirements of the NFIP and link to incentives available through the *Flood Resilient Communities Program* (task II.C).

   At the time of this report: Concurrent with the development of the State Floodplain Rules, RCFMP will be updating its suite of model river corridor and floodplain protection bylaws as well as the inundation standards in ANR's Act 250 technical guidance. The goal is to ensure close alignment and consistency between new state floodplain rules, model municipal regulations, and Act 250 reviews under Criterion 1D – Floodways. As such, updated bylaws and Act 250 technical guidance are on a similar timeline as the new state floodplain rules with updates planned by July, 2013. RCFMP works in close partnership with above-referenced organizations, and will be engaging them to provide input on the draft documents as well as assist in outreach efforts once finalized.

d. *Develop better floodplain mapping* for municipal and state agency use. Obtain LIDAR data (high resolution topography) to assist in the modernization of inundation mapping for river mainstems, tributaries, and lakeshores.

   At the time of this report: A number of efforts and opportunities are underway or will be further explored:

   1. Beyond the Bennington County federal flood map update process currently underway, ANR has been unable to secure a commitment from FEMA in funding further flood studies. Additional updated mapping requires higher quality topographic information. At this time, Vermont has already acquired the critical topography (the equivalent of 2 foot contour data from LiDAR) for two areas still needing study: Essex County and the Missisquoi Watershed.

   2. The Army Corps of Engineer's Silver Jackets Program, in cooperation with Vermont Emergency Management and other agencies, is conducting a post-Irene flood study and mapping effort along the Ottauquechee River (http://www.nfrmp.us/state/). The work will be done by the U.S. Geological Survey (USGS).

   3. As part of an Interagency Agreement with FEMA, the USGS has collected and surveyed post-Irene flood high water marks and is completing a flood inundation study for the Winooski River in Waterbury, as well as flood recovery maps for the upper White and Tweed Rivers where post-flood LiDAR has been acquired by VTrans.

   4. In 2012, the RCFMP coordinated a state and federal cost-share agreement between ANR (Ecosystem Restoration Program), USGS, Natural Resources Conservation Service, and the U.S. Forest Service to acquire LiDAR for Addison County. Data were collected in late 2012, and the $155,264 project will cover 478 square miles.

   The FEMA Cooperating Technical Partners (CTP) program provides a mechanism for qualified local, regional, and state agencies to produce FEMA Flood Insurance Studies and Flood Insurance Rate Maps. The CTP program has potential for improving the mapping products in Vermont with more control of the process by the state. Currently, maps are produced by out-of-state contractors, and the process thus far has been fraught with poor coordination and quality issues. ANR is interested in piloting a flood insurance study/mapping effort under the CTP program in the Missisquoi watershed. However, a commitment and information on state match

requirements has not been forthcoming from FEMA. RCFMP will continue to work the FEMA Risk Analysis Branch in Boston on this potential opportunity.

D. Best Management Practices for River Corridors and Buffers

The Rivers Program has and continues to develop guidance on Best Management Practices to restore and protect the equilibrium condition of rivers, minimize flood damages, and achieve water quality and habitat objectives, including:

1. Minimize or Remove Stream Channel Constraints. Stream reaches are inhibited from achieving equilibrium conditions due to specific constraints, such as the presence of fill, undersized stream crossing structures, berms and other channelization practices. Minimizing new or removal of existing stream channel constraints reduces the alteration of channel dimension, pattern, profile, and floodplain associated with unstable streams. This BMP becomes most effective when integrated into river corridor and floodplain protection.
2. Restore and Maintain Riparian Buffer Vegetation. Loss of ecological function, water quality degradation, and unstable streambanks result when woody riparian vegetation is removed from the riparian or near-stream area. Thus, a best management practice entails restoring and maintaining an undisturbed area consisting of trees, shrubs, ground cover plants, duff layer, and generally uneven ground surface, extending a specified distance horizontally across the surface of the land, from the top of the bank of an adjacent river or stream. This BMP becomes effective in achieving its intended purpose when it is integrated into river corridor and floodplain protection.
3. Protect River Corridors and Floodplains. The loss of floodplain function and the meander space to achieve stream equilibrium are the primary factors contributing to flood and fluvial erosion hazards, sediment and nutrient loading, and stream habitat degradation. Protecting river corridors and floodplains requires the avoidance of encroachment into defined areas—areas that provide the spatial context for restoring and maintaining stable and healthy riverine and flood-related processes.

To implement river corridor and buffer BMPs, the Agency has thus far developed the following programs and guidance:

- River Management to Achieve Equilibrium Conditions;
- ANR Riparian Buffer Guidance and Technical Papers;
- River Corridor Plans to delineate corridors and assess river conditions and stressors;
- River Corridor Easements;
- Integration of fluvial erosion hazard maps into local and regional Hazard Mitigation Plans; and,
- Model Flood and Fluvial Erosion Hazard bylaws that restrict further floodplain development.

River Management to Achieve and Maintain Equilibrium Conditions

Perhaps the most important tool is the application of the management standard to achieve and maintain stream equilibrium conditions. The Rivers Program employs this standard in its work to develop, evaluate and support activities and projects – using technical assistance, financial support, and regulatory review – that are consistent with natural fluvial geomorphic processes and the goal of achieving and maintaining the channel width, depth, meander pattern, and slope associated with natural equilibrium conditions. This standard is both a part of the Agency's procedures for implementing the Antidegradation Policy of the Water Quality Standards and an essential part of the State Hazard Mitigation Plan. This standard also guides the alternatives analysis for stream crossing types and sizing, stormwater management, and implementation of channel management activities. Applying this BMP will reduce river-related conflicts, avoid flood hazards, buy down the risk to public safety from flooding,

and minimize the environmental, social, and economic costs associated with stream instability and erosion.

ANR Riparian Buffer Guidance and Technical Papers

The Agency of Natural Resources (ANR) adopted Riparian Buffer Guidance (12/09/05) with associated Riparian Buffers and Corridors Technical Papers. The Guidance articulates a framework for Agency recommendations and testimony in the Act 250 process; it also assists applicants in designing Act 250-regulated projects that incorporate appropriate buffer zone widths for protecting riparian functions. The Rivers Program will be updating and incorporating the Buffer Guidance as part of the River Corridor Procedures development effort and will be engaging ANR leadership and staff in this process during calendar year 2013. More detailed technical information on the functions and values of riparian corridors and buffers is included in the series of Technical Papers.

River Corridor Plans

Municipalities and local river stakeholders are engaged in the process of conducting stream geomorphic assessments, analyzing the data to develop science-based river corridors, and identifying the strategies and stream-specific best management practices to restore and protect stream equilibrium conditions. The Rivers Program technically assists the development and implementation of river corridor plans by working with local partners on cost-effective practices (i.e., replacement of crossing structures, floodplain restorations, and removal of structural river and floodplain constraints). Technical assistance is focused where towns and landowners are actively engaged in following through with plan recommendations to adopt protective bylaws and implement high priority corridor easements to ensure the long-term viability of river corridor investments.

River Corridor Easements

A river corridor easement conserves a particular reach of river that has been identified as having: (a) high priority hydrologic, sediment, and nutrient attenuation areas (areas of floodplain that are essential for storing sediment and nutrient pollution during flooding), (b) areas that could provide flood inundation and fluvial erosion hazard mitigation benefits, and (c) important riparian habitat. The key provision of a river corridor easement is the purchase of the development and channel management rights within the river corridor. This easement essentially removes the river-human conflict and allows the stream to restore equilibrium conditions. The easement ensures that watercourses and wetlands within the delineated river corridor are not manipulated so as to alter the natural water level or flow, or intervene in the river's natural physical adjustment processes. The river corridors subject to the easement are defined by the geomorphic assessment and fluvial erosion hazard mapping process, and opportunities to secure the easements are identified in the corridor planning process.

The easements give the holder, or grantee, the right and opportunity within the corridor to establish a naturally vegetated, floating buffer measured from the river banks as they may move. The landowner may continue to conduct activities such as agriculture and timber harvesting within the river corridor, but is restricted from placing, repairing, or modifying structural elements, such as bank armor, levees, or earthen fills. The Program works closely with state and federal farm service agencies, the Vermont Housing and Conservation Board, and land trust organizations to combine corridor easements with other land conservation programs.

Integration of fluvial erosion hazard maps into local and regional Hazard Mitigation Plans

Regional Planning Commissions are assisting municipalities in incorporating Fluvial erosion hazard maps and geomorphic data into the Regional and local Hazard Mitigation Plans (HMP). FEMA-approved HMPs are a prerequisite for towns to qualify for a FEMA hazard mitigation grant, and FEMA requires that these plans are updated periodically. Developing and updating these plans provide an important opportunity to educate municipalities about these hazards and steps they can take to build resilience from these hazards.

Model Flood and Fluvial Erosion Hazard Bylaws

River corridors consist of a stable river's meander belt width – the corridor of floodplain area that, under equilibrium (or naturally stable) conditions, captures the lateral extent of the stream meanders and accommodates the channel slope. The stream belt width is derived from fluvial geomorphic assessments, and is a term that is interchangeable with the Fluvial Erosion Hazard (FEH) area. River corridors also contain a wooded riparian buffer – a specified, often vegetated setback from the top of a stream bank or top of a slope. A healthy stream requires both the river corridor to provide stream stability and a vegetated buffer to provide bank stability, temperature moderation, and additional water quality and habitat function.

The Vermont Rivers Program recognizes that the best way to maintain healthy rivers and floodplains, as well as protect public safety, infrastructure and property, is to discourage development in NFIP floodplains and FEH corridors. Since most land use decisions occur at the local level, the Rivers Program has prepared model flood hazard and fluvial erosion hazard bylaws for municipalities. These models were informed by regional, municipal, and consulting planners. The Rivers Program is helping municipalities become more resilient to the impacts of flooding by encouraging them to restrict development in known flood hazard areas (e.g., those areas that are already mapped on the FEMA Flood Insurance Rate Maps (FIRMS) for municipalities participating in the National Flood Insurance Program).

