

RIVERS AND RESILIENCE: LESSONS LEARNED FROM TROPICAL STORM IRENE

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INTRODUCTION

On the morning of Sunday, August 28, 2011, few Vermonters had any sense of how our small state would be tested by the tropical storm making its way across the Northeast.¹ Most of us did not realize how powerful the streams and rivers flowing through our communities could become. We did not fully appreciate how vulnerable our downtowns, homes, businesses, and farms were to the effects of a large rainfall event. Vermonters' understanding of their relationship to their watersheds was transformed by the storm, which dropped as much as eight inches in that one day. As a result of the devastating high waters that roared through our communities, lives were lost, houses and bridges were washed away, businesses were destroyed, roads were dissolved, and communities were isolated.

While our first response as a state was to reach out and take care of each other and to restore our communities, Vermonters are now, over a year later, starting to look to the future. We are asking what lessons we can learn from this catastrophe in order to be better prepared to face future storms. We are asking what we can do to avoid or at least reduce the kind of devastation that we saw in the days following Irene.

One lesson that many Vermonters are beginning to understand from Irene is that adjustments to our community and infrastructure development, river management, and floodplain protection policies can reduce the risk of flood damage to our homes, businesses, and farms, while also enhancing Vermont's natural beauty. In every watershed in Vermont, the goals of protecting our communities and preserving our natural environment are closely intertwined and interdependent.

A healthy watershed is one capable of absorbing and tempering the effects of large amounts of rain and snow. Healthy watersheds are marked by forests and fields that slow and absorb rainfall, as well as meandering streams with low banks that slow high waters by allowing the water to seep into adjacent floodplains and wetlands. In healthy watersheds, erosion is limited even during periods of high river flows, water quality is maintained,

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1. Greg Botelho & Phil Gast, *Flooding Conditions 'Awful' in Vermont Due to Irene's Rains*, CNN (Aug. 28, 2011, 10:52 PM), <http://www.cnn.com/2011/US/08/28/irene.vermont/index.html>.

and fish and wildlife habitat recovers quickly or may even be enhanced by flood events.²

Likewise, a safe community is one that can accommodate the natural fluctuation and movement of stream and river levels. Constructed with the foresight and knowledge that river systems are dynamic, not fixed, safe communities protect, where possible, those key natural functions of the landscape, such as lowering peak flows by storing water and reducing erosion.³

Vermont can be more flood resilient—we can protect our roads, homes, and businesses, cultivate healthy watersheds, and enhance the quality and scenic beauty of our environment—if we make decisions that recognize and adhere to the important lessons we learned from Tropical Storm Irene. Part I of this paper provides a brief history of floods in Vermont, an explanation of the impacts that scientists believe global climate change will have on extreme-weather events in Vermont, a primer on river science, and a summary of the lessons state government learned in responding to Tropical Storm Irene. Part II summarizes a number of options at the disposal of Vermont’s regulators, planners, and developers to reduce erosion and inundation caused by major storms like Irene. Part III of this paper examines one of those options in greater depth, exploring five possibilities for improving flood resilience by protecting and restoring the floodplains that protect our river valley communities.

I. ORIENTATION

A. *Brief History of Floods in Vermont*

Much of the erosion and flood damage we experienced in the aftermath of Tropical Storm Irene was the result of tinkering with our land and rivers.⁴ Most of Vermont’s forests were clear cut in the State’s early

2. U.S. ENVTL. PROTECTION AGENCY, EPA/600/R-11/207, HEALTHY WATERSHEDS INTEGRATED ASSESSMENTS WORKSHOP SYNTHESIS vii–xi, 5–15 (2011), *available at* http://water.epa.gov/polwaste/nps/watershed/upload/hwi_synthesis.pdf; *see also* U.S. ENVTL. PROTECTION AGENCY, NATIONAL WATER PROGRAM 2012 STRATEGY: RESPONSE TO CLIMATE CHANGE 36 (2012), *available at* http://water.epa.gov/scitech/climatechange/upload/epa_2012_climate_water_strategy_full_report_final.pdf; THE NATIONAL RESEARCH COUNCIL, RIPARIAN AREAS: FUNCTIONS AND STRATEGIES FOR MANAGEMENT 126 (2002).

3. MIKE KLINE & KARI DOLAN, VT. AGENCY OF NATURAL RES., RIVER CORRIDOR PROTECTION GUIDE 5, 8 (2008), *available at* http://www.anr.state.vt.us/dec/waterq/rivers/docs/rv_RiverCorridorProtectionGuide.pdf; KARI DOLAN & MIKE KLINE, MUNICIPAL GUIDE TO FLUVIAL EROSION HAZARD MITIGATION 4 (2010) [hereinafter MUNICIPAL GUIDE], *available at* http://www.vtwaterquality.org/rivers/docs/rv_municipalguide.pdf.

4. MUNICIPAL GUIDE, *supra* note 3, at 1.

history.⁵ As long ago as 1864, George Perkins Marsh lamented in his book *Man and Nature* about the impacts of deforestation on the Vermont landscape, describing the large amounts of soil washed into Vermont's valleys as a result of clear cutting, leaving sediment many feet thick and increasing river instability.⁶

But even before Marsh's comments, generations of Vermonters straightened, deepened, and bermed many of Vermont's rivers and streams with the goal of mitigating the risk of flood damage to river and streamside developments.⁷ These actions caused floodwaters to move downstream faster, which increased erosion and fomented the catastrophic movement of rivers that can occur during major flood events. Over a century later, Tropical Storm Irene confirmed that we continue to pay a price for these modifications to our river systems.

Tropical Storm Irene also reinforced the lesson, learned in prior flood disasters, that Vermonters are resilient people bound by our commitment to work together to protect and maintain our communities. Within the first twenty-four hours following Irene, a full-scale response was underway. Across the state, leaders in government, non-government organizations, and the business community found ways to take needed action. Thousands of additional volunteers and flood responders began rebuilding communities and providing assistance to those in need. Individuals and families were provided with medical assistance, social services, food, and shelter, while roads and other infrastructure were rebuilt and repaired.⁸

Recalling the spirit of our forefathers and mothers who responded, recovered, and rebuilt after the Great Flood of 1927, this generation of Vermonters exhibited a resilience of human spirit and community that contributed to an incredible, though not yet complete, recovery. The reverence and honor expressed by President Calvin Coolidge in Bennington, Vermont toward his home state following the 1927 floods is as apt today as it was eighty-five years ago: "I love Vermont because of her hills and valleys, her scenery and invigorating climate, but most of all because of her indomitable people."⁹

The indomitable people of Vermont have responded to numerous statewide flood disasters since President Coolidge spoke those words.

5. ELIZABETH H. THOMPSON & ERIC R. SORENSON, WETLAND, WOODLAND, WILDLAND: A GUIDE TO THE NATURAL COMMUNITIES OF VERMONT 18 (2000).

6. GEORGE PERKINS MARSH, *MAN AND NATURE* 235 (David Lowenthal, 3rd ed. 1974).

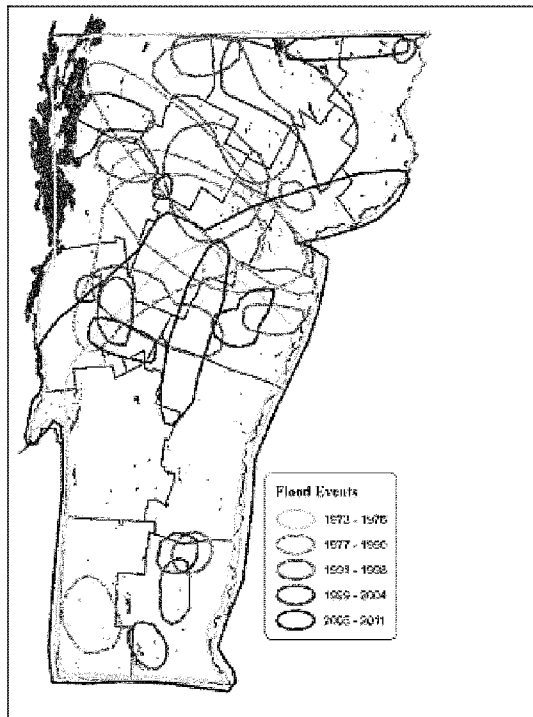
7. MUNICIPAL GUIDE, *supra* note 3, at 2.

8. IRENE RECOVERY COORDINATION TEAM, IRENE RECOVERY REPORT: A STRONGER FUTURE, (Jan. 2012) [hereinafter IRENE RECOVERY REPORT: A STRONGER FUTURE], available at http://www.vtstrong.vermont.gov/Portals/0/Documents/Irene_Recovery_Report_Jan_2012.pdf.

9. VT. Historical Society, *Flood of 1927*, VT. HISTORY EXPLORER, <http://www.vermonthistory.org/explorer/a-zefmenu/280-floodof1927az.html> (last visited Dec. 7, 2012).

Major flood events hit Vermont in 1936, 1938, 1973, and 1976.¹⁰ Indeed, a review of nationally declared flood disasters in Vermont reveals that Vermont has suffered a major flood in one of its watersheds, on average, every year for the past twenty-five years

Figure 1:
Regional and State-Wide Floods in Vermont from 1973–2011¹¹



It must be remembered that Tropical Storm Irene was not the only flooding event in Vermont in 2011. Central Vermont experienced major flood events in the spring of 2011 which, though not as severe, caused major damage in several watersheds and contributed to record high water

10. Jon Denner, *U.S. Geological Survey Water-Supply Paper 2375, National Water Summary 1988–1989—Floods and Droughts: Vermont*, USGS.GOV, <http://md.water.usgs.gov/publications/wsp-2375/vt/index.html> (last visited Nov. 24, 2012).

