Basin 11 Management Plan

West River, Williams River, Saxtons River

Vermont Agency of Natural Resources

June 2008

Agency of Natural Resources
Department of Environmental Conservation
Water Quality Division
Waterbury, VT 05671-0408

Cover photo: Turkey Mountain Brook at Burbee Pond Outlet, Windham

THE BASIN 11 WATER QUALITY MANAGEMENT PLAN WAS PREPARED IN ACCORDANCE WITH 10 V.S.A. SECTION 1253(D), THE VERMONT WATER QUALITY STANDARDS, THE FEDERAL CLEAN WATER ACT AND 40 CFR 130.6.

Approved and adopted:

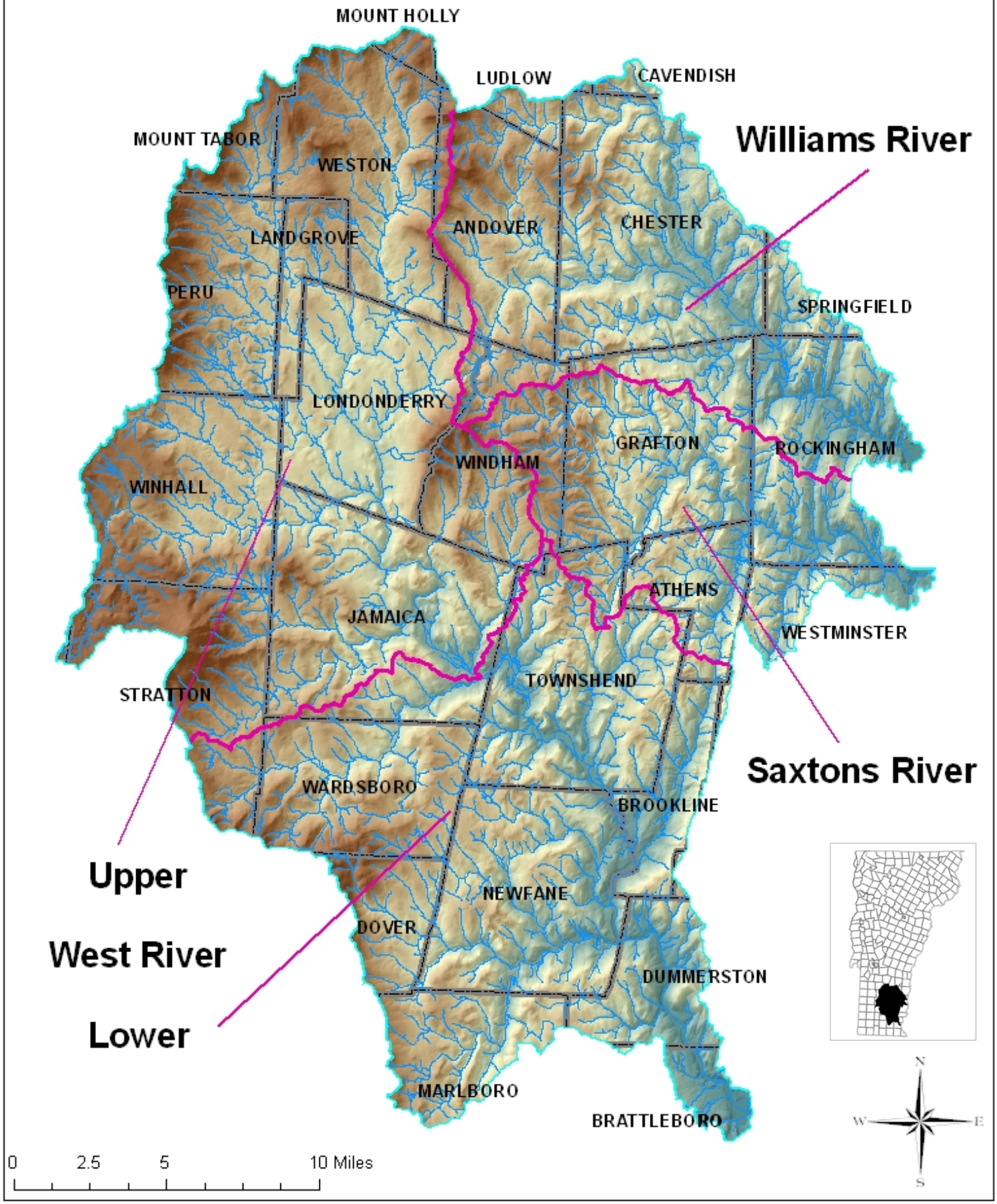
Laura Pelosi, Commissioner
Vermont Department of Environmental Conservation