The Program has in place a number of model flood hazard bylaws to help municipalities meet or exceed the requirements of the NFIP by including suggested language to avoid development in known flood hazard areas including FEH areas. Content of these model bylaws was also reviewed and approved by FEMA Region 1. The models help municipalities protect river corridors and floodplain assets in order to enhance public safety, minimize property loss and damages due to fluvial erosion, and achieve channel equilibrium conditions. Model regulations prohibit most new encroachments in the river corridor, including new primary residential and non-residential structures. Models have been adapted for communities with or without existing zoning and for those communities that do or do not have mapped fluvial erosion hazard corridors. PDF versions of the model are available online:

- FEH Municipal Guide, Appendix C: Model Fluvial Erosion Hazard Overlay District: http://www.anr.state.vt.us/dec/waterq/rivers/docs/rv_municipalguide.pdf
- Regulating Land Use in Flood Hazard Areas (NFIP): http://www.vtwaterquality.org/rivers/htm/rv_floodhazard.htm

The status of Vermont municipal river and stream buffer ordinances is presented in Appendix 3. As of 2007, 52 towns have a stream and/or lakeshore buffer or setback ordinance.

E. Incentives for Municipalities to Adopt River Corridor and Shoreland Protection Bylaws

Act 138 created a new *River Corridor Protection* section (10 V.S.A, § 1428) which directs the Secretary of Administration, after consultation with relevant state agencies, to create a Flood Resilient Communities Program (as discussed on page 7 under II C) and list the existing financial incentives under state law for which municipalities may apply for financial assistance, when funds are available, for municipal adoption and implementation of bylaws under 24 V.S.A. chapter 117 that protect river corridors and floodplains, shorelands, and buffers.

Obvious incentives that may motivate municipalities to adopt river corridor protection are flood hazard avoidance, public safety improvements, and abatement of water quality and habitat impacts. Minimizing water quality impacts, protecting aquatic habitat, and supporting recreation values should be motivating factors for shoreland and buffer protection. Continuing the Agency's outreach to

municipalities is essential to raise awareness about the important proactive steps that can be taken at the local level to achieve these objectives.

Financial incentives to nudge municipalities to adopt river corridor and shoreland protection zoning bylaws include qualifying criteria in grants, pass-through funds, technical assistance, and educational support that encourage municipalities to adopt and implement bylaws that conserve and restore river stability, floodplains, wetland and riparian buffer function. Table 3 below summarizes the status of currently available incentives and an inventory of all grant and loan programs within the Agencies of Natural Resources, Transportation, Commerce & Community Development, and the Department of Public Safety for which consideration has been made to incorporate incentives for municipal adoption of river corridor and shoreland protection. Notes are provided which describe the steps necessary for implementation of the incentive.

Model municipal river corridor and shoreland protection ordinances have been developed. Procedures will describe the standard lakeshore or stream geomorphic assessment and mapping protocols that will be the basis for the development of municipal shoreland zones, river corridors, and fluvial erosion hazard maps.

The fundamental standard to qualify for financial incentives is that the local bylaw must be designed to: (a) achieve and maintain stream equilibrium conditions; or, (b) ensure good shoreland management including maintenance of a buffer. Additional standards to qualify for incentives, such as the geographic extent of protection coverage required within a municipality, will be determined in a conference involving at least one representative of the local governing body, at least one representative of the municipal planning commission, and representatives of the DEC Rivers Program and Lakes Program. Criteria for consideration will include the history of flood and fluvial erosion damage, stream geomorphic condition, development pattern within the river corridor, lake characteristics, and shoreland development pattern.

Table 1: Municipal Incentives for River Corridor, Floodplain and Shoreland Protection

AGENCY	GRANT PROGRAM AS POTENTIAL INCENTIVE	Incentive to be Implemented as:			Require Change in:			COMMENT
		ELIGIBILITY CRITERIA	PRIORITY CRITERIA	ENHANCED STATE MATCH	STATUTE	RULE	PROCEDURE	
ANR	319		X				X	To be integrated in FY2014 grant guidance
	Watershed (License Plate)							Will be revisited with F&W commissioner in 2013
	Ecosystem Restoration		X				X	To be integrated in FY2014 grant guidance
	Water Supply Planning							Deemed not suitable by WS Division Director
	Water Supply Construction							Deemed not suitable by WS Division Director
	Clean Water State Revolving Fund		X			X		To be integrated in FY2014 grant guidance
	State Pollution Grant		X			X		To be integrated in FY2014 grant guidance
	Aquatic Nuisance		X				X	To be integrated in FY2014 grant guidance
VEM	Hazard Mitigation Assistance		X				X	FEMA grant program
	Pre-Disaster Mitigation		X				X	FEMA grant program
	Flood Mitigation Assistance		X				X	FEMA grant program
	ERAF			X		X		New Rule passed 9/2012. Takes effect 10/2014

AGENCY	GRANT PROGRAM AS POTENTIAL INCENTIVE	Incentive to be Implemented as:			Require Change in:			COMMENT
		ELIGIBILITY CRITERIA	PRIORITY CRITERIA	ENHANCED STATE MATCH	STATUTE	RULE	PROCEDURE	
VTRANS	Town Highway Bridge (State Match)							Deemed not suitable by VTRANS
	Town Highway Structures							Deemed not suitable by VTRANS
	Town Highway Class 2 Roadway							Deemed not suitable by VTRANS
	Town Highway Emergency			X	X			Will propose statutory change in 2013
	Better Back Roads		X				X	To be integrated in FY2014 grant guidance; further discussions necessary with RC&D
	State Aid to Town Highways					X		Deemed not suitable by VTRANS
	Municipal Planning		X				X	Will establish a priority to support river corridor and buffer planning bylaws
	Enhancement Grants		X				X	Integrated into 2013-2015 grant guidance
ACCD	VT Community Development Program		X				X	Integrated into grant guidance for program year 2012

F. ANR Recommendations to Improve River, River Corridor, and Floodplain Management Programs

In the January 2011 report, the Rivers Program recommended the following steps to further achieve the goals of Act 110. The legislative action (Act 138), staff increases, inter-agency coordination, increased public involvement, and FEMA grants that followed flood disasters in spring and summer of 2011 have allowed for significant progress in carrying out these recommendations through the initiatives outlined in Sections B. and C. of this report.

1. Develop and maintain capabilities within the new River Corridor and Floodplain Management Program to: (a) provide municipalities with technical assistance in river corridor mapping, planning, and protection in each of the state surface water planning basins; and, (b) conduct regional regulatory oversight of fluvial erosion hazard mitigation and buffer allowances in Act 250 review;

   Initiatives described in Section B.VI. (a) *Creating ANR River Corridor Procedures* and Section B.VI. (b) *Outreach to communities to strategically protect critical flood attenuation assets, will*:
   - Increase the regulatory and technical assistance capacity for river corridor and floodplain protection;
   - Increase outreach to communities on the importance of active river corridor and floodplain protection; and,
   - Strengthen the Rivers Data Management and Map Serve Systems.

2. Establish and maintain sufficient regional capacity in the stream alteration regulatory program to provide regulatory and technical assistance for activities that may affect the achievement and maintenance of stream equilibrium conditions;

   Initiatives described in Section B.I. *Establish technical standards and rules for conducting in-stream work and emergency protective measures;* Section B.III. *Develop ANR emergency operations with other local, state, and federal agencies;* Section B.IV. *Create and maintain a three-tiered river management training program; and* Section B.V. *Enhance Rivers Program Operations,* will
   - Develop a set of standard river management practices;
   - Adopt stream alteration rules and a revised general Permit that include standards for conducting emergency protective measures;
   - Create a cadre of "flood response regulators";
   - Establish a network of river scientists and engineers and habitat restoration specialists;
   - Create mobile offices for the river management engineers;
   - Obtain administrative assistance for river management engineers within each regional office; and,
   - Create and maintain a three-tiered river management training program.

   The administration's 2014 budget includes the two river management engineer positions requested for implementing Act 110 and Act 138. If the Legislature passes a budget that includes

this request, the DEC will have the regional staff deemed necessary to carry out these recommendations.

3. Support the Agency's efforts to develop incentives for municipalities to adopt local land use bylaws that promote avoidance of development within river corridors and floodplains, reduce flood hazards, enhance water quality, and achieve equilibrium conditions. Some potential incentives identified in this report will require additional discussion and development work to achieve Act 110 objectives. The new ERAF rule passed in 2012 is a good starting point with respect to state cost-share on FEMA Public Assistance Grants;

   Initiatives described in Section B.II(c) *Establish a Flood Resilient Communities Program;* Section C.I(c) *Increase the outreach to communities on the importance of active floodplain protection*; and Section E. *Incentives for Municipalities to Adopt River Corridor and Shoreland Protection Bylaws.* will:
   - Maximize public assistance funding for emergency measures and flood hazard mitigation outlined in river corridor plans;
   - Create a Focus on Floods web page to serve as a one-stop-shop for flood resiliency programs and will feature the flood resiliency communities program;
   - Promote a Vermont-based community rating system that will show each Community's progress with implanting protective bylaws and mitigation strategies and the financial and technical incentives provided by state and federal agencies.