11. Ned Swanberg, Vt. Agency of Natural Res., Presentation to the Ludlow Planning Commission (Feb. 12, 2013) (flood events mapped by Barry Cahoon, River Engineer, Vt. Agency of Natural Res., map digitized by Ben Copans, Vt. Agency of Natural Res.) (image on file with Vt. J. Env'tl. L.).

levels in Lake Champlain.¹² Ironically, the spring 2011 flooding led the Agency of Natural Resources¹³ (ANR) to announce a flood resilience initiative program weeks prior to Tropical Storm Irene.¹⁴

Over a year later, as we address the remaining damage from Irene and work to meet the critical needs of Vermont's citizens and businesses most impacted by the floods, we are now returning to the flood resilience effort announced in August 2011 with a reinvigorated sense of purpose. Although much careful planning and hard work still remains, Irene taught us that if we approach this next phase with the same spirit that marked our initial response to the storm, we can better protect our communities from future storms. Vermont can, in this way, continue to serve as a model of how people can live on the landscape in a manner that not only protects but also enhances the natural environment.

B. Climate Change Portends More, Not Less, Flooding in the Future

Planners know that our climate is changing. As catastrophic as the Irene floods were, they were not a one-time event. The data indicate that we face the risk of more frequent and greater floods in the future.¹⁵ Climate experts predict that global climate change will increase precipitation in Vermont.¹⁶ Their reports indicate that Vermont will also see an increased frequency of extreme weather events.¹⁷ These predictions comport with observations from recent years in which Vermont has suffered from increased flooding.¹⁸

12. *Lake Champlain Levels to Slowly Drop*, VPR NEWS (May 9, 2011, 6:06 AM), http://www.vpr.net/news_detail/90805/lake-champlain-levels-to-slowly-drop; *Flooding Damage Reaches Threshold for Federal Aid*, VPR NEWS (May 2, 2011, 5:50 PM), http://www.vpr.net/news_detail/90743/flooding-damage-reaches-threshold-for-federal-aid.

13. ANR's mission is to protect, sustain, and enhance Vermont's natural resources for the benefit of this and future generations. The Secretary of Natural Resources is Deb Markowitz. ANR has three departments: Environmental Conservation; Fish and Wildlife; and Forests, Parks, and Recreation. Throughout this article, there is information about current initiatives and projects that ANR and its Department of Environmental Conservation are leading, or are developing in close collaboration with other Vermont state agencies. The statements made about these efforts are based on the direct knowledge and experience of Commissioner Mears, gained through his leadership role in the agency and his supervision of the department managers and staff carrying out this work day-to-day. Please contact co-author Sarah McKeeman at sarah.mckeeman@state.vt.us for additional information about these initiatives.

14. Gov. Shumlin, *Premier Charest Call for U.S.-Canadian Study of Lake Champlain Flooding Issues*, VERMONT.GOV (Aug. 18, 2012), <http://governor.vermont.gov/newsroom-gov-shumlin-premier-quebec-lake-champlain-floods>.

15. SACHA PEALER & GWEN DUNNINGTON, CLIMATE CHANGE AND VERMONT'S WATERS 1 (2011), *available at* <http://www.anr.state.vt.us/anr/climatechange/Pubs/VTCCAdaptWaterResources.pdf>.

16. *Id.*

17. *Id.*

18. Audrey Clark, *100-Year Forecast? More Frequent and Serious Flooding*, VTDIGGER.ORG (June 6, 2012), <http://vtdigger.org/2012/06/06/100-year-forecast-more-frequent-and-serious-flooding>.

Simply planning for more of the same kind of weather we have seen in the past is not likely to be sufficient. According to Vermont Law School Professor Pat Parenteau, a legal expert in climate change law and policy, “there is no new normal.”¹⁹ Flood disaster experts reporting to Governor Shumlin as part of the Governor’s Council on Community Design recommended:

State agencies should begin to look ahead and determine steps to reduce impacts of flooding and erosion in the face of an increase in the number and severity of natural hazards due to climate change.²⁰

We must build and re-build our communities with this advice in mind.

We can and should contemplate the root causes of climate change. Although the solutions are beyond the scope of this paper, they provide an important backdrop to our response to increased flood risk. If we can devise solutions that will increase the resilience of our communities to flood damage, while also reducing our greenhouse gas emissions, we can make the transition to long-term sustainability more effectively and efficiently.

C. A Primer on River Science

In order to appreciate the opportunities and challenges for improving Vermont’s flood resilience, it may be helpful to understand some of the basics of river dynamics. Rivers, by their very nature, are complex, ever-changing, and intimately connected to changes in the landscape. While we have learned a great deal about the relationship of Vermont’s rivers to our landscape, with some of the more startling lessons learned in the aftermath of major-flood events, we still have a great deal to learn. One of the greatest challenges to understanding rivers is that they change over a period of time that extends beyond human lifespans.²¹

We recognize certain simple facts about river dynamics today that Vermonters two hundred years ago did not. For instance, rivers seek their own unique balance, based on their slope, type of bed material, underlying geology, and the volume of water flowing through them.²² The volume of

19. Patrick A. Parenteau, Senior Counsel to the Envtl. and Natural Res. Law Clinic and Professor of Law, Vt. Law Sch., *Dealing with Disaster in the Era of Climate Change*, Address at the Vt. Journal of Envtl. Law Symposium: After Irene: Law and Policy Lessons for the Future (April 20, 2012).

20. GOVERNORS’ INSTITUTE ON COMMUNITY DESIGN, RECOVERY AND RESILIENCE: THE VERMONT WAY 1 (Mar. 7, 2012), *available at* http://www.vtstrong.vermont.gov/Portals/0/Documents/GICD_Report_032812.pdf.

21. COLBERT E. CUSHING & J. DAVID ALLAN, *STREAMS: THEIR ECOLOGY AND LIFE* 11 (2001).

22. J. DAVID ALLAN & MARIA M. CASTILLO, *STREAM ECOLOGY: STRUCTURE AND FUNCTION OF RUNNING WATERS* 33–34 (2d ed., Springer 2007); BARRY CAHOON & MIKE KLINE, *ALTERNATIVES*

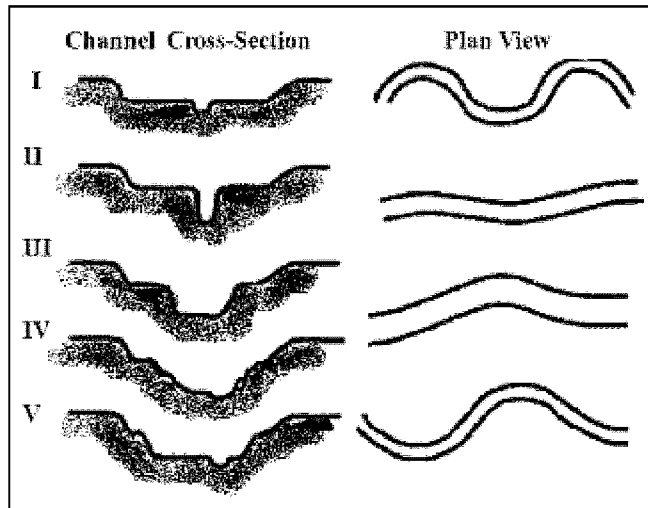
water that reaches rivers is closely related to the area of land within the watershed around the river and the type of activities on that land.²³ A change to any variable threatens the equilibrium of the river.

The most important lesson that we have learned from the repeated floods of the past several decades, a period during which we have been paying closer attention to our rivers than we did in earlier times, is that the common perception of rivers as static features of the landscape is fundamentally flawed. Vermont's rivers and streams have migrated across valleys for centuries, changing the landscape as they move.

The following diagram shows how Vermont's rivers have typically migrated and changed. Stage I shows an unaltered river channel, in equilibrium, both in cross-section and as viewed from above ("plan view"). Stage II illustrates a river that was straightened. Stage III, IV, and V demonstrate how rivers return to a state of equilibrium.

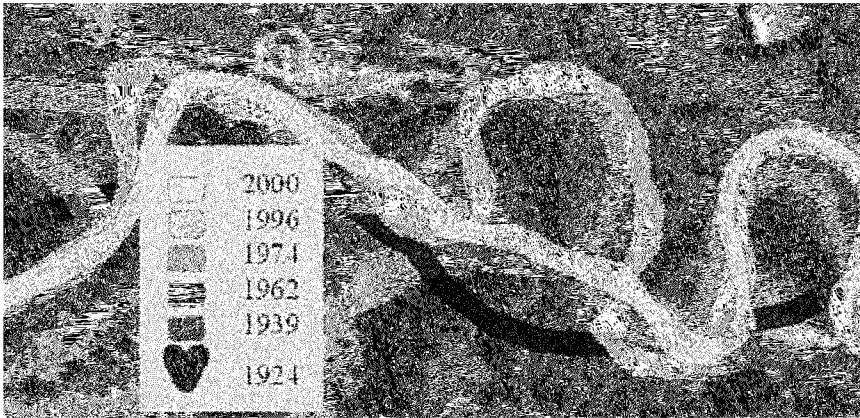
FOR RIVER CORRIDOR MANAGEMENT (2006) [hereinafter ALTERNATIVES FOR RIVER CORRIDOR MANAGEMENT], *available at* http://www.anr.state.vt.us/dec/waterq/rivers/docs/rv_managementAlternatives.pdf.

23. ALLAN & CASTILLO *supra* note 22; ALTERNATIVES FOR RIVER CORRIDOR MANAGEMENT, *supra* note 22.

Figure 2²⁴

Closer to home, Figure 3 depicts the Third Branch of the White River as it returns to equilibrium following a straightening in 1924. The map below shows how floods in 1927, 1936, and 1938 led to dramatic changes in channel location and also how channel migration has continued up through 2000.

24. Mike Kline, Chief River Scientist, Vt. Agency of Natural Res., Presentation on Alternatives for River Corridor Protection (Aug. 8, 2004) (image adopted from S.A. SHUMM, *THE FLUVIAL SYSTEM* (1977)) (The image demonstrates the channel evolution process, from a meandering form in equilibrium to a straightened incised condition, and finally re-establishment of a new equilibrium stage.).