6/26/08
Date

George Crombie, Secretary
Vermont Agency of Natural Resources

6/26/08
Date

Basin 11


MOUNT HOLLY
LUDLOW
CAVENDISH
Williams River
MOUNT TABOR
WESTON
ANDOVER
CHESTER
LANDGROVE
PERU
SPRINGFIELD
LONDONDERRY
GRAFTON
ROCKINGHAM
WINDHAM
WINHALL
ATHENS
JAMAICA
WESTMINSTER
TOWNSHEND
STRATTON
Saxtons River
WARDSBORO
BROOKLINE
Upper
NEWFANE
West River
DOVER
DUMMERSTON
Lower
MARLBORO
BRATTLEBORO
0
2.5
5
10 Miles
N
W
E
S

Basin 11 Towns

West River

Athens
Brattleboro
Brookline
Dummerston
Dover
Grafton
Jamaica
Landgrove
Londonderry
Marlboro
Mount Holly*
Mount Tabor
Newfane
Peru
Putney*
Stratton
Sunderland*
Townshend
Wardsboro
Westminster
Weston
Wilmington
Windham
Winhall

Williams River

Andover
Cavendish*
Chester
Grafton
Londonderry
Ludlow*
Rockingham
Springfield
Weston
Windham

Saxtons River

Athens
Grafton
Rockingham
Townshend
Westminster
Windham

* Towns with small areas in Basin 11

Table of Contents

List of Tables

List of Figures

About This Plan

i. Whose Plan Is It

Development of the Basin 11 Management Plan has taken a circuitous route over its lifetime. Beginning in 1998 with a small group of concerned watershed residents and a few regional organizations, a series of public forums led to the West River "Action Plan." One of the first actions implemented was the formation of a local watershed group to carry out the suggested tasks for water quality and watershed improvements. Formed in 2000, the fledgling West River Watershed Alliance (WRWA) partnered with the Windham County Natural Resources Conservation District (WCNRCD) to hire a part-time watershed coordinator, Em Richards, to begin drafting a basin plan following the guidelines of the Agency of Natural Resources and funded by the Agency.

Hundreds of meetings, participants and presentations later, the draft plan was turned over to the Vermont Department of Environmental Conservation's newly established Watershed Coordinator, Marie Levesque Caduto. That very public process has led to this plan.

ii. What Is In The Plan

The plan is laid out to allow the reader to develop an understanding of the basin and the issues facing it, and then it progressively gets more specific. Each issue of concern is described in detail identifying the known causes and the water quality, habitat or other factors being impacted by those causes. Recommendations are made for addressing each issue and action steps (strategies) to take are listed for each recommendation. Impaired waters and those in need of further assessment to determine their condition are listed to guide future studies and actions. Water management classification and typing recommendations are proposed for consideration by the Water Resources Panel as are waters to consider for other forms of protection such as Outstanding Resource Water status.

In this way we hope to clearly reveal what interested people can do, now and over the coming five years, to improve water quality by taking often small but sometimes large steps toward solutions.

iii. How To Use This Plan

Our hope is that this is a living plan for people throughout the Basin and not a stale document that collects dust on a shelf. Our goal is to have the recommendations and strategies implemented over the five-year life of the plan by individuals on their own property, local groups in their areas, and regional, state and federal agencies throughout their territories.

The Plan can be used to:

- ✓ Learn about the Basin and the three watersheds in it;
- ✓ Understand what is happening in the watersheds and what issues have emerged as concerns;
- ✓ Discover how you, your group, or your agency can be involved in achieving better water

quality in our rivers, streams, lakes and wetlands; and

- ✓ Take individual action to create a better environment for ourselves and a healthier watershed for all the life with which we share it.

WCNRCD Watershed Coordinator Em Richards teaching
water quality monitoring

The Basin Plan serves:

- as a guidance document for collaborating partners, as well as any individual or group that works on watershed issues.
- as a guide for the VANR and the USEPA (and other federal, state, and local agencies) in its effort to protect and improve State watersheds to the level required by the Vermont WQS.
- as a platform for a petition to the State to classify waters in establishing water quality management goals.