4. Support the DEC's work with other state agencies and departments to evaluate and change rules, procedures, and guidance consistent with stream equilibrium policy and state buffer guidance;

   Initiatives described in Section B.I *Establish technical standards and rules for conducting in-stream work and emergency protective measures*; Section B.VI.(a) *Create ANR river corridor procedures, and* Section C.I.(a) *Establish enhanced State floodplain regulations*, will*:*
   - Develop a set of Standard Operating Procedures for river management;
   - Enhance ANR authority to regulate stream alterations during emergencies;
   - Develop a more robust enforcement and compliance program;
   - Establish enhanced State floodplain regulations for activities exempt from municipal zoning; and,
   - Develop river corridor procedures, river corridor maps, and improved floodplain mapping.

5. Develop and maintain a stable funding program to conserve river corridors, lake shorelands, and buffers.

   Initiatives described in Section B.VI.(b) *Outreach to landowners and communities to strategically protect flood attenuation assets; will c*reate a multi-stakeholder Flood Resilience and Land Conservation Initiative. This initiative includes several committees, including a Governing Committee to seek stable funding sources and a Policy and Procedures Committee to examine ways that existing programs and funding sources may be used to focus more on river corridor and floodplain conservation.

6. Recognize that the avoidance strategy with respect to stream encroachments and management toward equilibrium conditions bolster local resilience to the impacts associated with climate change-related increases in frequency and severity of precipitation events.

   Passage of Act 138 is a significant recognition by the State of Vermont that an avoidance strategy that manages our rivers and streams toward equilibrium is critical to reducing vulnerability to flood hazards, adapting to climate change, and protecting the ecological integrity of our rivers and streams. Act 138 requires increased regulation, technical assistance, coordination, hazard identification, and incentives to achieve these goals.

In addition to the above activities, the DEC Rivers Program is participating in a number of other activities to enhance disaster preparedness and mitigation funding eligibility, including:

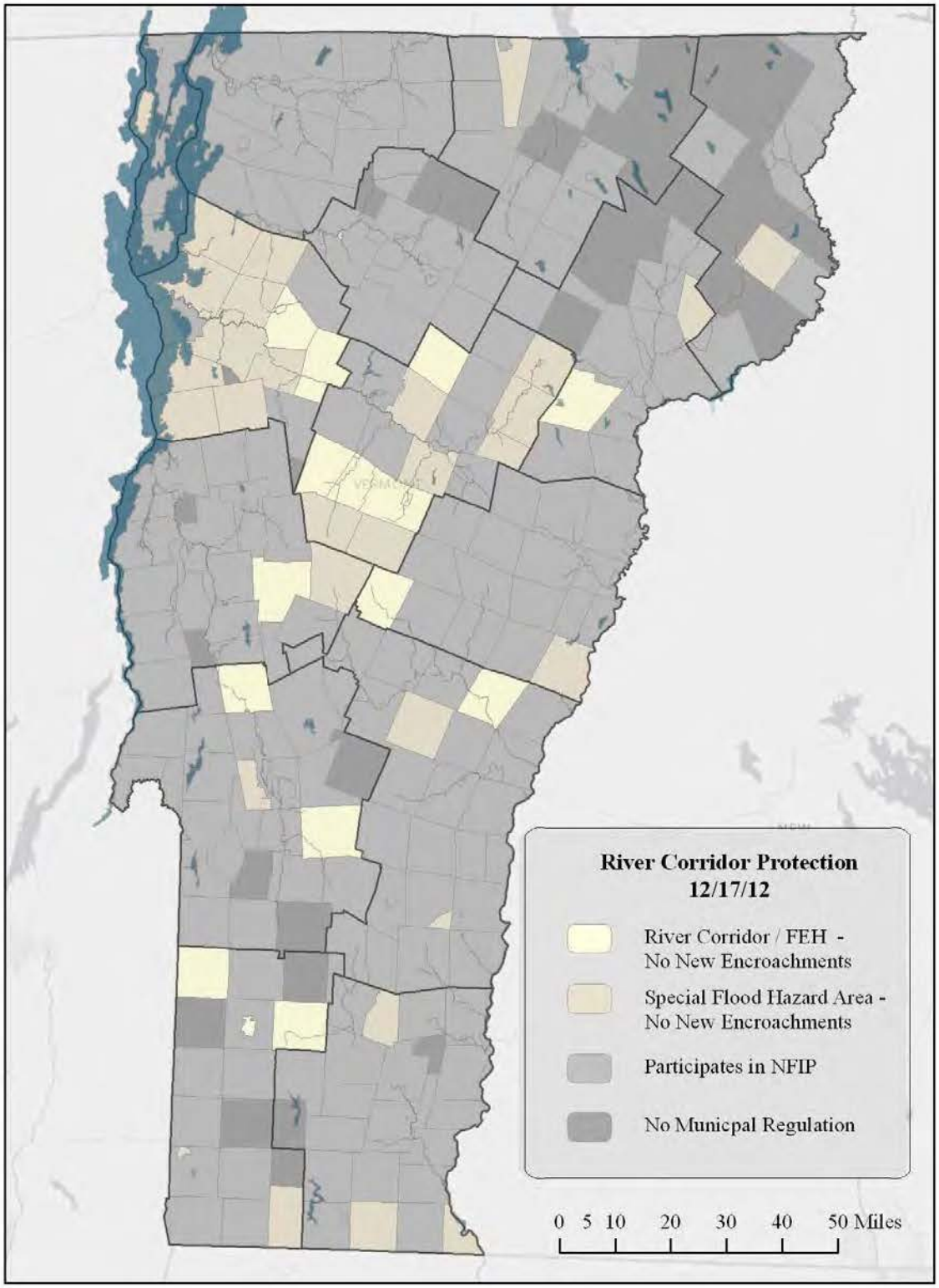
- Adoption of codes and standards to maximize the availability of federal funding;
- Ensuring that state, regional, and local hazard mitigation plans are updated and approved by FEMA;
- Coordination of ANR emergency operations with other agencies through the Incident Command System;
- Development of a flood disaster outreach program within the ANR.

Protecting natural processes that maintain water quality and aquatic habitat enables the State to avoid the cost of developing and maintaining artificial structures to capture/retain sediments and nutrients. These actions also represent an important component of the State's efforts to combat the ill effects of climate change, particularly in light of hydrologic models that predict a greater frequency of flash flood events and extreme storms. The three distinct and major floods events of 2011, culminating with Tropical Storm Irene, provided a blatant reminder of how critical our natural systems are to reducing our vulnerability and to bolstering our resilience.

Appendix 1a: Municipally Adopted River Corridor and Floodplain Protection Bylaws (as of 12/17/12)

Community	River Corridor	SFHA		Community	River Corridor	SFHA
Bakersfield	Yes			North Bennington Village		Yes
Baltimore		Yes		Northfield	Yes	Yes
Barnard		Yes		Peacham	Yes	Yes
Bennington	Yes			Plainfield		Yes
Berlin		Yes		Readsboro		Yes
Bolton	Yes	Yes		Richmond		Yes
Braintree	Yes			Ripton	Yes	Yes
Brandon	Yes	Yes		Roxbury		Yes
Cabot (interim)		Yes		Rupert	Yes	Yes
Charlotte		Yes		Sharon	Yes	Yes
Colchester		Yes		Shelburne		Yes
Essex, Town of		Yes		Shrewsbury	Yes	Yes
Essex Junction		Yes		South Burlington		Yes
Fayston	Yes	Yes		Stowe	Yes	
Granby		Yes		Thetford		Yes
Granville		Yes		Troy		Yes
Halifax		Yes		Vernon		Yes
Hinesburg	Yes	Yes		Waitsfield	Yes	Yes
Isle La Motte		Yes		Warren		Yes
Jeffersonville		Yes		Westford		Yes
Jericho	Yes	Yes		West Rutland		Yes
Kirby		Yes		Williston		Yes
Manchester Village	Yes	Yes		Windham		Yes
Marshfield		Yes		Winhall	Yes	Yes
Middlebury	Yes			Winooski		Yes
Middlesex		Yes		Worcester	Yes	Yes
Milton		Yes				
				Total	**20**	**48**
				Total 2011 (10/25/10)	13	25
				Percent increase	65%	52%

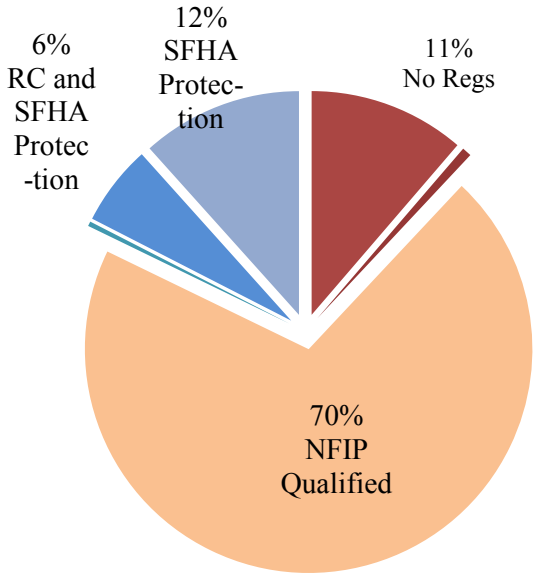
Municipal Bylaws Protecting River Corridors and Floodplains



Municipal Bylaw Outreach to Communities in 2011-2012

Many communities in Chittenden and Washington Counties have recently taken action to protect river corridors and /or floodplains. The effort to review and update flood hazard bylaws was required to meet deadlines for new FEMA Digital Flood Insurance Rate Maps (DFIRMs). A few communities in Windham, Windsor, and Rutland Counties have recently updated their bylaws and standards after their interim regulations (adopted for DFIRM deadlines) approached expiration. There is currently a Preliminary DFIRM in Bennington County, and communities in that county are beginning to update their bylaws.