Figure 3²⁵

When we ignore the science and history by trying to force rivers to remain in one place, we risk throwing them out of balance, which damages communities. We can avoid the cost of repairing our communities if we give rivers the space to move and reach equilibrium.²⁶

No matter how hard we try, our rivers and streams will resist any effort to hold them in one place and in one shape. While there are places and circumstances where the cost of waging that battle is necessary (we would prefer the Winooski River in and around Montpelier remain in its channel), fighting rivers turns out to be an expensive and risky proposition. Many rivers have been repeatedly straightened at substantial cost. A better approach, one informed by science, is to resist tinkering with the equilibrium conditions that developed in the millennia before humans settled this region and simply give rivers the room they need to move.²⁷

While rivers are naturally resilient and can recover a new equilibrium if given the chance, turning them into the equivalent of pipelines will lengthen the time it takes them to recover.²⁸ In part, this is because a river system has many features outside of the river channel that are critical to its ability to absorb floods. Floodplains along rivers serve a major role in absorbing and slowly releasing the large volumes of water that can be collected in the

25. Ned Swanberg, *supra* note 11 (Changes in the Third Branch of White River from 1924 to 2011. The 1924 channel location was digitized from a fifteen-foot USGS Topographic Quadrangle. Later channel locations were digitized from aerial photographs by George Springston, Norwich University, Department of Geology and Environmental Science.).

26. MUNICIPAL GUIDE, *supra* note 3, at 1.

27. Michael Kline & Barry Cahoon, *Protecting River Corridors in Vermont*, 46 J. AM. WATER RESOURCES ASS'N 9 (2010).

28. ALLAN & CASTILLO *supra* note 22; ALTERNATIVES FOR RIVER CORRIDOR MANAGEMENT, *supra* note 22.

valleys of Vermont's hills and mountains.²⁹ Wetlands hold flood waters for even greater periods of time, filtering out sediment, nutrients, and other pollutants.³⁰

Otter Creek's response to Irene is a good example of how intact floodplains can mitigate storm surges. Following Irene, Vermont's river scientists documented Otter Creek's natural resilience. Otter Creek originates in the Green Mountains and travels through Rutland and Addison Counties before emptying into Lake Champlain.³¹ During the storm, flow rates in Rutland were over 16,000 cubic feet per second and the water level was nine feet above the flood line.³² Forty miles downstream, Otter Creek runs through Middlebury. A flow rate of 16,000 cubic feet per second would have devastated the college town; fortunately, the flow rate through Middlebury was around 6,000 cubic feet per second.³³ The flow rate was reduced because the creek spilled over into intact floodplains, including intact wetlands and forested swamp.³⁴ The floodplain absorbed some of the water and reduced the creek's energy.³⁵

29. See FREITAG ET AL., *supra* note 2, at 68.

30. See NATIONAL WATER PROGRAM 2012 STRATEGY, *supra* note 2, at 36; VT. AGENCY OF NATURAL RES., RESILIENCE: A REPORT ON THE HEALTH OF VERMONT'S ENVIRONMENT (2011) [hereinafter RESILIENCE], available at <http://www.anr.state.vt.us/anr/envrptsb/ANREnvReport2011.pdf>.

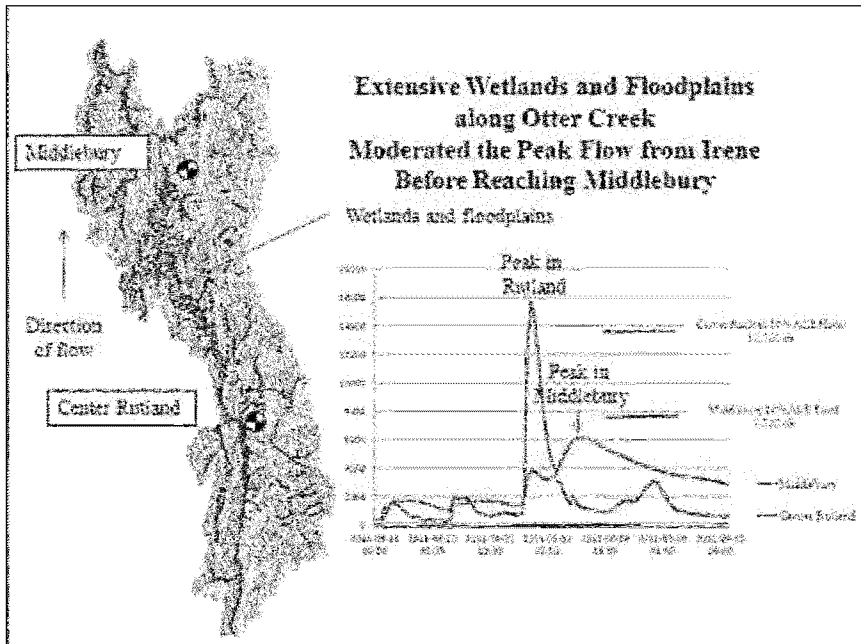
31. RESILIENCE, *supra* note 30, at 8.

32. *Id.*

33. *Id.*

34. *Id.*

35. *Id.*

Figure 4³⁶

Two additional components of river science critical to recognizing the benefits of allowing our streams to meander are water quality and aquatic ecology. Balanced rivers maintain greater water quality including cooler temperatures and increased clarity.³⁷ Phosphorous levels, which when too high lead to harmful algal blooms, are lower in balanced streams, making the task of protecting our streams, rivers, ponds, and lakes easier.³⁸

Similarly, rivers in equilibrium will not invite frequent human intervention and can maintain the complexity of depth, shape, and material that support a rich diversity of organisms, including insects, crustaceans, fish, and wildlife.³⁹ A healthy river in Vermont typically has a mix of depths, bed materials, and bank vegetation. Healthy rivers provide habitat

36. Ned Swanberg, *supra* note 11 (The gage analysis was conducted by Eric Smeltzer & Ned Swanberg, Vt. Dep't Envtl. Conservation and based off finalized U.S.G.S. flow records.).

37. VT. AGENCY OF NATURAL RES., RIPARIAN BUFFERS AND CORRIDORS—TECHNICAL PAPERS 3–6 (2005), available at http://www.vtwaterquality.org/rivers/docs/Educational%20Resources/rv_RiparianBuffers&CorridorsTechnicalPapers.pdf.

38. *Id.*; Vt. Dep't of Envtl. Conservation, *Values of Riparian Buffers*, 1, 2 http://www.vtwaterquality.org/rivers/docs/rv_riparianvalues.pdf (last visited Nov. 28, 2012).

39. *Values of Riparian Buffers*, *supra* note 38; *Protecting River Corridors*, *supra* note 27.

for a wide range of species.⁴⁰ Thus even those who do find joy in flipping over rocks to find crawfish, or fishing for brook trout on a spring evening during a mayfly hatch should at least find the economic value of tourism and fishing on Vermont's rivers and lakes appealing.⁴¹

Protecting Vermont's communities from flood damage requires an understanding of all that science can offer, and will require us to continue to deepen that understanding through site-specific study and analysis. When we get the science right, we can build it into our decision-making, with benefits to public safety, the economy, water quality, and aquatic habitat.

The conflict between humans and rivers is as old as human settlements along rivers, as old as civilization itself.⁴² Settlement patterns in Vermont reflect over two centuries worth of decisions and investments, and it would be unwise to try to reverse course immediately. We can take the long view and incorporate an understanding of river dynamics into future development and restoration of existing infrastructure.⁴³ We know enough to mitigate risk in future development.

D. Personal Observations on the Value of Coordination and Collaboration

The view of government response to Irene from within has been a transformative experience. To be sure, the state's response to Irene exposed differences in Vermonters' understanding of river science. The difficulty of identifying a scientifically sound response was compounded by the need to shape and communicate that response to federal, state, and local government as well as citizens. The importance of achieving a common understanding of how rivers and streams work may be one of the most significant lessons that we can pull from Irene.

Vermont's state agencies had to work together to respond quickly to the flood damage. With the loss of the Waterbury office in the floods, Vermont's emergency responders were thrown together in a makeshift operations center in Burlington. The Irene Recovery Office was later created and staffed with seasoned leaders. Neale Lunderville, the former Agency of Administration Secretary under Governor Douglas led the Irene

40. RIPARIAN BUFFERS AND CORRIDORS, *supra* note 37, at 7.

41. *Values of Riparian Buffers*, *supra* note 38; GILBERT AND MANNING, ECONOMIC AND SOCIAL VALUE OF VERMONT STATE PARKS 74–75 (2002); *see* VT. FISH & WILDLIFE DEP'T, SUMMARY OF 2009 ACCESS AREA PROGRAM: MAINTENANCE AND CONSTRUCTION REPORT I (2010), *available at* http://www.vtfishandwildlife.com/%5Clibrary%5CReports_and_Documents%5CFisheries%5CAccessareas%5Caccess-area-annual-report-2009.pdf (discussing the economic value of fishing and related licenses and the recent increase in the sales of such licenses).

42. *See, e.g.*, Mark Isaak, *Flood Stories from Around the World*, THE TALKORIGINS ARCHIVE, <http://www.talkorigins.org/faqs/flood-myths.html> (last revised Sept. 2, 2002) (summarizing flood stories from the world's folklore); *Genesis* 6:5–8:14.

43. *Protecting River Corridors*, *supra* note 27.

Recovery Office before Sue Minter took over. In the months following Irene, an interagency team met at least weekly to discuss the recovery.

In addition, despite the logistical challenges presented by the loss of the Waterbury state office complex, ANR staff traveled the state, offering technical assistance and guidance to affected communities. At the same time, senior staff and ANR leaders met with community leaders to discuss local needs.⁴⁴

Slowly but surely, our agencies began to make sense of the nearly overwhelming number of requests for help and information. In the process of working together throughout the flood response, agencies learned about the roles and strengths of other agencies while agency leaders learned about the strengths and limitations of their departments and agencies.