Watershed groups and interested parties will be able to use the information in the plan to:

- improve understanding of the watersheds and water-based resources and promote watershed education efforts;
- consider and implement project ideas related to water quality or water resource development;
- identify technical or financial resources for project implementation;
- identify the technical or financial needs of potential partners;
- support grant proposals;
- provide guidance to local and regional planning and zoning processes;
- provide guidance to state land use regulatory processes.

Vermont ANR programs will use the solutions or strategies in the plan to help guide decisions regarding allotment of technical and financial resources. In addition, VANR review of permit applications for potential impact to water resources is guided by the management goals for State surface waters adopted during the planning process.

It should be emphasized that although the basin planning process is governed by state and federal law and regulation, the Basin 11 initiative has been organized by local associations, agencies, and individuals, with the assistance of State and Federal agencies, to restore **impaired waters** and protect all waters. Together, federal, state, and local government and private organizations and citizens can solve problems, develop projects and new action plans, and forge partnerships to conserve, and restore water resources in the basin.

Executive Summary

Vermont Agency of Natural Resources
Basin 11 Management Plan
for the
West River, Williams River, Saxtons River

Preliminary Draft

A basin plan provides an overview of a watershed's health and a description of the prospective and ongoing steps to restore and protect its waters. With the purpose of improving both water quality and aquatic habitat, a basin plan presents the recommendations of local watershed residents, stakeholders from varying interests and natural resource professionals from many agencies, to guide the Vermont Agency of Natural Resources (VANR) in its work.

By identifying local concerns, known pollution problems and threats to water quality, actions can be taken to address issues, prevent or stop pollution and improve existing conditions. The basin planning process involves myriad voices, local landowners, business interests, farmers, foresters, municipalities, regional planning groups, environmental organizations, natural resource professionals and state and federal agencies. The concerns identified here have been brought to the table by individuals and are addressed by the entire group in the hope of seeing and promoting options from all possible sectors. A sediment-laden stream may be addressed by dealing with streambank erosion, road improvements, construction runoff or a fallow farm field. All these must be examined and the thoughts and perspectives of the many people involved in this plan have fostered this approach.

The greatest concerns in Basin 11 are 1) thermal modification or a change in temperature from the natural condition of the stream; 2) sedimentation; 3) habitat alteration; 4) flow alterations; and 5) pathogens. These top five concerns along with nutrient loading, atmospheric deposition of pollutants and invasive species are addressed in this plan.

Thermal modification impacts 107 river miles of the Basin, the largest impact of any pollutant addressed. Temperature is a primary regulator of biological activity and an increase in the temperature regime of streams may have an adverse impact on fish populations by increasing their rate of metabolism while, at the same time, reducing the amount of dissolved oxygen in the water. Elevated water temperatures may reduce the vigor of cold-water fish species and make them more susceptible to disease or parasites. Recommendations for addressing temperature changes include:

- planting **riparian** buffers;
- educating agriculture and forest industry personnel on the positive water quality impacts of AAPs and AMPs;
- increasing the amount of forestland being managed sustainably with water quality protection as an integral goal;
- investigating, educating on and promoting **low impact development** solutions; and
- removing obsolete and non-essential impoundment structures.

Sedimentation has been identified as the second greatest cause of impacts to the rivers and streams of Basin 11. It is also the largest threat to aquatic habitat, biota, and other uses of these waters. Deposited sediments can smother aquatic insect communities, destroy fish spawning and habitat areas, deplete dissolved oxygen, increase streambank erosion, and diminish recreational and aesthetic uses of waterways. Sedimentation is also associated with nutrient enrichment as nutrients commonly bind to soil particles and result in nutrient loading as soil erosion takes place. The sources of much of the sedimentation and subsequent nutrient enrichment can be traced back to specific land use practices such as gravel back roads, eroding streambanks, construction sites, and runoff from urban and agricultural areas. Recommendations for addressing sedimentation include:

- reducing gravel road erosion;
- replacing the Ball Mountain dam gates to enable "run of river" flows;
- reducing sediment that enters surface waters from urban and residential areas;
- implementing streambank restoration and preservation projects; and
- investigating, educating on and promoting low impact development solutions.