Outside of the DFIRM-adoption process, a few communities have begun or completed a process of joining the National Flood Insurance Program (NFIP) in response to local direct experience with flood events and related damage. Several communities in the Northeast Kingdom have expressed interest in the NFIP and are considering model, no encroachment-based bylaws as a way to protect remaining floodplain functions and to minimize sophisticated administrative permitting processes. Other communities in the Northeast Kingdom and elsewhere in the state have undertaken updates to their municipal plans and/or zoning and have sought to incorporate current standards to prohibit new encroachment.



Of the fourteen communities that updated their zoning language or flood hazard area regulations in the past year, nine were communities that addressed flood hazard standards to join the NFIP or to prepare for an updated DFIRM. Eight of the nine communities adopted no encroachment standards. Of the other five communities that made some independent change to their zoning text in 2011, two of the five adopted higher standards.

The flood plain section of the Rivers Program website http://watershedmanagement.vt.gov/rivers/htm/rv_floodhazard.htm provides support to communities managing their river corridors and floodplains. Outreach to communities has occurred at statewide conference events such as the VLCT Planning and Zoning Conference as well as workshops and presentations sponsored by the Windham and Bennington Regional Commissions.

	2011-2012 Community Outreach Contacts
30	Conference contacts
50	Regional workshop contacts
19	DFIRM update communities
32	NFIP Outreach communities
4	Independent requests by communities
135	Total

Appendix 1b: Status of River Corridor Assessment, Outreach, Planning and Mapping (as of 12/17/2012)

Description	# of Towns
FEH language, map, or equivalent adopted as an ordinance	20
FEH map incorporated into current or draft Pre-Disaster Mitigation Plan	37
FEH language, map, or equivalent incorporated into Town Plan	9
Draft FEH maps completed	88
River Corridor Plan underway or completed	117
Phase 2 stream geomorphic assessment underway or completed (prerequisite for FEH map development)	140
Phase 1 stream geomorphic assessment underway or completed (prerequisite for Phase 2 SGA)	194
Conducted preliminary outreach	153
No action yet	53

Appendix 2: 2011- 2012 River Corridor Activity Summary

The River Corridor & Floodplain Management Section has been active in providing technical assistance to municipalities and individual landowners regarding river corridor protection and flood/fluvial erosion hazard mitigation across Vermont. Below is a summary of river corridor protection-oriented activities completed or underway in 2011-2012, organized by River Basin and watershed. These activities include Phase 1 and 2 stream geomorphic assessment (SGA), river corridor planning, Fluvial Erosion Hazard (FEH) mapping, project implementation.

Basin 1 – Batten Kill, Walloomsac, Hoosic

Batten Kill

The Watershed Management Division continues to provide technical assistance to the Batten Kill Corridor Planning Steering Committee and has been successful at moving projects toward implementation on the Batten Kill. The committee decided to focus some effort on the White Creek and Mill Brook tributary to the Batten Kill because it is an unstable system that contributes excessive sedimentation into the system.

Corridor Planning is ongoing in the White Creek and Mill Brook. Many restoration projects have been identified including river corridor protection, replacing undersized structures and removing or relocating berms. Buffer plantings are underway within the watershed at strategic locations.

Post Tropical Storm Irene, the Vermont Land Trust and Vermont Rivers Program monitored our three river corridor easement sites for channel migration and instability. We found the sites functioned as expected by flooding the floodplains and storing sediment on the floodplain and in channel bars. Because of the easements the adjustments will remain and there is no opportunity to dredge, armor or re-channelize the streams so they will continue working toward stability and equilibrium.

The Watershed Management Division continued to provide technical assistance toward the removal of the Dufresne Dam. Due to permitting delays the removal was rescheduled for 2013.

During the river corridor planning process the Watershed Management Division staff met with towns and outlined each town's options for improving their river corridor protection and reducing flood hazards. This outreach resulted in Arlington, Dorset, Manchester, Rupert, Sandgate, Sunderland and Woodford broadening their flood hazard language in their town plans to describe river corridor protection as a planning priority.

Roaring Branch

The Rivers program, in partnership with the Town of Bennington, completed Phase I and Phase II of a large flood plain restoration project along the Roaring Branch. Bennington is situated in a particularly hazardous location on an alluvial fan at the foot of the Green Mountains. The Roaring Branch is a tremendously dynamic and powerful force at times of flood, delivering astounding volumes of boulders, rock and woody debris into the urbanized area. For 150 years or more, this municipality and its residents have struggled with the river, attempting to confine it and control it with a system of earthen berms and structural levees.

Unfortunately for village residents and town taxpayers, the river has won most of the contests, breaching and then catastrophically avulsing through the berms, inundating residential and industrial areas, and devastating public infrastructure including roads and bridges. Each flood would trigger a spasm of channel dredging and reconstruction of the temporary and inadequately confining structural elements along the channel margins. These channelization practices did not provide long-term protection of the property and infrastructure behind the berms. Rather, these structures remained extremely vulnerable to the next flood.

In 2008, Bennington formed a partnership with the DEC and initiated a public process to adopt Fluvial Erosion Hazard (FEH) bylaws in which additional development encroachments into currently undeveloped areas of the river corridor are prohibited. The ordinance model and FEH zone map were provided by the Rivers Program. Support for the town selectboard and planning commission through the adoption process was also provided by Rivers Program staff.

In response to the town adoption of the FEH bylaws, the Rivers Program pursued ERP (formerly C&C) funds to design and construct a major flood plain restoration project. This project consisted of removing 3,500 linear feet of earthen berms, involving over 35,000 cubic yards of earth and rock excavation, construction of a new engineered, armored berm set well back from the river, and the restoration of approximately 12 acres of functioning floodplain within a critical area of the village.

The partially completed project was severely tested by Tropical Storm Irene. While the project did receive some structural damage, it otherwise performed as anticipated and, in the opinion of Bennington town officials and DEC, damages in the project area would have been orders of magnitude worse, had the project not been implemented.

The Roaring Branch caused a partial breach of the new armored berm at the transition point where the flood plain narrows from the new restored section to the upstream approach to the Park Street Bridge. This damaged area has since been reconstructed as part of the town flood recovery operations.

Based on pre-project surveyed cross sections, an estimated 550,000 cubic yards of sediment, primarily composed of gravel, cobbles and boulders, was deposited in a one mile reach of the Roaring Branch from the confluence with the Walloomsac River to the VT 9 bridge. This provides a clear indication of how hazardous a situation exists in Bennington where an active alluvial fan through an urbanized area is confined to the width of the river channel, and why the restoration and protection of any overbank portion of the active fan is a critically necessary action for the protection of public safety.

The Watershed Management Division has been working with the Town of Bennington and its engineering consultants, Milone & MacBroom to excavate a large percentage of the sediment, to remove the confining berms and to extend and complete the designed flood plain restoration project up to the Branch Street, or 'Brooklyn" bridge.

River and flood plain restoration is was completed in early 2012.

Bennington Floodplain Restoration Project before construction: failing berm looking upstream from Park Street Bridge (left) and looking downstream toward Park Street Bridge (right)

Restored reach of the Roaring Branch with new floodplain access to attenuate floodwater and sediment

In addition the Watershed Management Division continues working with regional partners and consultants to attempt to identify and conserve floodplain parcels upstream on Bennington City in an effort to provide some flood storage during large events such as Tropical Storm Irene.

Basin 2 – Poultney, Mettowee

River restoration work continues in the Poultney-Mettowee basin. We look forward to working with the local partners on a new phase of outreach to local landowners and communities to work toward implementing the projects identified in the Mettowee Phase 2 report.

Hubbardton River

Floodplain restoration site in West Haven. The left picture shows new floodplain that was excavated; the right picture is post-construction under flood flows with the new floodplain being inundated. Photos courtesy of Paul Marangelo of The Nature Conservancy.

The Nature Conservancy applied for and received restoration funding to complete a project on their clay plain forest reserve in West Haven. The project consists of two small tributaries that are both highly incised and lack floodplain access. The first tributary was treated with woody debris jams to trap sediment and build up the bed of the stream, ultimately re-connecting it to its historic floodplain. The second tributary was treated by excavating a new floodplain at a lower elevation to improve storage of sediment and flood waters during high flows. This paired tributary approach will be monitored closely over time to see which treatment best improves the stream function and water quality.

In 2011 TNC continued their work to restore these channels. They completed a riparian buffer planting and installed a grade control structure to prevent further bed scour. Early monitoring of the project indicates the floodplain has been accessed and both the floodplain and channel have aggraded to by storing measurable sediment, keeping it from entering the Hubbardton River and ultimately Lake Champlain.

Mettowee River

The Watershed Management Division has continued to support the Mettowee River Corridor Planning effort with our partners. We have developed a list of the top ten projects that would work toward restoring the water quality and stream equilibrium. Outreach to landowners is ongoing to work toward implementing the high priority projects in the watershed.

Basin 3 – Otter Creek, Little Otter, Lewis Creek

Middlebury River – The Town of Middlebury

Work continues with corridor planning on the Middlebury River. The Watershed Management Division staff has provided technical assistance to both the Addison County Regional Planning Commission (ACRPC) and the Town of Middlebury toward adopting a River Corridor Protection bylaw to protect the river corridor from future encroachment. The WMD worked with the town to draft the bylaw and complete outreach to affected landowners and interested parties about the benefit of the bylaw. The selectboard adopted a bylaw protecting both the mapped floodplain and erosion hazard areas in December 2012.

New Haven River

The Watershed Management Division is working with a consultant to develop a River Corridor Plan to outline strategies to improve water quality and reduce hazards on the New Haven River in Bristol and New Haven. The Watershed Management Division has worked with partners at the Farm Service Agency and Natural Resource Conservation District to implement both CREP and River Corridor Easement at strategic sites within the watershed. Great progress was made in 2012 as we have received agreement from 2 landowners to do large scale riparian plantings and implement the River Corridor Easement on a very dynamic area of the New Haven River.