For the Department of Environmental Conservation (one of ANR's three departments), one of our more significant challenges was to manage the tension between fulfilling our competing obligations to assist our sister departments and agencies in providing a timely response to the flood (for example by constructing new roads, bridges and culverts), while ensuring that regulatory standards were met. Where regulatory approvals were needed from the Department of Environmental Conservation, every effort was made to streamline the process in a manner that allowed critical work to go forward while maintaining the core standards.

For instance, bridges and roads had to be rebuilt to reconnect communities.⁴⁵ While the rebuilding was necessary for a broader recovery, our river scientists and engineers were concerned that the roads and bridges would be constructed in a manner that would increase the risk of flooding downstream or make them vulnerable to being washed away in the next high-water event.⁴⁶ This led to potential conflicts between the large number of volunteers and local road crews who wanted or needed to do work in rivers, and the Department of Environmental Conservation's river engineers, who supported the efforts of municipal governments and the Agency of Transportation as they restored major transportation arteries.

Some of the work done in rivers without our Department's authorization, or done contrary to our instructions, increased the risk of future flood damage.⁴⁷ In those cases, river channels were straightened,

44. CMTY. RECOVERY P'SHIP, COMMUNITY RECOVERY PARTNERSHIP REPORT (2012), available at http://www.vtstrong.vermont.gov/Portals/0/Documents/CRP_Report10_2012_F.pdf.

45. John Schwartz, *Vermont Rebuilding Quickly from Hurricane Irene's Big Hit*, N.Y. TIMES, Dec. 5, 2011, http://www.nytimes.com/2011/12/06/us/vermont-rebounding-from-hurricane-irene.html?pagewanted=all&_r=0#.

46. See *id.* (Mary Watzin, Dean of UVM's school of Environment and Natural Resources noting that repairs should be done to make Vermont more resilient to future storms).

47. Dave Gram, *Vt. Experts: Some Post-Irene River Repairs Harmful*, BOSTON.COM (Nov. 15, 2011),

river beds were deepened, and river banks were raised above the floodplain in ways that were not necessary or appropriate.⁴⁸ Much of the work done in streams and rivers also raised the ire of the many Vermonters who were concerned that the river alterations would have long-term impacts on fisheries and the ecological health of our streams and rivers.⁴⁹

Heeding those lessons, the Vermont Legislature passed Act 138 in the spring of 2012, instructing our department to develop new rules relating to emergency stream and river alteration work.⁵⁰ This mandate will provide a necessary opportunity for regulators, legislators, and scientists to develop concrete sets of procedures and requirements that reflect a common understanding of how we should work to repair and restore streams and rivers in the wake of flood events like Irene.

At the same time, we hope to build upon the increasingly effective relationship between the Agency of Transportation and ANR. Our agencies continue to hold routine meetings to sort through the regulatory and other challenges associated with rebuilding and planning for a new and more resilient system of transportation infrastructure.

ANR has developed similar relationships with the Agency of Commerce and Community Development, the Agency of Agriculture, the Department of Health, and the Department of Emergency Management. These relationships will be the foundation for building a plan of action for making Vermont more resilient to future flooding. Working together, in collaboration with our partners in municipal government, and with the support of organizations such as the regional planning commissions, business groups, environmental and conservation organizations, and with input from the general public, we hope to find common ground on a shared set of approaches that will increase Vermont's resilience to the floods that we know are coming.

II. PLANNING AHEAD

A. Long Term Steps for Disaster Prevention

Although the amount of work still needed to rebuild homes and reconstruct roads, bridges, culverts, and other critical infrastructure

http://www.boston.com/news/local/vermont/articles/2011/11/15/experts_post_irene_river_repairs_harmful_in_vt.

48. *Id.*

49. RICH KIRN, IMPACTS TO STREAM HABITAT AND WILD TROUT POPULATIONS IN VERMONT FOLLOWING TROPICAL STORM IRENE 1 (2012), available at http://www.vtfishandwildlife.com/library/Reports_and_Documents/Fisheries/Habitat_and_Trout_Population_Impacts_Following_Irene.pdf.

50. VT. STAT. ANN. tit. 10 § 751 (2012).

damaged by Tropical Storm Irene is daunting, most of these projects will conclude in the next year or two, allowing Vermont's agencies, municipalities, businesses, community organizations, and other groups to focus on the work needed to prevent future flooding disasters.

A first step should be a collaborative dialogue aimed at identifying the highest value actions for reducing the risk of severe flood damage from major storm events. River scientists agree that a concerted effort to protect remaining floodplains is a top priority.⁵¹ Floodplains are an invaluable asset for slowing down and storing floodwaters when rivers are running high. In addition to providing this essential service, floodplains are critical for maintaining healthy, stable rivers over the long term.⁵²

Floodplain protection could be accomplished in many ways, including: strengthening local and state regulations that limit building projects; developing policies that encourage and promote infill development in safe downtown locations; conserving floodplains upstream from developed areas through either the outright purchase of land or conservation easements negotiated with private landowners; and developing long-term transportation infrastructure plans that aim to keep roads out of hazardous floodplain areas whenever possible.⁵³

In addition to taking steps to protect floodplains, Vermont should encourage projects designed to restore floodplains that have been lost or degraded due to filling, construction, or the placements of conventional flood control structures like berms and levees.⁵⁴ Private landowners may be willing to help finance floodplain restoration projects if it can be shown that doing so would result in less land lost to erosion. In other situations it may be in the community's or state's interest to provide financial support for removing structures that block rivers from spilling onto their floodplains.

In addition to floodplain protection and restoration, Vermont could intensify efforts to mitigate existing hazards through, for example, best management practices for building or repairing roads in river corridors, and upgrading bridges and culverts. The Vermont State Hazard Mitigation Plan states that the "largest single source of flood losses, both in terms of cost and number of people affected, is damage to transportation infrastructure.

51. SUE MINTER, VERMONT RECOVERING STRONGER: IRENE RECOVERY STATUS REPORT 2 (2012), *available at* <http://vtstrong.vermont.gov/Portals/0/Documents/VTRecoveringStronger%20RptJune%202012.pdf>.

52. ASS'N OF STATE FLOODPLAIN MANAGERS, NATURAL AND BENEFICIAL FLOODPLAIN FUNCTIONS (2008), *available at* http://www.floods.org/PDF/WhitePaper/ASFPM_NBF%20White_Paper_%200908.pdf.

53. IRENE RECOVERY REPORT: A STRONGER FUTURE, *supra* note 8, at 47–54.

54. BOB FREITAG ET AL., FLOODPLAIN MANAGEMENT: A NEW APPROACH FOR A NEW ERA 68 (2009); *Values of Riparian Buffers*, *supra* note 38.

Infrastructure damage also represents the greatest public safety hazard.”⁵⁵ Roads situated adjacent to rivers and streams, a common feature in Vermont, can be designed to minimize the risk of erosion and collapse.⁵⁶ When roads need to be rebuilt due to severe flood damage, in some instances, it may be possible to relocate road segments that are in particularly hazardous areas.⁵⁷ The Agency of Transportation is working on new methods to assess the risks facing Vermont’s transportation infrastructure and to prioritize strategies for reducing that risk.⁵⁸

Similarly, Vermont has learned from experience that undersized bridges and culverts can fail, resulting in significant damage and expense.⁵⁹ On the other hand, bridges and culverts that are designed to survive major flood events not only avoid expensive repairs, but also have significant environmental benefits. Stable and properly sized bridges and culverts promote river corridor connectivity, which is critical to the ecological health of our rivers because it allows wildlife to move freely.⁶⁰ ANR and the Agency of Transportation are working to develop standards for roads, bridges, and culverts that will promote river corridor connectivity and reduce expensive repairs following flooding.⁶¹

Any one of these diverse strategies can seem like a monumental challenge in a state that is still bouncing back from the dislocation and loss caused by Tropical Storm Irene. But there are many reasons to believe that Vermont’s leaders and citizens will rise to the challenge of taking concerted steps to reduce our risk from future flooding disasters.

First, many communities have experienced repeated flooding, and these experiences have helped foster broader awareness of the costs of not acting now to mitigate future risks. Large-scale flooding devastated the southern half of Vermont on two occasions between 1973 and 2010.⁶² During that same period, regional flooding occurred twenty-five times.⁶³

55. VT. EMERGENCY MGMT., STATE HAZARD MITIGATION PLAN 159–60 (Dec. 2011).

56. MUNICIPAL GUIDE, *supra* note 3, at 16.

57. VT. AGENCY OF TRANSP., HAZARD MITIGATION GRANT PROGRAM APPLICATION: ASSESSING AND MITIGATING VULNERABILITY AND RISK FROM FLOODING ON TRANSPORTATION INFRASTRUCTURE (Nov. 2012) (draft).

58. *See Gov. Shumlin, Premier Charest, supra* note 14 (noting that the Governor called on agency and department heads to discuss how Vermont can be better prevent and respond to future flooding).

59. MUNICIPAL GUIDE, *supra* note 3, at 5.

60. VT. FISH & WILDLIFE DEP’T, VERMONT STREAM CROSSING HANDBOOK (2005), *available at* http://www.vtfishandwildlife.com/library/Reports_and_Documents/Aquatic%20Organism%20Passage%20at%20Stream%20Crossings/_AOP_%20Handbook.pdf.

61. *See Gov. Shumlin, Premier Charest, supra* note 14.