Physical habitat alterations are changes in the form, structure and course of the waterway and result from flow changes and regulation, channelization or instream modifications, road and bridge work, and channel instability. The fluvial geomorphic adjustments that occur in response to these disturbances are part of a predictable process that often results in conflicts with human investments along riparian corridors such as roads, bridges and culverts, railroads, agricultural lands, and residential and commercial structures. As these conflicts build, traditional channel management activities contribute to a vicious cycle of ever-increasing conflict and instability. Similarly, existing floodplain land management mechanisms inadequately protect against encroachments that directly or indirectly lead to greater channel instability and increased magnitude of sediment discharge. Recommendations for addressing habitat alterations include:

- conducting stream geomorphic assessments;
- implementing streambank restoration and preservation projects;
- establishing or increasing buffers along surface waterways;
- increasing awareness of maintenance measures that will reduce back road erosion; and
- determining the impacts of flood control dams on aquatic biota and physical habitat upstream and downstream from the USACE dams.

Flow alterations are another important condition affecting our rivers and streams. Changes in the natural flow regime caused by dams, hydroelectric operations and water withdrawals change the physical, ecological and social characteristics of a river. These have multiple effects on rivers and riverine habitat. Changes range from a minor alteration of depth and velocity in the case of low-head, run-of-the-river dams, to a complete change from river to lake characteristics in the case of large dams. Dams can flood upstream habitat and act as barriers to upstream and downstream movement of aquatic organisms. Dams also block sediment transport, causing sediment to build up behind dams as well as causing sediment "starvation" downstream. Recommendations for addressing flow alterations include:

- completing assessments of all dams in the basin to identify potential candidates for removal;
- removing obsolete and non-essential impoundment structures;
- conducting studies to determine water resource capacity and capacity limits;

- monitoring compliance and enforcement of the West River flood control dams with the coordination plan in place with VANR and USFWS;
- providing public outreach and river stewardship education pertaining to the adverse impacts of rapid releases from flood control dams on stream habitat, biota and water quality; and
- coordinating the efforts of Federal, State, and local agencies to address fish passage issues and natural flow regimes at dams in the West and Williams Rivers.

Pathogens are any disease-causing organism, including bacteria, viruses, and protozoa. The pathogens that are of concern in Vermont surface waters are those that come from fecal matter of humans and other warm-blooded animals. These pathogens cause gastrointestinal problems and become a more serious health risk to people who have weakened immune systems. Surface waters containing this waste pose a risk to human health when ingested through drinking water or inadvertent ingestion through contact recreation. The most likely source of human waste or sewage is from malfunctioning wastewater treatment plants and septic systems. Sources of animal waste are highest in urban areas due to pet wastes and agricultural areas due to fertilizing with manure. Wildlife that resides in the water can also contribute pathogens. Recommendations for addressing pathogens include:

- identifying surface waters with elevated levels of pathogens and disseminate this information to the public;
- working with towns, local agencies and organizations to eliminate sources of potentially harmful pathogen influx;
- reducing pathogens that enter surface waters from agricultural land uses from the application of manure;
- reducing pathogens that enter surface waters from urban and residential areas;
- seeking increased funding opportunities for water quality BMPs and implement these BMPs on willing farms;
- continuing outreach to farmers about new AAPs and cost-share programs;
- working with the Town of Londonderry to investigate and remediate bacteriological inputs into the West River; and
- installing composting toilets along the Rock River access trail to prevent untreated human waste from being washed into the river.

Under USEPA guidance and federal regulations, impaired waters, meaning those that do not meet Vermont Water Quality Standards, must be identified by the State and reported under Section 303(d) of the Clean Water Act. All waterbodies identified as impaired in the State's 303(d) list are scheduled for the development of a TMDL (Total Maximum Daily Load) pollution source control plan. The State is currently at work on TMDLs for the impaired surface waters of Basin 11. Ball Mountain Brook above the North Branch confluence and Styles Brook (VT11-15) has a completed TMDL. In the 2006 Vermont 303(d) List of Impaired Waters for Basin 11, the West River below Ball Mountain Dam (VT11-10) has sediment and temperature impairments, and the river one mile above and below the village of South Londonderry (VT11-17) is impaired for *E. coli* bacteria. Bear Creek and, portions of Kidder Brook and Ball Mountain Brook are listed as impaired for acid deposition . Waters listed on previous 303(d) lists are in various stages of TMDL development.