River Corridor Area to be conserved on New Haven River

Neshobe River

The Watershed Management Division has been involved in a river corridor planning project on the Neshobe River in Brandon. The corridor plan was drafted and released to the public in 2011 and many projects were identified to help restore the natural function of the watershed. A very well attended public meeting was held in early September 2011 where residents came to learn and express concern over river flooding and channel adjustment during TS Irene. As a result the town of Brandon has adopted a zoning ordinance to prevent and future encroachment into the floodplain and erosion hazard zone.

2011 NAIP aerial image of one of the post Irene Neshobe River corridor protection priority sites. The Neshobe River broke through a large boulder berm and scored new channels through the field. This is a site where the landowners have recognized the inherent conflict in farming this location. The red outline is the river corridor to be protected.

Lewis Creek

Work continues on the Lewis Creek watershed to implement the River Corridor Plan. Last year a new committee was established to look into a planning process called the Watershed Initiative. A grant was established with the Lewis Creek Association where they provided scoping services for River Corridor Easements. Two river corridor easements have been funded using Ecosystem Restoration funds in 2012 to permanently protect floodplain function in strategic locations within the watershed.

Furnace Brook

The Watershed Management Division continues to provide technical assistance to the Town of Pittsford to develop a plan and design for the removal of Kendrick Dam on the Sugar Hollow Brook. This dam was identified as being a hazard and in need of repair or removal. The removal of this dam would improve sediment transport and floodplain function downstream and remove a significant flood hazard.

Basin 4 – Lower Lake Champlain

East Creek

In 2011 a River Corridor Plan was completed for the East Creek, a direct drainage to Lake Champlain. The plan was presented to stakeholders at a well-attended public meeting and some preliminary landowner contacts have been made. In 2012 we continued the landowner and community outreach to try to move projects toward implementation with a focus on restoring degraded wetlands within the watershed. A big part of the current effort includes field truthing and implementing projects from the Lake Champlain Wetland Restoration Plan. Ten top priority projects have been identified and vetted by the steering committee made up of ANR staff, consultants and local residents.

Basin 5 – Upper Lake Champlain, LaPlatte, Malletts Bay, St. Albans Bay, Rock and Pike Rivers

LaPlatte River

As a result of several years of extensive education, outreach and technical assistance provided to the Town of Hinesburg conservation commission, planning commission, and select board, the town recently adopted Fluvial Erosion Hazard mapping into town zoning regulations. In addition, several reaches of Phase 2 stream geomorphic assessment were completed on McCabes Brook, a major tributary to the LaPlatte located in Charlotte.

Rugg Brook

Surveying the LaPierre Restoration project was completed in Spring 2012. The extensive flood plain construction has provided significant benefits to the stream. After 5 years the site has continued to show success in providing floodplain access for flows, capturing significant amounts of sediment and nutrients. Vegetation plantings are well established, helping reduce flood flow velocities across the floodplain, as well as providing important habitat along the brook. The site will continue to be monitored in partnership with the CREP monitoring that occurs annually to track the buffer planting work.

Upper Rugg Brook

A stream day-lighting project was completed along 700 ft of Rugg Brook. Rivers Program staff, Northwest Regional Planning Commission and Collins Perley Sport Complex partnered together, to do stream restoration along the Rugg Brook tributary. The stream was historically culverted for over 300 ft. The restoration involved day-lighting the stream and removal of the culvert, restoring another 400 ft of stream to a more natural channel, and enhancing adjacent wetlands. Hundreds of plants and trees were planted to provide long term buffer and water quality benefits. The project also provides flood water attenuation for the watershed by providing a floodplain in the area previously culverted.

FEH Outreach and Technical Assistance

Educational outreach and technical assistance regarding fluvial erosion hazards was provided at the request of the Chittenden County Regional Planning Commission to the towns of Westford, Jericho, Underhill, Bolton, Huntington, Richmond, Hinesburg, Charlotte, Essex, Milton, and Colchester. Information was used to help update the local All Hazard Mitigation Plans and provide possible language for updates to the town plans and zoning.

Basin 6 – Missisquoi

Missisquoi River

Two river corridor easement projects have been completed along the South Branch Trout River and Upper Missisquoi River. Both projects are in key sediment attenuation areas and will reduce landowner conflicts with the dynamic nature of the river systems. These projects protect approximately 40 acres of river corridor and establish 2 stream-miles of vegetated buffers.

The project with the U.S. Department of Agriculture-Agriculture Research Service National Sedimentation Laboratory has been completed. The project involved evaluating the contribution of sediment and nutrient loading into Lake Champlain from unstable stream channels along the Missisquoi River main-stem and its tributaries. A total of 27 sites were evaluated throughout the Missisquoi Basin. Results show that stream bank erosion contributes approximately 36% (31,600 t/yr) of the total suspended sediment (TSS) load, and approximately 36% (52.0 t/yr) of the Total Phosphorus (TP) at the mouth of the Missisquoi. Best management practices were evaluated for reductions in TSS and TP load; and can achieve reductions of approximately 12-85% and 29-84% respectively. These practices require a long term protection of riparian vegetation and corridors to achieve the highest load reductions over time.

A river corridor plan was developed for approximately 30 miles the Upper Missisquoi River from North Troy to Lowell. The corridor plan identifies several types of projects and corridor protection opportunities that the local watershed group, Missisquoi River Basin Association and agency partners, such as CREP, will be able to use to help prioritize and pursue for implementation. Data will also be used to support the development of Fluvial Erosion Hazard maps.

School group volunteers planting riparian buffer

Five riparian buffer sites were planted the Missisquoi Basin with the "Trees For Stream Program" with the Franklin Natural Resources Conservation District. This program supports volunteer buffer projects, particularly on lands that do not qualify for other state or federal programs. The program involved school groups and local volunteers to plant, 1,430 trees on over 6 acres of stream bank.

Rock River

Monitoring of the Rock River tributary restoration project was completed this year. The site continues to show improvements in floodplain connection, providing important sediment and nutrient storage in the impaired watershed. The site will be monitored for 5 years. Significant habitat and water quality improvements have occurred with buffer installation and removal of access to the stream by cows.

FEH Outreach and Technical Assistance

Educational outreach and technical assistance regarding fluvial erosion hazards was provided at the request of the Northwest Regional Planning Commission to the town of Montgomery. The community is in process of revising their town plan and is interested in helping find ways to make the community better prepared for flood issues. Work will continue with Montgomery in 2013 as the town plan is developed.

Basin 7 – Lamoille

Browns River

Through an Ecosystem Restoration Program grant, work along the Browns River to remove 4 old bridge abutments and an undersized farm bridge was completed. A new 60 ft. wide bridge was installed in place of the old undersized 35' farm bridge. The work was done with the Winooski Natural Resource Conservation District, Rivers Program Staff, the Lamoille Basin Planner, and a very helpful landowner. This project provided significant improvement to an area of the Browns River that has historically had erosion issues due to undersized bridges.

Browns River, New Bridge Deck

Lamoille River

Work with Green Mountain Power (formally CVPS) under their FERC relicensing process has provided a riparian inventory in areas influenced by GMP dams. Assistance from the Rivers Program and the Lamoille Basin Planner provided prioritization of areas and potential opportunities for implementation of riparian buffer planting and potential conservation easements in those areas. Work will continue in 2013 with landowner meetings and implementation where feasible.

Village of Jeffersonville during spring flooding. Yellow box indicates area of floodplain protection

Brewster River

The Village of Jeffersonville was significantly flooded 2 times in 2011. With support from the Lamoille County Regional Planning Commission (LCPC) and the Rivers Program staff, the village moved forward with passing more restrictive floodplain bylaws that will prevent further encroachments in the floodplain. The village also decided to purchase an important floodplain area to preserve the floodplain functions of conveyance and storage that had been observed during the flooding events. Funding for a floodplain easement was awarded to the Village through the Ecosystem Restoration Program. The community is currently developing their All Hazard Mitigation Plan with assistance from LCPC. As part of that effort, the stream geomorphic assessment has been done on the Brewster River to help support the community with their effort to understand their flooding issues and opportunities for corridor projects.

FEH Outreach and Technical Assistance

Educational outreach and technical assistance regarding fluvial erosion hazards was provided at the request of the Lamoille County Regional Planning Commission to the towns of Hyde Park, Elmore and Wolcott. Towns are currently revising their town plans and have requested assistance in looking at their floodplain language. Work will continue in 2013 as the towns revise their plans.

Basin 8 – Winooski River

Pekin Brook

Work continues to secure a river corridor easement on a high priority parcel along Pekin Brook, a major tributary to the Kingsbury Branch of the Winooski River. This project will protect ~31 acres of river corridor on an extremely sensitive reach of Pekin Brook and a small section of an unnamed tributary. However, landowners have recently become difficult to contact and it is uncertain if the project will continue to move forward.

Mad River

Project development has also continued in the Mad River sub-watershed, and thus far has resulted in a donated river corridor easement that permanently protects 8.5 acres of very highly sensitive river corridor.

In a partnership with Vermont Land Trust and Friends of the Mad River, many other parcels in this watershed have been targeted for outreach and development of river corridor easement projects. For all of the project development efforts mentioned above, significant technical assistance was provided to project partners in the development of river corridor maps for targeted parcels and corridor easement valuation estimates.

In response to damages incurred from Tropical Storm Irene, the Mad River Cooperative organized an educational event about river dynamics and flood resiliency. Rivers staff provided a presentation focusing on basic river science and actions that can be taken to increase a community's resilience to flooding.