62. RESILIENCE, *supra* note 30, at 8.

63. *Id.*

Even those who do not experience the immediate effects of these disasters know that they harm the state in lasting ways. In 2011, insurance claims for flood damage to Vermont homes and businesses exceeded fifty-two million dollars.⁶⁴ Recovery efforts funded by taxpayers were extremely costly. Complete data on local, state, and federal expenditures in the wake of the storm is not yet available, but data from Vermont floods that occurred between 2003 and 2008 suggest that the total spent on insurance claims is usually a tiny fraction (less than five percent) of total recovery costs.⁶⁵

These kinds of figures on insurance claims and public recovery expenditures still underestimate the full costs of Vermont's frequent flooding to communities and families. The National Center for Atmospheric Research estimates that "seven Vermont floods between 1955 and 2008 caused total flood losses in the range of five to twenty million dollars and four caused damage in excess of \$20 million."⁶⁶ Damage from the 1972 flood is estimated at 255 million dollars, and damage from the 1984 flood at ninety-three million dollars.⁶⁷ Irene is estimated to have produced between 175 and 250 million dollars in damages.⁶⁸

Today the heightened awareness of these costs and a new understanding among community and state leaders of the steps needed to restore equilibrium to Vermont's rivers provides a unique opportunity for change. Informed leaders working with the steady support of an engaged public can keep development out of hazardous locations; mobilize the resources needed for restoration projects; light a fire under strategic floodplain conservation efforts; and tenaciously pursue the design and construction of stormwater infrastructure capable to absorbing the stormwater flows of tomorrow.

Vermont faced a similar watershed moment when its legislature passed the state's current land use law, Act 250.⁶⁹ Its passage was made possible by a commitment shared by Vermont's citizens and elected leaders to protect the prevailing land use pattern—historic villages and towns alternating with working farms and forests—that lies at the heart of what makes Vermont such a unique and special place. As the threat to that historic land use from sprawl grew in the public's consciousness, support

64. Ned Swanberg, Vt. Agency of Natural Res., Ray Doherty, Vt. Emergency Mgmt., & Richard Downer, FEMA, Presentation on the FEMA Hazard Mitigation Grant Program (Jan. 15, 2013).

65. *Id.* (Data from the National Flood Insurance Program Community Information System Insurance Reports and FEMA Public Assistance Records.).

66. RESILIENCE, *supra* note 30, at 8.

67. *Id.* at 3.

68. Schwartz, *supra* note 45.

69. Land Use and Development Law, VT. STAT. ANN. tit. 10 § 6001 (2012).

for bold legislation to manage future growth steadily climbed.⁷⁰ On passing the new law, the legislature noted that it was essential to ensure that future development is not “detrimental to the environment [and] will promote the general welfare through orderly growth and development . . . suitable to the demands and needs of the people of this state.”⁷¹

Today, the majority of Vermont’s historic villages and towns face some degree of vulnerability to flooding. These risks will inevitably be exacerbated by climate change, which is expected to increase the intensity and frequency of storms. The future well being and economic health of these communities and the state at large depends on confronting these vulnerabilities. Vermonters increasingly understand these connections between our flood resilience and the resilience of our communities, economy, and environment.

III. PROTECTING OUR FLOODPLAINS

A. An Overview of Floodplain Development

There are many reasons to be optimistic that Vermonters will work hard to reduce the future risks of severe flooding. The challenge of stemming the slow but steady loss of floodplains to development, however, should not be underestimated. Floodplain loss has occurred since Vermont’s first settlements.

In many areas, towns and villages developed in narrow valleys, near river crossing locations and waterfalls. In these settlements, land with low slopes was limited, and floodplains provided large, flat areas, free of the natural features that made building difficult. As a result, many floodplains in Vermont have already been developed and development pressures in these areas may continue.⁷²

A glance at data on existing structures demonstrates how intensive this development has been. In Bennington County (where we have good data on floodplain encroachment), for example, there are over 800 structures in the Special Flood Hazard Area (SFHA), defined as that part of the floodplain subject to a one percent chance of flooding in any given year (and often referred to as the 100-year floodplain).⁷³ Of these 800 structures, 312 are single family homes, 209 are commercial buildings, 149 are mobile homes,

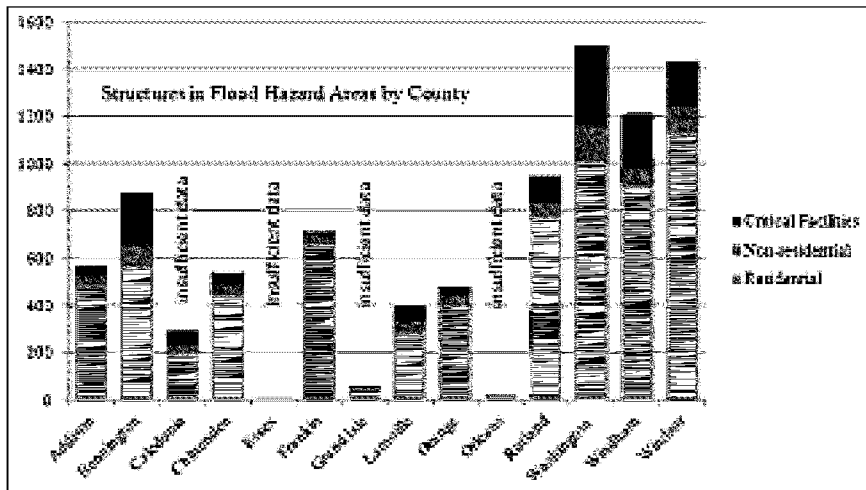
70. ELIZABETH COURTNEY AND ERIC ZENCEY, GREENING VERMONT: THE SEARCH FOR A SUSTAINABLE STATE (2012).

71. VT. NATURAL RES. BOARD, ACT 250: A GUIDE TO VERMONT’S LAND USE LAW 6 (2006), available at <http://www.nrb.state.vt.us/lup/publications/act250brochure.pdf>.

72. IRENE RECOVERY REPORT: A STRONGER FUTURE, *supra* note 8, at 48.

73. Ned Swanberg, *supra* note 11; 44 C.F.R. § 59.1 (2012) (defining SFHA as “the land in the flood plain within a community subject to a 1 percent or greater chance of flooding in any given year”).

108 are multi-family apartment buildings, and over a dozen are critical facilities.⁷⁴ Likewise, Washington County has over 1,000 buildings already in these flood hazard areas, of which fifty-six are, or were prior to Tropical Storm Irene, government buildings.⁷⁵ Figure 5 depicts the number of existing structures in flood hazard areas in all Vermont counties for which we have good data.

Figure 5⁷⁶

The buildings in river valley communities are not the only encroachments that have stacked up on floodplains. Much of the critical infrastructure that serves river valley communities—including roads, water and wastewater systems, and power transmission facilities—sits next to or in close proximity to rivers.⁷⁷

74. Ned Swanberg, *supra* note 11.

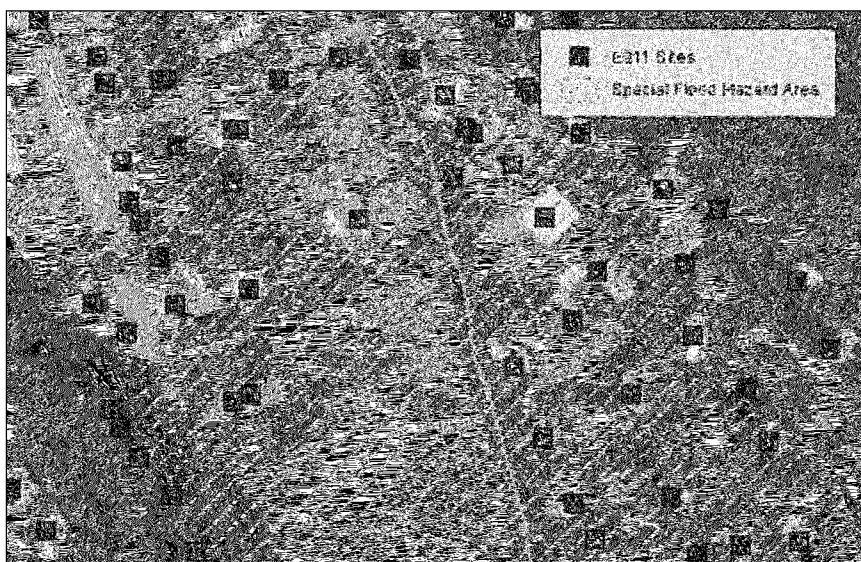
75. *Id.*

76. *Id.* (Based on data on E-911 locations in Special Flood Hazard Areas. The E-911 data (released Aug. 2011) is available on the Vermont Center for Geographic Information website at www.vcgi.org. The Special Flood Hazard Area data is incomplete and uses mixed sources. The extent of Special Flood Hazard Areas is compiled from official final FEMA sources for Windham, Windsor, Rutland, Chittenden, and Washington Counties and other municipalities with DFIRMs. The data also includes the current Preliminary DFIRM data for Bennington County. In all other areas the data represents best available but non-official digital versions of Flood Insurance Rate Maps prepared by Regional Planning Commissions and other sources. Digitized flood hazard areas have not been created for most of Caledonia, Essex, Grand Isle, and Orleans Counties.).

77. SASHA PEALER & GWEN DUNNINGTON, CLIMATE CHANGE AND VERMONT'S WATERS 3 (2011), *available* at <http://www.anr.state.vt.us/anr/climatechange/Pubs/VTCCAdaptWaterResources.pdf>.

A powerful visual representation of floodplain encroachment can be seen in Figure 6, which depicts one Special Flood Hazard Area in one watershed. The small squares indicate where there are existing structures sitting in the midst of this hazardous area. More development will only intensify the hazards for these existing structures, while also impairing the floodplain that protects downstream communities from roaring, high-speed flows caused by big storms.

Figure 6⁷⁸



Even though many of the state's floodplains have been developed, there are still undeveloped floodplains up and downstream of historic towns and villages, and they play a key role in slowing water when rivers spill over river banks.⁷⁹ Many of these floodplains also provide rich, productive land for agriculture because past flooding has delivered layer after layer of nutrients to the soils, and those nutrients create fertile land for cultivation.⁸⁰ While the use of floodplains for agriculture and flood attenuation can be,

78. Ned Swanberg, *supra* note 11 (Each gray square is the location of a building identified on E-911 maps. These maps serve to direct emergency personnel to emergency locations. Special Flood Hazard Areas delineated by Digital Flood Insurance Rate Map.).