Vermont Water Quality Standards require that all Class B waters be divided into Water Management Type B(1), Type B(2) and Type B(3) as part of this basin planning process. These

types are based on both existing water quality and reasonably attainable and desired water quality goals. The proposed management goals for Basin 11 are presented to each municipal selectboard and/or planning commission in the West, Williams, and Saxtons River watersheds. Each town is asked to review the proposal and provide input to ensure that the Agency of Natural Resources' suggested management goals are compatible with their town goals for surface waters.

The proposal for re-classification and typing is based on current water quality, habitat and biota as well as land cover, land use and the expectations for land use set out in each town plan. The management goals associated with typing and classification pertain to water quality. The means of achieving these goals will relate to land management, stormwater management, and the implementation of Accepted Agricultural Practices, riparian corridor protection, erosion control practices for construction sites, better road management practices, and Acceptable Management Practices for silviculture among others. The quality of surface waters in Vermont is highly dependent upon the content and amount of surface runoff from surrounding land.

Over the five year life of this plan, the Agency of Natural Resources will focus on implementation of the recommendations and strategies herein. In collaboration with all the partners referenced, with the support of municipal governments, and with the energy of watershed residents interested in improving the quality, ecology and enjoyment of the West, Williams and Saxtons Rivers, the next basin plan will be able to document a wide range of improvements made by the work of many hands and move on to address new and emerging challenges that lie ahead.

Part I Action Plan

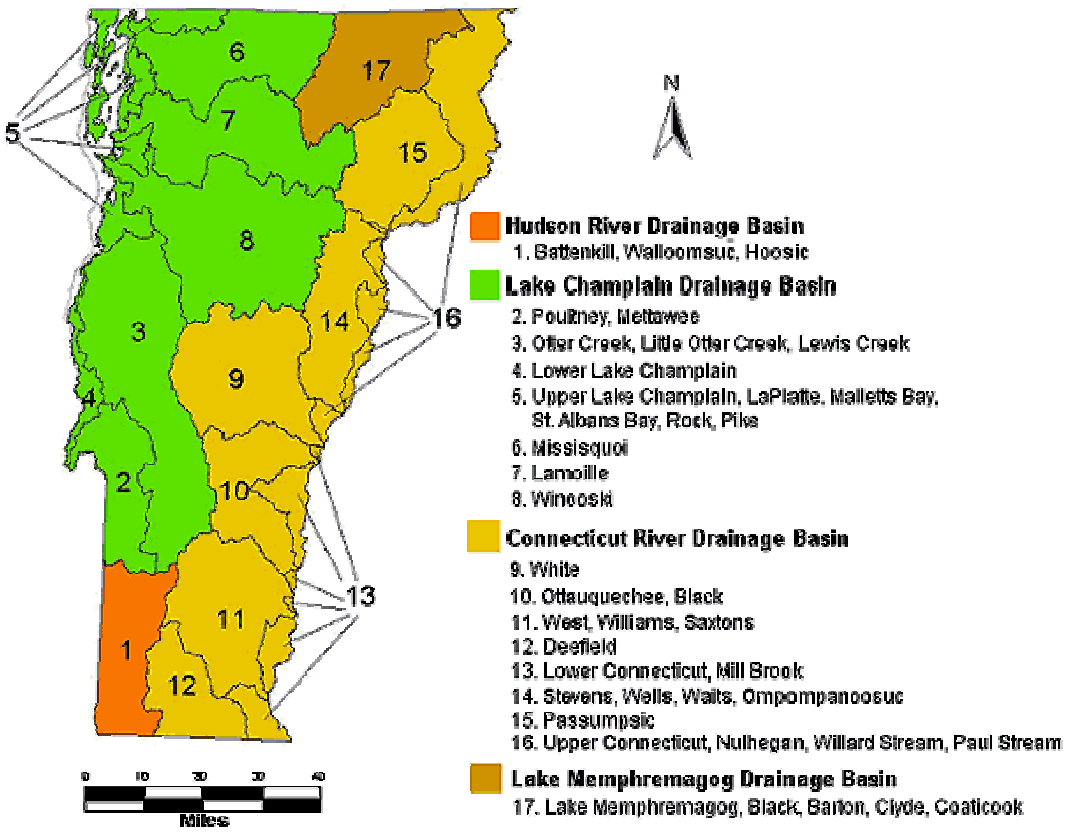
1. Introduction

What is a watershed?