Extensive education and outreach has, and continues to be, provided to the Warren planning commission and zoning administrator as the town seeks to adopt Fluvial Erosion Hazard mapping into their town zoning regulations. The town has held public education events around the topic, at which the flume was presented by Rivers Program staff. Program staff also assisted in a detailed parcel analysis to determine the potential impact of new zoning regulations to individual landowners, and met one on one with landowners at their request to discuss the fluvial erosion hazard map in depth. It is anticipated that Rivers program staff will continue to provide assistance to Warren as they move forward with the ordinance adoption process.

Little River

Rivers Program staff provided technical assistance to the Town of Stowe and Lamoille County Regional Planning Commission in their efforts to stabilize an actively migrating meander bend of the West Branch Little River that was threatening a cemetery adjacent to the Quiet path. The project included planting of a riparian buffer and an educational sign explaining the river dynamics of the site. The project's end result is enhanced river stability for the West Branch, improvement of riparian and in-stream habitat conditions, and reduction of conflict between town infrastructure (the path and a cemetery) and dynamic river processes.

In partnership with the Natural Resources Conservation Service (NRCS), several agricultural parcels on the main stem Little River are being targeted for outreach for water quality enhancement and land conservation practices. Rivers program staff have provided technical assistance in the development of river corridor easement maps and valuation estimates, and work will continue to develop these projects further in the coming year.

One River Corridor Easement on the main stem Little River in Stowe's lower village is scheduled to be closed by Stowe Land Trust in December 2012. This easement will protect 14.4 acres of extremely sensitive river corridor from encroachment and channel manipulation in perpetuity, and abuts a parcel that was protected with a River Corridor Easement several years ago.

Stevens Branch and North Branch

Project development has continued in the Stevens Branch and North Branch sub-watersheds. A river corridor easement that was to be completed in 2012 fell through due to landowner pulling out of the project with no explanation provided. The North Branch sub-watershed continues to be a focus for the Vermont River Conservancy for developing river corridor easement projects, and Rivers Program staff have assisted in these efforts. One river corridor easement project was executed on the North branch in 2011, and several other landowners have expressed interest in pursuing easements. Work will continue with watershed partners to develop these projects.

Dog River

A river corridor easement on the Dog River in Northfield is currently under development and is scheduled for completion in 2013. This project will conserve 7.4 acres of river corridor with the Vermont River Conservancy in an extremely important location for increasing flood resilience in the Village of Northfield. Located just upstream of extremely flood-prone Water Street, this project will ensure that the Dog River will be able to access important floodplain and work towards establishment of stream equilibrium conditions in a location critical for flood hazard mitigation downstream in downtown Northfield.

Main Stem of the Winooski

An effort to remove the Marshfield-8 dam in Marshfield was completed in the summer of 2012 with funding from the U.S. Fish and Wildlife Service and a remediation fund. This dam was in disrepair and no longer served a functional purpose. The project was initiated by the dam owner due to concerns over the dam's safety. Completion of the project has resulted in restored sediment continuity and fish passage to a damaged reach along the main stem of the Winooski River.

In response to severe flooding on Great Brook in Plainfield in the spring of 2011, the town of Plainfield developed a Flood Advisory Committee to guide a flood resiliency initiative. Rivers staff provided the committee with technical assistance in the form of an educational presentation (including the flume) on river dynamics, options for increasing flood resilience, and education about possible funding options for these efforts. The group secured its own funding to initiate a Phase 2 stream geomorphic assessment of Great Brook, which was initiated in the Fall of 2012. It is anticipated that Rivers staff will continue to provide assistance to this group in the upcoming year as more stream geomorphic assessment is completed, a river corridor plan written, and a fluvial erosion and landslide hazard map is developed in 2013.

Basin 9 – White River

Upper White Main Stem, Tweed River, and Lower Main Stem White River

Project development continues on the Upper White and Tweed Rivers. These efforts have included discussions with landowners about corridor easements and riparian plantings, as well as identifying culverts that are geomorphically unstable and/or barriers to fish passage, and in need of retrofit or replacement. Technical assistance from Rivers Program staff have facilitated these efforts through landowner meetings, creation of parcel-specific river corridor maps, and estimating values of river corridor easements. A river corridor easement was executed on a parcel along the Upper White main stem in Granville in partnership with Vermont Land Trust (funded by Upper Connecticut Mitigation Enhancement Fund). The White River watershed was particularly hard hit by tropical storm Irene, and many potential river corridor protection projects have been identified as a result of the damage to public and private property experienced during this storm. It is expected that River Program staff will continue to provide technical assistance to watershed partners in the coming year to further develop these opportunities.

First Branch White River

A Phase 2 stream geomorphic assessment of the entire First Branch main stem and major tributaries was initiated in 2012. Fieldwork will resume in 2013 and culminate in the creation of a river corridor plan and associated fluvial erosion hazard map. Rivers program staff participated in preliminary outreach to the Chelsea planning commission regarding flood hazard regulations in 2012 at the request of the town and the Two Rivers Ottauquechee Regional Planning Commission.

Second Branch White River

A river corridor easement was executed on an agricultural parcel on the second branch of the white river with funding from the Upper Mitigation Enhancement Fund. This subwatershed does not yet have

Phase 2 stream geomorphic assessment, and Rivers Program staff provided technical assistance educating the landowners about river dynamics, delineating the river corridor in the field, and providing an estimate of the easement value.

Third Branch White River

The town of Bethel organized a flood hazard committee in the wake of Tropical Storm Irene to explore flood resilience options. River program staff provided a flume demonstration at an educational meeting organized by this group. With the support of this group, the White River partnership secured funding to initiate stream geomorphic assessment of the main stem White River and Third Branch White River within the town of Bethel, to be initiated in 2013. It is anticipated that Rivers Program staff will continue to provide technical support for this project in the coming years.

Basin 10 – Black River

Main Stem Black River

Phase 2 stream geomorphic assessments and corridor planning were completed on the Black River between Lake Rescue and Echo Lake, as well as some of the major tributaries upstream of Lake Rescue. It was anticipated that results of this assessment would provide some insight into potential sources of sediment causing anecdotal changes in depositional features in Round Pond in the northern end of Lake Rescue. However, Tropical Storm Irene caused such severe aggradation of sediments in Lake Rescue that is appears a dredging project will move forward in that area irrespective of the results of the stream geomorphic assessment.

In 2011, upon request by the Southern Windsor Regional Planning Commission and the Town of Cavendish Planning Commission, educational outreach and technical assistance were provided regarding adoption of Fluvial Erosion Hazards into town flood hazard regulations. Damages caused by Tropical Storm Irene have renewed the town's interest in pursuing adoption of fluvial erosion hazard regulations, and Rivers Program staff have been working with the town to map a unique area dubbed the "Cavendish Canyon" for inclusion in the erosion hazard map. This is an area where the river avulsed and bypassed a natural rock gorge during Tropical Storm Irene, an occurrence that was known to happen during the flood of 1927 and 1976 as well. Rivers staff continues to work with the town on adoption of a fluvial erosion hazard map into town regulations.

The "Cavendish Canyon", a special case of river avulsion being mapped for inclusion in the Black River Fluvial Erosion Hazard area.

The town of Cavendish applied for and received funds from the Ecosystem Restoration Program to conserve several key river corridor parcels within the town of Cavendish along the Black River. Rivers Program staff have been providing technical assistance on this project, as well as several riparian planting projects being initiated by the local watershed group, the Black River Action Team.

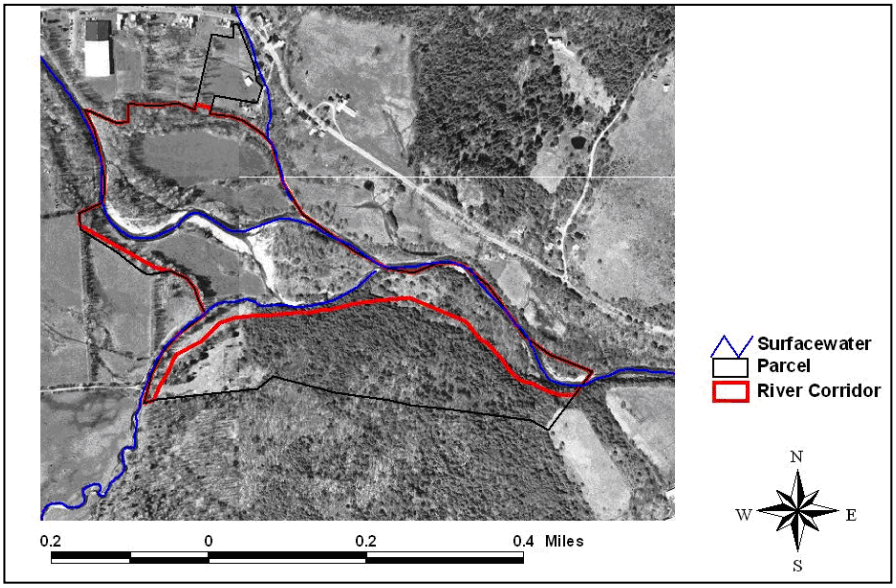
Ottauquechee River

A Phase 1 and Phase 2 stream geomorphic assessment was completed on the mainstem Ottauquechee River in 2012. Data associated with this project are currently under review, and a river corridor plan and fluvial erosion hazard map are expected to be completed in early 2013. Additional assessment on key tributaries is planned for 2013, as well. These assessments will lay the groundwork for much needed development of river corridor protection projects in the Ottauquechee watershed,

Basin 11 – West, Williams, and Saxtons Rivers

Saxtons River

The River Corridor Plan is complete for the Saxtons River and project implementation is underway within the basin. One easement on the Bull Creek has been implemented by the Vermont Land Trust conserving 16 acres of prime floodplain and river corridor. In addition the Watershed Management Division is working with the Vermont River Conservancy to acquire the second river corridor easement within



the Saxtons river watershed. The easement is approximately 70 acres and was identified as a high priority as it is a very dynamic alluvial fan section at the confluence of the Bull Creek and Saxtons River. The property stores a tremendous amount of sediment and flood waters in the watershed and is also the highest sensitivity to modifications and would be a hazardous place for any development.