79. VT. AGENCY OF NATURAL RES., CONSERVATION OF RIVER CORRIDOR LANDS: A PROPOSAL TO ESTABLISH LANDOWNER AND MUNICIPAL INCENTIVES AND RESOURCES 3 (2006), available at http://www.vtwaterquality.org/rivers/docs/Educational%20Resources/rv_Landowner&MunicipalIncentivesforRiverCorridorConservation.pdf

80. *Values of Riparian Buffers*, *supra* note 38.

and in many places is entirely compatible, certain approaches to cultivation that emphasize best management practices are more suited to maintaining the flood attenuation benefits of these lands.

B. Vermont's Current Approach to Managing Floodplain Development

In Vermont, where land use planning and regulation occurs primarily at the municipal level, decisions about where and when to develop are made by local elected officials, zoning administrators, and development review boards.

Currently, nearly ninety percent of Vermont's municipalities regulate floodplain development in a manner that allows them to qualify for participation in the National Flood Insurance Program (NFIP).⁸¹ The NFIP is administered by the Federal Emergency Management Agency (FEMA).⁸² Communities that want to participate must first adopt local regulations that meet or exceed federal standards, and then their home owners, renters, and businesses become eligible to purchase flood insurance from the NFIP.⁸³

An important issue is that FEMA's minimum standards allow construction in mapped SFHAs (more commonly known as hundred year floodplains).⁸⁴ Because the minimum standards are intended primarily to reduce the risks to insured structures, they allow structures to be built in some parts of SFHAs, as long as the buildings are designed and constructed to minimize flood damage.⁸⁵

This reduces local flood resilience in two ways. First, it places new buildings in harm's way. FEMA's maps neither take into account the risks from erosion nor the risks from sudden changes in the shape and location of river channels, which is common in many Vermont watersheds. Property owners who receive permits to build in floodplains may be incurring risks that they do not fully understand. While those who purchase insurance policies will receive assistance to repair and rebuild after flooding, many do not carry such policies, and other sources of post-disaster recovery assistance are almost always inadequate for covering the cost of repairing

81. See FEDERAL EMERGENCY MANAGEMENT AGENCY, COMMUNITY STATUS BOOK REPORT: VERMONT (2013), available at <http://www.fema.gov/cis/VT.pdf> (listing the communities in Vermont that participate in the National Flood Program).

82. 42 U.S.C. § 4041 (2006).

83. 44 C.F.R. §§ 60.1–3 (2012).

84. *Id.* § 59.1.

85. MUNICIPAL GUIDE, *supra* note 3, at 1; RIVER CORRIDOR PROTECTION GUIDE, *supra* note 3, at 6–9; SAM RILEY MEDLOCK ET AL., PREPARING FOR THE NEXT FLOOD: VERMONT FLOODPLAIN MANAGEMENT 12 (2009), available at http://www.vermontlaw.edu/Documents/VLS.065.09%20LAND%20USE%20PAPER_PFF.pdf.

major damage.⁸⁶ Gaps in insurance coverage will increase as a result of 2012 Congressional reforms, which will eliminate some existing subsidies to older structures, and allow the cost of insurance to rise faster to meet liabilities. In the next few years, it is likely that fewer homes and businesses in flood hazard areas will maintain adequate insurance.⁸⁷

Allowing construction in floodplains not only exposes new buildings to flood risks, it also reduces floodplain storage, aggravating the risks to existing buildings, roads, and other infrastructure downstream of the development. Given the likelihood that the pool of insured structures in Vermont will decrease with rising insurance costs and property owners will have even more financial vulnerability, it seems more important than ever to protect floodplains by ensuring that we regulate their development with more robust standards than FEMA's minimums.

For the past forty years, the Vermont state land use permit process has added another important layer of review when someone wants to build something in a floodplain area. Under criteria 1(D) of Act 250, permit applicants must demonstrate that their projects will not cause "undue" impacts to floodplains.⁸⁸ In many municipalities, however, projects proposed in floodplain areas are not required to undergo this review because they are not large enough to trigger the Act 250's jurisdictional thresholds.⁸⁹ Many small residential and commercial projects in floodplains receive no Act 250 scrutiny.

During the 1990s a string of devastating floods led to several developments that fostered greater awareness across the state of the importance of floodplain services.⁹⁰ In the wake of their damage, the legislature passed Act 137, calling on the Department of Environmental Conservation to "define appropriate flood hazard mitigation measures."⁹¹

86. JACQUELYN MONDAY ET AL., AN EVALUATION OF COMPLIANCE WITH THE NATIONAL FLOOD INSURANCE PROGRAM PART A: ACHIEVING COMMUNITY COMPLIANCE 25-27 (2006), available at

<https://www.fema.gov/library/viewRecord.do?jsessionid=C01BEB73F17EB5B9711523E52AB0AEA6.Worker2Library?id=2589>; Discussion with Ned Swanberg, Flood Hazard Mapping Coordinator, Vt. Dep't of Envtl. Conservation (Nov. 2, 2012) (noting that in many Vermont communities the percentages of single-family homes that carry insurance is significantly lower than the national average).

87. Discussion with Ned Swanberg, *supra* note 86 (mentioning that insurance premiums for some homeowners in Vermont with older buildings are likely to rise significantly as the new reforms are implemented. The average homeowner in an SFHA already pays 1,400 dollars annually for every 170,000 dollars of coverage).

88. Land Use and Development Act, VT. STAT. ANN. tit. 10, § 6086 (2010).

89. *Id.* § 6001.

90. RESILIENCE, *supra* note 30, at 3.

91. tit. 10, § 905b(3)(A).

Act 137 led to the establishment of a state Rivers Program.⁹² Since 2004, the program has been developing partnerships with community-based organizations and other regional and local partners to assess the geomorphology (or physical condition) of specific sections (or reaches) of rivers.⁹³ More than 8,000 of Vermont's 23,000 river and stream miles have now been analyzed using aerial photography and 1,500 have had detailed field-based assessments.⁹⁴ Seventy-five percent of these studied river miles are unstable due to centuries of actions taken to control their flows and reshape their channels.⁹⁵ This work led to the profound discovery that river instability is largely responsible for the erosive floodwaters that put public safety and property at risk in Vermont, and that send large quantities of sediment and nutrients downstream where they harm river habitat and lake water quality.⁹⁶

Using these assessments, some community-based organizations have partnered with DEC on the development of river corridor maps and plans. River corridor maps identify the area that rivers need to meander, and achieve a more stable equilibrium that makes them less prone to flooding.⁹⁷ These maps are essential for making informed land use decisions that minimize hazards and protect floodplain services.

In some parts of the state, river corridor plans have been developed. These plans recommend specific steps for managing rivers back to an equilibrium condition through, for example, restoration projects or conservation of key remaining floodplains upstream of villages, or through upgrading under-sized bridges and culverts.⁹⁸

Finally, in recent years a number of communities (six percent of all Vermont municipalities) have responded to all of this new information by

92. VT. AGENCY OF NATURAL RES., OPTIONS FOR STATE FLOOD CONTROL POLICIES AND A FLOOD CONTROL PROGRAM 3 (1999), available at http://www.vtwaterquality.org/rivers/docs/rv_act137.pdf.

93. RESILIENCE, *supra* note 30, at 8–9.

94. *Id.*

95. *Id.*; VT. AGENCY OF NATURAL RES. & VT. AGENCY OF AGRIC., FOOD, AND MARKETS, VERMONT CLEAN AND CLEAR ACTION PLAN: 2010 ANNUAL REPORT 22 (2011), available at <http://www.leg.state.vt.us/reports/2011ExternalReports/265791.pdf>.

96. VERMONT CLEAN AND CLEAR ACTION PLAN, *supra* note 95, at 24–26.

97. The Vermont Legislature defined “river corridor” as “the land area adjacent to a river that is required to accommodate the dimensions, slope, planform, and buffer of the naturally stable channel and that is necessary for the natural maintenance or natural restoration of dynamic equilibrium conditions and for minimization of fluvial erosion hazards, as delineated by the agency of natural resources in accordance with river corridor protection procedures.” VT. STAT. ANN. tit. 10 § 1422 (2010). In other words, river corridors represent the areas where rivers need room to meander and adjust their form so that over time they can regain more stability. Development in these areas is subject to risk from erosion.

98. MICHAEL KLINE, RIVER CORRIDOR PLANNING GUIDE TO IDENTIFY AND DEVELOP RIVER CORRIDOR PROTECTION AND RESTORATION PROJECTS 1, 12 (2010), available at http://www.vtwaterquality.org/rivers/docs/rv_rivercorridorguide.pdf.

limiting future development in mapped river corridors.⁹⁹ They have formally adopted river corridor maps and passed bylaws that prohibit new structures within the corridors. In these communities, rivers have more room to move.¹⁰⁰ Many of these local bylaws incorporate the provisions of model bylaws developed by ANR.