A **watershed**[1] is a distinct, topographically-defined land area that drains into a single river, river system or standing body of water. Because rivers may join to become larger rivers, many watersheds may be considered sub-watersheds of a larger river. As one would expect, the activities taking place on the land within a watershed play a critical role in the quality of water draining from the area within it. A watershed is an ecological unit based on topography rather than political boundaries.

A river **basin** for the purposes of this document is one of seventeen planning units in Vermont. Some basins include only one major watershed after which it is named such as the White River Basin. Other Basins include two or more major watersheds such as in this Basin which encompasses the West, Williams and Saxtons Rivers into Basin 11.

Figure 1 - Seventeen State-designated Basins



[1] **Bold** references are defined in the Glossary.

Water quality conditions, current issues and threats for these three watersheds will be discussed and addressed in this document, *The Basin 11 Management Plan*.

In general, a basin plan provides an overview of a watershed's health and a description of the prospective and ongoing steps to restore and protect its **waters**. In the Basin 11 planning initiative the Windham County Natural Resources Conservation District (WCNRCD) and its partners, the West River Watershed Alliance (WRWA), the Windham Regional Commission (WRC) and the Southern Windsor County Regional Planning Commission (SWCRPC) in a cooperative effort with the Vermont Agency of Natural Resources (VANR), specifically its Department of Environmental Conservation (VDEC), have involved a wide range of stakeholders to develop a document purposefully designed to help maintain and improve surface water quality for the three watersheds.

The Basin 11 Management Plan addresses the community's and the State's most prevalent and pressing concerns regarding water quality. The basin plan helps communities decide how to restore waters most affected by polluted run-off and protect waters and adjacent access areas threatened by pollution. Local concerns toward water quality, uses, and values have been identified and issues have been prioritized and discussed to assist local planners and decision-makers in directing available funding resources toward environmentally and economically sound implementation strategies.

2. Resolving State and Local Water Quality Issues and Concerns

In the Basin 11 planning initiative, a watershed approach has been used to integrate and include recommendations and strategies derived from public involvement in order to more effectively protect and manage surface water and ground water resources. Water quality issues were identified through the public process (described in Part II) and have been categorized under seven topics. The topics include: Water Quality, Land Use, Public Access, Road Maintenance, Dams and Impoundments, Water Withdrawals, and Watershed Education. These topics and their related issues have been examined by the Basin 11 Watershed Council in detail through a multi-year process. The Basin 11 Watershed Council serves as the main body that guides the basin planning process within the watershed. The open ended Council, comprised of volunteer local watershed constituents, is guided and supported by a Watershed Coordinator. Basin 11 Watershed Council members and their technical advisors have considered recommendations and suggested strategies to address respective watershed issues. In-depth summaries of the recommendations and strategies to address the issues are presented in Chapter 4 of Part II. From these recommendations and strategies, specific project plans have been developed and prioritized to be implemented over the next five years.

The projects, selected from each of the seven topic areas, listed above, are presented in Table 1 with specific information to facilitate implementation.

Table 1 - Basin 11 Priority Projects

Water Quality

Project Name	Description	Lead Agency* with Partnering Organizations	Timeframe	Potential Funding Sources	Contact Persons
WRWA WQ Monitoring Program	Support WRWA basin–wide chemical and macro-invertebrate sampling programs	WRWA* WCNRCD WRC VDEC	On-going through plan period	Windham Foundation CRJC Partnership Prog CRWC NEGEF VT Watershed Grants Basin Town budgets	WRWA Water Quality Monitoring Program Director
Stream Geomorphic Assessments (SGAs) in Basin 11	Conduct SGAs in all sub-basins in the West, Williams and Saxtons Rivers	WCNRCD* VDEC WRWA TNC CRWC WRC SWCRPC	2004 –2010	River Corridor Grants USEPA Section 319 CRJC Partnership Prog.	WCNRCD
Pathogen Influx Control	Working with towns, identify and remediate sites of concern in Basin 11	WRWA* VDEC WCNRCD WRC SWCRPC Towns Health Officers	2006 –2010	VDEC Windham Foundation State Municipal Grants	WRWA Water Quality Monitoring Program Director
Riparian Buffer Inventory	Using SGA data develop a riparian buffer inventory and landowner outreach program. Fund riparian plantings	WCNRCD* WRWA VDEC WRC SWCRPC Vermont Coverts Woodland Owners	2007 – 2010	CRJC Partnership Prog. River Corridor Grants WHIP Program	TBD