Many new assessments are underway in Basin 11 including a Phase 1 and 2 geomorphic assessments of the Williams River and a Phase 2 Geomorphic Assessment and River Corridor Plan of both the Winhall River and Wardsboro Brook. All three of these watersheds experienced severe damages during the Irene flood and are in need of further assessment efforts to determine what can be done to mitigate future damages.

Basin 12 – Deerfield River

The Deerfield River Corridor Planning effort is underway in 2012 where work continues to update the prior assessment and determine where to focus our efforts to restore the watershed after downtown Wilmington was severely flooding in Tropical Storm Irene.

A Phase 1 and 2 Geomorphic Assessment is beginning on the Green River, a tributary to the Deerfield River.

Basin 13 – Lower Connecticut River, Mill Brook

Whetstone and Crosby Brook

The Watershed Management Division worked with a diverse group of people in the West Brattleboro area to acquire one of the few remaining floodplains in the area. The property was transferred to a local nonprofit and will be used for community gardens and recreation land. The Whetstone Brook will have access to the floodplain and be able to move at will within the property in perpetuity.

A floodplain restoration project was completed in the lower Crosby Brook to restore floodplain function and plant trees to stabilize the banks.

Crosby brook restoration project. Photo to left shows addition of large woody debris to slow water and trap sediment. Photo to right shows vegetative stabilization of bank to prevent future failure and addition of sediment to the brook.

Crosby Brook restoration project: note lowered terrace to increase flood water and sediment storage and plantings to stabilize slope.

Basin 14 – Waits, Wells, Ompompanoosuc, and Stevens Rivers

Waits River and Wells River

The recent completion of the Waits River Corridor Plan has transitioned into project development efforts. One river corridor easement project that was expected to be executed in 2012 fell through due to an unexpected death of the landowner. A new project development effort is scheduled to take place in 2013 with a focus on the Wells River in Newbury.

Ompompanoosuc River and Stevens River

A Phase 2 stream geomorphic assessment was completed in the Ompompanoosuc watershed in the Towns of West Fairlee and Thetford. Phase 2 stream geomorphic assessment was also completed in the Stevens River watershed in the Towns of Barnet and Peacham. The resulting River Corridor Plans from both the Ompompanoosuc and Stevens River Phase 2 stream geomorphic assessments are complete, and additional reaches were assessed on the Ompompanoosuc River in 2012 within the towns of Thetford and Norwich. In response to severe flooding in the Spring of 2011, the town of Peacham adopted the river corridor map developed as a result of the Phase 2 stream geomorphic assessment into their town zoning regulations. Peacham does not have a National Flood Insurance Program for their community (a map usually provided by FEMA), and so is using the river corridor map in lieu of a floodplain map.

Basin 15 – Passumpsic

Work with the Caledonia County Natural Resource Conservation District (CCNRCD) has continued with Phase 1 and Phase 2 assessments in the Passumpsic watershed. River corridor plans were completed for West Branch Passumpsic and East Branch Passumpsic River. The corridor plans have helped support work in the towns of Lyndon and Burke to develop projects for riparian planting, prioritizing potential easement locations, and potential areas of flooding concern to be identified in the town's All Hazard Mitigation Plan. Additional work has started in the Lower Passumpsic community of Danville to

help support development of river corridor maps and assisting the town with developing their Hazard Mitigation Plans and Floodplain language for their community.

10/1/2010 Flooding at LynBurke Motel, Rte 5.

East Branch Passumpsic high erosion hazard and ice jam area.

FEH Outreach and Technical Assistance

Educational outreach and technical assistance regarding fluvial erosion hazards was provided at the request of the town of Burke. Meetings with Burke show a community ready to move forward with becoming more prepared with flood planning and using Phase 1 and Phase 2 data and FEH maps to help them move forward with updates to their town plan and zoning. Work will continue in 2013 as the town develops their town plan.

Basin 16 – Upper and Mid-Connecticut River Drainages

Leach Stream

An important river corridor easement was completed with the Vermont Land Trust on Leach Stream just outside the village of Canaan. The corridor protects 22 acres and 5,300 ft of stream bank. The corridor will provide important floodplain functions, storing water and sediment during flooding events; while also providing important habitat in the area through enhanced buffers along the stream.

Blood Brook

At the request of the Two Rivers Ottauquechee Planning Commission and the Town of Norwich, an FEH map was finalized on Blood Brook based on previously collected Phase 2 data. The town of Norwich recently expressed renewed interest in FEH adoption and, after a presentation by Rivers Program staff to the town planning commission, requested a parcel analysis to determine the potential parcel-level impacts from adoption of a new regulation. It is anticipated that Rivers Program staff will continue to provide technical assistance as the town considers adoption of new flood hazard regulations.

Basin 17 – Lake Memphremagog, Black, Barton, Clyde, and Conticook

Black River

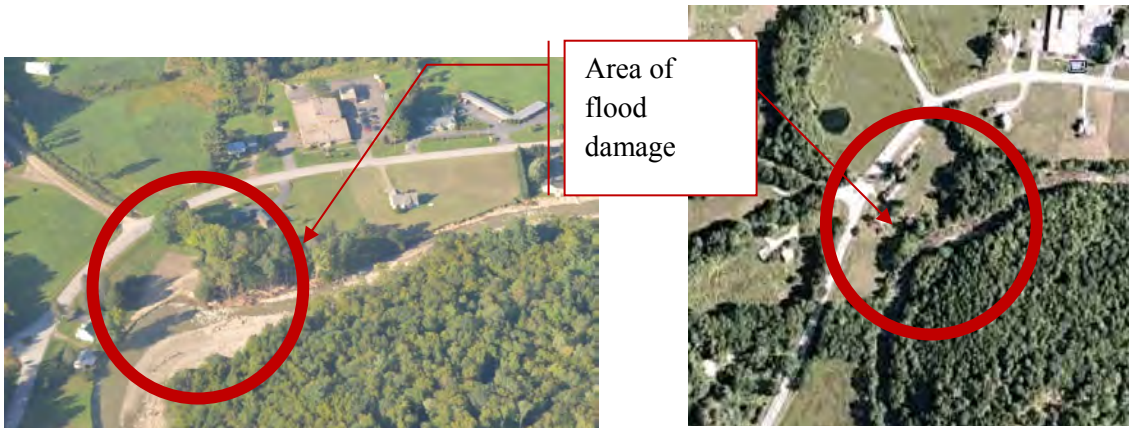
The Black River corridor plan and initial project identification was completed in early 2011. Information has been used to begin work with the Orleans Natural Resource Conservation District and other partners in the watershed to identify riparian planting opportunities and priorities for conservation easements. Work in 2013 will be to determine other assessment needs and begin working with towns on river corridor/FEH opportunities.

Education / Outreach

Flume Workshops	
8	River/Road and Aquatic Organism Passage road crew workshops
13	Community education and development around geomorphic assessment and FEH efforts
4	Water quality, stream dynamics, and permitting education for Act 250 District board member and ANR leadership team
5	Lake Shore workshops with NRPC and ANR lakes seminar looking at lake flooding topics, concerns, and opportunities
2	Floodplain and Alluvial Soils, management strategies to reduce soil loss from river related process
2	Conference presentations ; Vermont League of City and Towns and VTrans Annual Contractors conference

Tropical Storm Irene Flood Related Work

Rivers staff assisted with 4 flights in September to document flood related damages. Photos from the flights are being geo-tagged and linked to Google Earth to be able to provide long term tracking and easier access to information on particular sites that were damaged.



Chester VT, Photo after Irene 9/9/2011

Chester VT, Google Earth Image, pre-Irene 2009

Rivers staff worked with the six southern Regional Planning Commissions to conduct debris and damage surveys in 43 communities most impacted by flooding from Irene. Information will provide damage assessments to create maps, update Hazard Mitigation Plans, and look for funding assistance and opportunities.

Assistance with site visits for debris removal location and priority needs were provided by River Program staff. Rivers staff also provided technical assistance to contractors and other agency employees in survey, design, and interpretation of available physical stream data in channel restoration efforts resulting from Tropical Storm Irene. Staff worked with volunteers from the Vermont Geological Society to document flooding impacts in select locations.

Appendix 3: Municipally Adopted Buffer Bylaws, As of 2007

Table 7 presents the current status of municipal zoning with respect to buffers and setbacks on rivers and lakes. (Note the Watershed Management Division does not guarantee its accuracy since it is a bit dated, but it is correct to the best of our knowledge.)