C. The Challenges Ahead

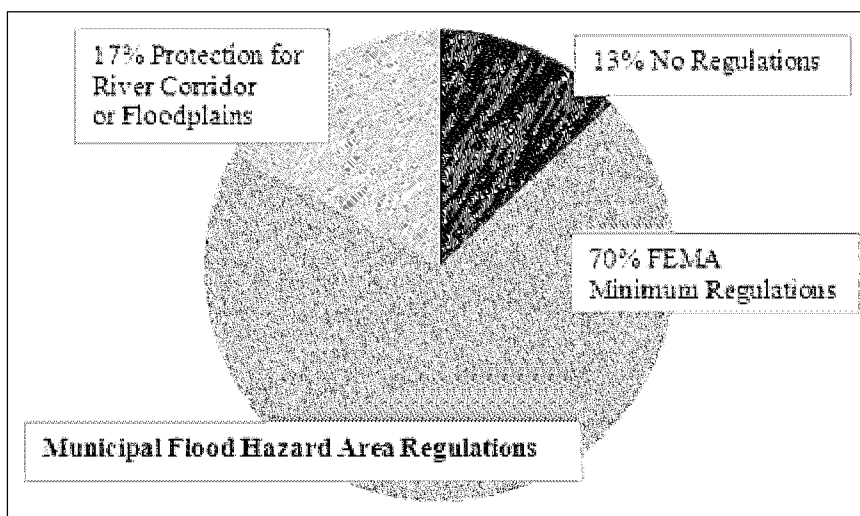
Compared with other flood years, then, Vermont emerged from Tropical Storm Irene with a more broadly accepted, science-based perspective on the true condition of the state's rivers. New knowledge, and the beginnings of some efforts to protect and restore the natural function of floodplains as an alternative to the ineffective structural approaches we depended on in the past has set the stage for an informed conversation about future disaster prevention.

As this conversation gets underway, it is important that we both acknowledge the progress made in the last decade and reflect on what adjustments might be needed to ensure even faster progress in the next.

One concern is that after nearly a decade of river assessments, river corridor planning, and work with communities on their flood hazard bylaws, the number of municipalities that have made a significant change in how they regulate floodplain development is still very small. Seventy percent of Vermont municipalities are still using regulations based on FEMA's minimum standards. Thirteen percent have no regulations at all.

99. VT. DEP'T OF ENVTL. CONSERVATION, RIVER, RIVER CORRIDOR, & FLOODPLAIN MANAGEMENT PROGRAMS: BIENNIAL REPORT TO THE GENERAL ASSEMBLY PURSUANT TO ACT 110, 25 (2013) [hereinafter Act 110 Report], available at <http://www.leg.state.vt.us/reports/2013ExternalReports/285582.pdf>.

100. *Id.*; RESILIENCE, *supra* note 30, at 8–10.

Figure 7¹⁰¹

An obstacle to achieving more floodplain protection at the local level is that communities do not have responsibility for managing flood hazards across an entire watershed. The hazards produced from placing fill and new structures on a particular floodplain primarily occur downstream.

When a municipality considers how strictly it should limit floodplain development, it must weigh the perceived benefits of accommodating new growth in the present against unknown future costs that will mostly play out in distant places. Passing a robust flood hazard bylaw can be difficult if elected officials fear that their citizens will not easily see the benefit. Some municipal governments in Vermont may resist the adoption of strong bylaws unless and until they have confidence that other upstream and downstream communities will do the same, creating long delays in their dissemination throughout watersheds.

An additional challenge springs from the size of Vermont's town governments. Many Vermont towns are run on the dedication and hard work of volunteers who maintain other day jobs. ANR offers technical assistance to evaluate flood hazards and improve municipal plans and bylaws. But even with this help, the work involved is substantial and few communities begin it without a compelling reason and a deadline.

Most of the communities that have updated their local regulations in the last five years have done so in response to a pressing deadline from

101. Ned Swanberg, *supra* note 11.

FEMA.¹⁰² When FEMA updates floodplain maps, all of the communities in the mapped areas must formally adopt the new maps and update local regulations to meet or exceed minimum standards for NFIP jurisdictions.¹⁰³ This requirement creates an opportunity for ANR to offer technical assistance and to encourage the adoption of stronger regulations. Without the FEMA deadlines, progress is much slower, and FEMA has not scheduled an update any of its maps in eight Vermont counties.¹⁰⁴

A few other communities have adopted bylaws because they have experienced recent flood damage.¹⁰⁵ Since Tropical Storm Irene, the Department of Environmental Conservation's Rivers Program has experienced an upsurge in requests for help analyzing and mitigating flood hazards. But the volume of requests may ebb with the passing of time.

Lastly, even when municipalities do establish bylaws governing land use in floodplains, effective administration and enforcement may not occur. When ANR or FEMA audit town permitting files—a practice aimed at evaluating whether towns are meeting requirements for participation in the NFIP—the agencies often find that local bylaws are being inconsistently applied.¹⁰⁶ Frequent turnover in town offices and leadership is one reason for this; it creates a high hurdle for building institutional knowledge of local flood hazard regulations and how to apply them to development proposals.

These challenges are inherent in our system of small town governments, and they should not obscure the fact that Vermont's town officials are deeply committed to keeping their residents safe and managing development in accordance with the public interest. Over time, it is likely that the state will continue to make incremental progress toward greater protection for floodplains. The critical question is whether this progress will be swift and consistent enough to improve our flood resilience even as climate change brings more frequent and intense storms.

D. Options for Enhancing Flood Resilience

In the spring of 2012, the Institute for Sustainable Communities, a non-profit organization based in Montpelier, Vermont, began a partnership with

102. ACT 110 REPORT, *supra* note 99, at 25.

103. 44 C.F.R. § 60.3 (2012).

104. Ned Swanberg, Vt. Agency of Natural Res., Presentation to the Burke Planning Commission (Nov. 13, 2012) (showing the absence of a plan to update maps in Addison, Caledonia, Essex, Franklin, Grand Isle, Lamoille, Orange, and Orleans counties).

105. ACT 110 REPORT, *supra* note 99, at 25.

106. Discussion with Rob Evans, Manager of River Corridor and Floodplain Mgmt. Section of Vt. Dep't of Env'tl. Conservation (Oct. 12, 2012); JACQUELYN MONDAY ET AL., *supra* note 86, at xii (noting that local administration of NFIP standards varies based on several factors including resources, staffing, turnover, and expertise of local personnel).

the state to initiate the Resilient Vermont Project.¹⁰⁷ The project is bringing together a range of public and private organizations to bolster the state's resilience by producing (1) an inventory of the many resilience-building activities underway throughout the state; (2) a shared vision of "resilience" in the Vermont context; and (3) a prioritized menu of actions and investments that will move the state toward that shared vision.¹⁰⁸

During this collaborative process, participants representing community-based organizations, businesses, the agricultural and forestry sectors, environmental non-profits, state agencies, and other groups will explore new ideas about how the state can best prevent, respond to, and recover from future natural disasters. We should not miss the opportunity to discuss how we can accelerate the protection of floodplains, while also supporting efforts aimed at making river valley communities grow and thrive.

The remainder of this paper outlines potential changes to state policies or programs that, while far from exhaustive, suggest a starting point for discussion. The authors urge the Resilient Vermont Project to explore these proposals.

1. Option One: Expand Assistance and Incentives for Municipalities

A first option is to expand the assistance available to help Vermont's diverse villages, towns, and cities assess local flooding hazards and evaluate their standards for regulating development in floodplains.

As noted above, some towns have already worked closely with ANR's Rivers Program, regional planning commissions, watershed groups and other partners to make local development more flood resilient. They have developed river corridor maps to supplement FEMA's maps, and a few have incorporated standards recommended in model bylaws. These early adopting communities have often been keenly aware of the value of protecting floodplain services.

Most communities, however, still do not have access to river corridor plans and maps. These communities cannot analyze where existing development—sometimes even critical facilities like town offices or fire stations—is situated in areas vulnerable to erosion hazards. They also lack local land use regulations that prevent future development in these areas. The state and others are asking what they could do to better assist these communities.

107. Institute for Sustainable Communities, *Toward a More Resilient Vermont*, ISCVT.ORG (July 10, 2012), <http://www.iscvt.org/news/toward-a-more-resilient-vermont>.

108. Liz Schlegel, *Institute for Sustainable Communities Launches 'Resilient Vermont' Partners with State to Help Vermont Move from Recovery to Resilience* (July 10, 2012), available at http://www.iscvt.org/who_we_are/publications/ISC%20RVT%20Release.pdf.

As a first step, ANR is planning to produce and make available a complete set of river corridor maps for all of Vermont's river miles.¹⁰⁹

Accompanying the provision of river corridor maps could be an effort to provide municipalities with more technical assistance for reviewing and updating floodplain bylaws. While this kind of help is already available to towns that seek it out, a better funded and more proactive effort to assist local governments across the state has the potential to hasten the pace at which communities adopt strong floodplain development controls.

Additional assistance could also be made available to help municipalities identify and mitigate risks to existing roads, water, wastewater, and/or other important public facilities.

Another means of helping municipalities make what are often difficult land use decisions in river corridors is to provide meaningful financial incentives. Recovery and Resilience the Vermont Way—a 2011 report issued after a meeting between Vermont's senior state officials and disaster recovery and prevention specialists from other parts of the country—recommended that Vermont “use the power of state funding to create incentives for local municipalities to prevent new development in floodplains and restore vegetated buffers.”¹¹⁰ The report offers as an example giving municipalities that limit floodplain development priority funding for community development.¹¹¹

Vermont's legislature embraced this idea in the spring of 2012 when it passed Act 138. The new law mandates the development of a Flood Resilient Communities Program to aggregate and publicize a range of state incentives for local land use plans, policies, and regulations that address flood hazards and improve the protection of floodplains.¹¹²

The program will be developed over the next year. It will include a major new incentive in the form of enhanced disaster recovery assistance. After federally declared disasters, municipalities can apply for Public Assistance Grants from FEMA to repair or replace damaged infrastructure such as roads and bridges. Municipalities must provide a twenty-five percent local match for these federal funds, and the state contributes to that required local match via a special fund called the Emergency Relief and Assistance Fund (ERAF). Under a new state rule promulgated in 2012, municipalities that take certain actions to reduce their risk of flood damage—such as adopting a local flood hazard bylaw or Hazard Mitigation Plan—will be eligible to receive a larger contribution from the Fund towards their required local match. Municipalities that take all of the

109. ACT 110 REPORT, *supra* note 99, at 11.

110. RECOVERY AND RESILIENCE: THE VERMONT WAY, *supra* note 20, at 8.

111. *Id.* at 9.