Local Buffer Setback Provisions

Town	Lake(s) 20 acres or larger	Stream buffer width	Lakeshore buffer width	Building setback from stream and/or lake
Addison	Y	-	-	100 ft
Albany	Y	-	-	-
Alburgh	Y	-	-	-
Andover		-	-	-
Arlington		-	-	-
Athens	Y	-	-	-
Averill	Y	50 ft	50 ft	100 ft
Averys Gore		50 ft	50 ft	100 ft
Bakersfield		~100 ft	-	100 ft
Baltimore		-	-	-
Barnard	Y	-	50 ft	50-100 ft
Barnet	Y	-	-	100 ft
Barre City		-	n/a	-
Barre Town		-	-	50 ft
Barton	Y	-	-	25 ft
Belvidere		-	-	-
Bennington	Y	-	-	50 ft
Benson	Y	-	-	75 ft
Berkshire		-	-	yes
Berlin	Y	-	-	75 ft
Bethel		-	-	-
Bloomfield		-	n/a	-
Bolton		25-75 ft	100 ft	50-200 ft
Bradford		-	-	35-50 ft
Braintree		-	-	100 ft
Brandon		-	-	yes
Brattleboro	Y	yes	40-50 ft	50-100 ft
Bridgewater		-	n/a	-
Bridport	Y	-	-	-
Brighton	Y	-	30 ft	-
Bristol	Y	-	-	50 ft
Brookfield	Y	-	-	75 ft
Brookline		-	n/a	-
Brownington	Y	-	-	-
Brunswick	Y	-	-	-
Burlington	Y	-	-	50-250 ft
Cabot	Y	-	50 ft	75 ft
Calais	Y	20 ft	50 ft	150 ft
Cambridge		-	-	-

Town	Lake(s) 20 acres or larger	Stream buffer width	Lakeshore buffer width	Building setback from stream and/or lake
Canaan	Y	-	-	50 ft
Castleton	Y	-	-	-
Cavendish	Y	-	-	-
Charleston	Y	-	-	-
Charlotte	Y	-	-	100 ft
Chelsea		-	-	35 ft
Chester		-	-	-
Chittenden	Y	-	-	-
Clarendon		-	-	-
Colchester	Yes	85 ft	100 ft	100 ft
Concord	Y	-	-	35 ft
Corinth		-	n/a	-
Cornwall		-	n/a	-
Coventry		-	-	-
Craftsbury	Y	-	-	-
Danby	Y	-	-	-
Danville	Y	-	-	-
Derby	Y	-	-	25 ft
Dorset	Y	?	50 ft	50 ft
Dover		?	n/a	?
Dummerston		-	n/a	50 ft
Duxbury		-	n/a	-
East Haven		-	-	-
East Montpelier	Y	?	?	?
Eden	Y	-	-	-
Elmore	Y	-	40-100 ft	40-100 ft
Enosburg		-	-	-
Essex	Y		150 ft	150ft
Essex Junction		?	n/a	?
Fair Haven	Y	-	n/a	50 ft
Fairfax	Y	-	-	-
Fairfield	Y	-	-	75 ft
Fairlee	Y	50 ft	50 ft	50 ft
Fayston		-	n/a	?
Ferdinand	Y	50 ft	50 ft	100 ft
Ferrisburg	Y	-	-	80 ft
Fletcher	Y	-	40 ft	40 ft
Franklin	Y	-	-	25-50 ft
Georgia	Y	50 ft	50 ft	50 ft
Glastenbury		-	-	-
Glover	Y	-	-	-
Goshen	Y	-	-	-
Grafton		-	-	-
Granby	Y	-	-	-
Grand Isle	Y	-	75 ft	75 ft
Greensboro	Y	25 ft	50-300 ft	150 ft
Groton	Y	-	-	40 ft
Guildhall		-	n/a	75 ft
Guilford	Y	-	-	-

Town	Lake(s) 20 acres or larger	Stream buffer width	Lakeshore buffer width	Building setback from stream and/or lake
Halifax	Y	-	-	75 ft
Hancock		-	-	-
Hardwick	Y	25 ft	25 ft	75 ft
Hartford	Y	100 ft	30 ft	-
Hartland	Y	-	-	-
Highgate	Y	-	-	10 ft
Hinesburg	Y	-	-	75 ft
Holland	Y	-	-	-
Hubbardton	Y	-	25 ft	25 ft
Huntington		-	n/a	-
Hyde Park	Y	-	-	100 ft
Ira		-	n/a	-
Irasburg		-	-	-
Isle la Motte	Yes	-	-	-
Jamaica	Y	-	-	-
Jay		-	n/a	-
Jericho		-	-	-
Johnson		-	-	-
Killington	Y	-	150 ft	200 ft
Kirby		-	-	-
Landgrove		-	n/a	-
Leicester	Y	-	-	75 ft
Lemington		-	n/a	50 ft
Lewis	Y	50 ft	50 ft	100 ft
Lincoln		-	n/a	25 ft
Londonderry	Y	`		
Lowell	Y	-	-	-
Ludlow	Y	-	-	50 ft
Lunenburg	Y	-	-	-
Lyndon	Y	-	-	-
Maidstone	Y	-	25 ft	25 ft
Manchester		50 ft		50 ft
Marlboro	Y	50 ft	50 ft	75 ft
Marshfield	Y	25 ft	25 ft	75 ft
Mendon		-	n/a	150
Middlebury		25-100 ft	-	25-100 ft
Middlesex	Y	25 ft	25 ft	75 ft
Milton	Y	-	25 ft	50 ft
Monkton	Y	-	-	-
Montgomery		-	n/a	-
Montpelier	Y	-	n/a	-
Moretown		25 ft	-	25 ft
Morgan	Y	-	-	20 ft
Morristown	Y	-	-	50 ft
Mount Holly		-	-	-
Mount Tabor		-	-	-
Newark	Y	-	-	-
Newbury	Y	10 ft	10 ft	100 ft
Newfane	Y	-	-	75 ft

Town	Lake(s) 20 acres or larger	Stream buffer width	Lakeshore buffer width	Building setback from stream and/or lake
Newport City	Y	-	-	-
Newport Town	Y	-	-	-
North Hero	Y	-	25 ft	75 ft
Northfield		-	-	-
Norton	Y	-	-	-
Orange	Y	-	-	-
Orwell	Y	-	50 ft	50 ft
Panton	Y	-	-	-
Pawlet		-	n/a	-
Peacham	Y	50 ft	50 ft	-
Peru		-	-	-
Pittsfield		-	n/a	-
Pittsford	Y	-	-	-
Plainfield		-	-	-
Plymouth	Yes	-	50 ft	75 ft
Poultney	Y	-	-	50 ft
Pownal	Y	-	-	50 ft
Proctor		-	-	-
Putney		50-100 ft	-	50-100 ft
Randolph		10 ft	-	50-200 ft
Reading	Y	-	50 ft	50 ft
Readsboro	Y	-	-	-
Richford		-	-	-
Richmond	Y	-	-	50 ft
Ripton		-	-	-
Rochester		-	-	-
Rockingham	Y	-	-	-
Roxbury		-	-	-
Royalton	Y	-	-	-
Rutland City		-	-	-
Rutland Town	Y	-	-	-
Rupert		-	n/a	-
Ryegate	Y	50 ft	50 ft	100 ft
Salisbury	Y	-	-	25-100 ft
Sandgate	Y	25 ft	-	100 ft
Searsburg	Y	-	-	-
Shaftbury	Y	-	~50 ft	50 ft
Sharon	Y	-	-	-
Sheffield	Y	-	-	-
Shelburne	Y	-	100 ft	100 ft
Shoreham	Y	-	-	20 ft
Shrewsbury	Y	-	-	100 ft
Somerset	Y	-	-	-
South Burlington	Y	-	-	-
South Hero	Y	-	-	75 ft
Springfield	Y	-	-	25 ft
St Albans City		-	-	-
St Albans Town	Y	-	50 ft	75 ft
St George		-	n/a	-

Town	Lake(s) 20 acres or larger	Stream buffer width	Lakeshore buffer width	Building setback from stream and/or lake
St Johnsbury		-	-	-
Stamford	Y	-	-	-
Stannard	Y	-	-	-
Starksboro		100 ft	100ft	-
Stockbridge		10 ft	n/a	10 ft
Stowe	Y	50 ft	200 ft	50-200 ft
Strafford	Y	-	-	200-400 ft
Stratton	Y	-	-	-
Sudbury	Y	25-50 ft	25-50 ft	-
Sunderland	Y	-	-	-
Sutton	Y	-	-	-
Swanton	Y	50 ft	50 ft	50 ft
Thetford	Y	-	-	-
Tinmouth	Y	-	-	50 ft
Topsham		-	-	-
Townsend	Yes	-	-	-
Troy		-	n/a	-
Tunbridge		-	-	-
Underhill		-	-	100 ft
Vergennes		-	n/a	-
Vernon	Y	-	-	-
Vershire		10 ft	-	10 ft
Victory		-	-	-
Waitsfield		50 ft	n/a	-
Walden	Y	-	-	-
Wallingford	Y	-	-	-
Waltham		-	-	-
Wardsboro		-	-	-
Warners Grant		50 ft	n/a	100 ft
Warren	Y	50-100 ft	50-100 ft	100 ft
Warrens Gore	Y	50 ft	50 ft	100 ft
Washington	Y	50 ft	50 ft	?
Waterbury	Y	-	-	-
Waterford	Y	-	-	-
Waterville		-	-	-
Weathersfield	Y	25-85 ft	50-100 ft	50-100 ft
Wells	Y	-	-	-
West Fairlee	Y	-	-	-
West Haven	Y	-	-	200 ft
West Rutland		50-500 ft	n/a	-
West Windsor		-	-	50 ft
Westfield		50 ft	n/a	50 ft
Westford		100 ft	100 ft	100 ft
Westminster		-	-	50 ft
Westmore	Y	15 ft	15 ft	50-100 ft
Weston	Y	-	-	-
Weybridge		-	-	-
Wheelock	Y	-	-	-

Town	Lake(s) 20 acres or larger	Stream buffer width	Lakeshore buffer width	Building setback from stream and/or lake
Whiting		-	n/a	-
Whitingham	Y	-	-	125 ft
Williamstown	Y	-	-	-
Williston	Y	150 ft	150 ft	150 ft
Wilmington	Y	-	-	-
Windham	Y	-	-	-
Windsor	Y	50 ft	50 ft	50 ft
Winhall	Y	-	-	200 ft
Winooski	Y	-	-	-
Wolcott	Y	25 ft (some)	100 ft	25-150 ft
Woodbury	Y	50 ft	50 ft	100 ft
Woodford	Y	-	-	50 ft
Woodstock		50 ft	-	50 ft
Worcester	Y	-	-	-