112. VT. STAT. ANN. tit. 10, § 1428(c) (2010).

actions listed in the rule will receive as much as seventy percent of their required twenty-five percent match from the state fund, reducing the amount of local resources they must expend significantly.¹¹³

2. Option Two: Improve State Review of Municipal Floodplain Permits

While permitting development in floodplain areas falls primarily within the purview of Vermont's cities and towns, the state oversees some municipal permits. Under Chapter 117 of Vermont statutes, municipalities that participate in the National Flood Insurance Program must seek the state's review of permit applications for development in SFHAs.¹¹⁴ Through this collaboration, the floodplain managers at ANR can help town officials understand and consistently apply local bylaws and ordinances. The state can also inform local officials and planners about the flood risks that new buildings will face when local bylaws stop short of prohibiting new structures in flood hazard areas. Finally, ANR's floodplain managers can help municipal planners identify erosion hazards that are not addressed by FEMA's standards, but that are endemic to Vermont's steep river valleys and fast-moving rivers.

There are ways to make the state's statutorily required review of local permits in SFHAs more effective. First, the state could create and publicize clearer guidance about the nature of this municipal requirement, to ensure that all NFIP communities submit their permits for technical review. A further step could tie federal and state grants to municipal participation, and to the consistency with which municipalities incorporate the comments they get into permit decisions and conditions.

3. Option Three: Develop Uniform State Standards for Floodplain Development

Some states, such as our neighbor Massachusetts, have established minimum standards at the state level that are more protective of floodplain resources than FEMA requires. Establishing a set of state standards for development in floodplain areas would represent a change in course for Vermont. Municipalities would still create and adopt flood hazard bylaws and issue permits in accordance with those regulations. However, minimum state standards would ensure greater consistency in how those bylaws protect remaining floodplains. Today only six percent of Vermont

113. Milly Archer, *Flood Damage Mitigation Incentives for Municipalities Under the New ERAF Rule*, VT. LEAGUE OF CITIES & TOWNS NEWS, Nov. 2012, at 1, 6, available at http://www.vlct.org/assets/News/Newsletter/2012/vlctnews_2012-11.pdf.

114. VT. STAT. ANN. tit. 24, § 4424 (2007).

municipalities prohibit new structures in river corridors, where the risk of damage from erosion is greatest.¹¹⁵ Setting a state standard would allow Vermont to prohibit new structures in all river corridors. Minimum standards could also enhance the degree of flood proofing required if and when structures were allowed in these areas.

Vermont recently took a step toward a greater state role in setting standards when the Legislature passed Act 138 last spring. Among other flood resilience measures, Act 138 requires ANR to develop a new set of state “Floodplain Rules,”¹¹⁶ to regulate land uses on floodplains that are exempt from municipal regulation (including agriculture, silviculture, transportation, utilities and schools). ANR and other state agencies will develop these new rules by the spring of 2014.

4. Option Four: Expand and Strengthen Act 250 Permitting

Historically, Act 250 has provided an important tool for protecting floodplains. Any project or subdivision requiring an Act 250 permit must meet the Act’s requirements under criteria 1D, which aim to prevent certain defined impacts to floodplain capacity. Act 250 permitting has augmented the review that floodplain projects get through local permitting. Two aspects of the Act 250 regulatory process are critical in defining and limiting the reach of this oversight.

First, only larger projects fall under Act 250 jurisdiction. In municipalities that have permanent zoning and subdivision bylaws, commercial and industrial development is only required to have an Act 250 permit if it is to be situated on a tract of land larger than ten acres.¹¹⁷ In municipalities that do not have these local regulations, commercial and industrial development must have an Act 250 permit if it is on a tract of land larger than one acre.¹¹⁸ In all municipalities, Act 250 review is only required for residential projects when they include ten or more units.¹¹⁹ Across Vermont, incremental small-scale development in floodplains receives little scrutiny under Act 250, despite its potential to increase hazards downstream.

Second, when new construction undergoes Act 250 review, the standards used to determine what constitutes an “undue” impact to “floodways” under Criteria 1D are often not robust enough to preserve the floodplain’s natural functions. Act 250 standards stop short of prohibiting

115. ACT 110 REPORT, *supra* note 99, at 25

116. VT. STAT. ANN. tit. 10, § 754(a) (2012).

117. *Id.* § 6001(3)(A)(i).

118. *Id.* § (3)(A)(ii).

119. *Id.* § (3)(A)(iv)

new structures or new fill in SFHAs.¹²⁰ When new structures or fill are allowed, the standards call for some basic flood-proofing to keep built structures sound even when floodwaters lap at their doorstep.¹²¹

Act 250 has been and will continue to be an important asset for protecting floodplain areas. Vermont could, however, consider two possible changes to the Act 250 process to improve floodplain protection and flood resilience. First, the Legislature could adjust the regulatory thresholds that trigger the permit requirement. Act 250 jurisdiction could be triggered by any development in a floodplain, regardless of its size.

Second, the Legislature could strengthen the definition of “undue” and “unreasonable” impact under criteria 1D. Construction and fill could be prohibited in SFHAs. Alternatively, permit applicants could be required to demonstrate that their project would not cause any adverse impacts to floodplain functions by, for example, submitting models that demonstrate that the proposed development would not increase the velocity of floodwaters.

5. Option Five: Create Incentives for Flood Resilient Land Management

A final option for additional floodplain protection lies in Vermont’s Current Use Program. Created in 1978, the Program, administered by the Vermont Department of Taxes, offers owners of agricultural and forest land use value taxation—taxation based on the land’s productive value rather than its “highest and best” value (its value for development).¹²² The program is designed to lower property taxes on those maintaining property for working agriculture and forestry. The hope is that the reduced tax burden will encourage property owners to leave the land undeveloped.

While the Current Use Program was created primarily to preserve Vermont’s working landscape, its value for helping Vermont avoid flood damage is noteworthy. As of 2012, over two million acres of forest and agricultural land belonging to more than 17,000 property owners across Vermont were enrolled in the Program.¹²³ The enrolled forested lands soak up precipitation in every major watershed in the state, slowing runoff into

120. See VT. AGENCY OF NATURAL RES., TECHNICAL GUIDANCE FOR DETERMINING FLOODWAY LIMITS PURSUANT TO ACT 250 CRITERION 1(D) 5 (2009), available at http://www.vtwaterquality.org/rivers/docs/rv_floodway_tech_guidance_10-09-09.pdf (allowing projects within 100-year floodplain); see also 44 C.F.R. § 60.3 (2012) (defining SFHA as the area within the 100-year floodplain).

121. TECHNICAL GUIDANCE FOR DETERMINING FLOODWAY LIMITS PURSUANT TO ACT 250 CRITERION 1(D), *supra* note 120, at 5.

122. See generally VT. DEP’T OF FORESTS, PARKS, AND RECREATION, USE VALUE APPRAISAL PROGRAM MANUAL (2010), available at <http://www.vtfpr.org/resource/documents/UVAManual.pdf>.

123. VT. DEP’T OF TAXES, 2013 ANNUAL REPORT 23 (2013), available at http://www.state.vt.us/tax/pdf.word.excel/pvt/reports/2013/2013AnnualReport_Rev20130118.pdf.

streams and rivers. The enrolled agricultural lands provide those essential floodplains that give rivers the room they need to spread out and release energy.

While the Current Use Program has made the state more flood resilient, the Program could be modified to provide greater benefits. One option would be to incentivize the adoption of flood resilient land management practices on enrolled lands. Agricultural landowners could garner additional tax breaks by maintaining a vegetated riparian buffer larger than the minimum buffer required under Vermont's Accepted Agricultural Practices.¹²⁴ Qualified landowners could also be offered financial incentives to incorporate other management techniques designed to slow or store stormwater.

A similar financial incentive could be offered to forestland owners who commit to implementing forest management practices that maximize the services their lands provide for absorbing and slowing stormwater. Examples of such practices might include removing temporary logging roads and increasing the size of culverts needed to ensure that higher stream flows are not blocked in a manner that may wash out roads and destroy habitats.

A set of financial incentives for flood resilient land management would provide ecological benefits beyond dampening high-river flows. Runoff from farmland and other uplands washes phosphorus into rivers and streams, where it is carried to Lake Champlain and many other lakes across Vermont. In addition, high river flows scour phosphorus-laden sediment off the banks of streams and rivers. Enhancing the storage of stormwater on lands enrolled in the Current Use Program would not only address future flood hazards, but also reduce phosphorus pollution that harms aquatic ecosystems.

CONCLUSION

Vermont's response to Irene thus far has shown that we can come together to overcome incredible challenges. We can continue to work together to explore actions and public policy changes that will advance our ability to reduce future flood damage while advancing other important goals such as restoring the ecological health of our watersheds and fisheries.

Our opportunity to act is, however, time limited. Experience with natural disasters across the United States has shown that awareness of risk among the public and among elected leaders can be short-lived. In

124. *Accepted Agricultural Practices (AAPs)*, VT. AGENCY OF AGRIC., <http://www.vermontagriculture.com/ARMES/awq/AAP.html> (last visited Dec. 6, 2012).

Vermont, it is critical to take steps now to prevent future damage, before our own heightened awareness of our vulnerability to future hurricanes recedes and other critical community issues demand renewed attention.

The collaborative work among state agencies that blossomed following Irene must continue in order to achieve this goal. Equally important, state agencies must engage more broadly with municipal governments, federal agencies, regional planning commissions, businesses, farmers, housing advocates, environmental and conservation groups and the Vermont public. This was the recommendation of the Governor's Council on Community Design and is the hope of the participants in the dialogue being led by the Institute for Sustainable Communities.¹²⁵ Through this dialogue, we can find a shared understanding of our challenges and the opportunity to develop a common understanding of the necessary solutions. Every Vermonter can benefit from building a Vermont that is stronger and more resilient.

125. RECOVERY AND RESILIENCE: THE VERMONT WAY, *supra* note 20, at 8 (2012).