Aquatic Invasives Control	Continue annual aquatic plant control efforts in Retreat Meadows and initiate work in Herrick's Cove	WRWA WCNRCD Town of Rockingham	On-going through plan implementation period - 2010	Vermont Aquatic Nuisance Species Grant-in-Aid Grants CRJC Partnership Prog.	Town of Brattleboro* WRWA
Develop Aquatic & Riparian Invasives Management Plan	Working with local agencies and towns, develop long-term management plan to reduce invasive populations	Town of Brattleboro* WCNRCD WRWA VDEC Town of Rockingham	2007 - 2009	Vermont ANS Grant in-Aid Grants CRJC Partnership Prog. Basin Town budgets VT Watershed Grants	WCNRCD WRWA
Hapgood Pond Assessment	Conduct field assessment of impaired condition.	USFS* VDEC BCRC	2007	VDEC	VDEC Watershed Coordinator

Land Use

Project Name	**Description**	**Lead Agency* with Partnering Organizations**	**Timeframe**	**Potential Funding Sources**	**Contact Persons**
Demonstration Rain Garden Project	Plan and construction rain garden at Dummerston Covered Bridge park & ride	WCNRCD* Dummerston Cons. Comm. VDEC	April 2006 – June 2007	VDEC CRJC Partnership Prog. SEP NEGEF	WCNRCD
Fluvial Erosion Hazard Mapping	Fund and implement FEH mapping of Basin 11 towns through RPCs	WRC* SWCRPC WRWA VDEC	On-going through 2008	FEH Funding	WRC

Agricultural Nutrient Reduction	Promote NRCS/NRCD USDA/FSA programs to local farmers	VAAMF* NRCS WCNRCD FSA SVNMP	On-going through plan implementation period	EQIP Program VAAFM NMP Incentive Grants	NRCS
Public Outreach on AAPs	Education initiative on newly revised AAPs to local farmers	VAAFM* WCNRCD SVNMP NRCS	On-going through plan implementation period	VAAFM	WCNRCD - ARS
Forestry LWD Project	LWD introduction at stream sites	USFS* WCNRCD	2008 – 2009	USFS Challenge Grants	USFS

Public Access

Project Name	**Description**	**Lead Agency* with Partnering Organizations**	**Timeframe**	**Potential Funding Sources**	**Contact Persons**
Rock River Program Plan	Plan and construct pedestrian underpass at Williamsville Station and bank stabilization along Rock River	VDEC * WRWA WCNRCD CRWC WRC RRP VTrans Towns of Newfane and Dummerston VLT	2006 – 2010	VTrans VDEC	VDEC Watershed Coordinator

West River Trail Easements	Work with landowners to obtain easements connecting southern portions of the West River Trail	FWRT* VLT WRC WRWA Towns of Brattleboro, Dummerston and Newfane	On-going through plan implementation period		FWRT
Collaboration with VTrans to facilitate public access	Build agency awareness to maintain or create public pull off areas along rivers	WRWA* VTrans Trout Unlimited CRWC	On-going through plan implementation period		WRWA

Roads and Road Maintenance

Project Name	**Description**	**Lead Agency* with Partnering Organizations**	**Timeframe**	**Potential Funding Sources**	**Contact Persons**
Support Network for Town Road Managers	Facilitate large equipment cost sharing and maintenance efforts between towns	VT Local Roads* VTrans VDEC WRC SWCRPC Basin towns	On-going through plan implementation period		VT Local Roads
Culvert/Bridge Mapping	Find funding for towns to complete culvert and bridge inventories and GIS mapping	VDEC* Basin towns VTrans WRC SWCRPC TNC WCNRCD	2007 – 2009	Better Backroads Grants VT Watershed Grants River Corridor Grants	VDEC Watershed Coordinator

Alternative De-Icing and Snow Removal Methods	Investigate means to reduce salt application. Plan pilot project.	WRWA* VDEC RPCs CRWC USEPA	On-going through plan implementation period. Plan pilot project by 2008	Better Backroads Grants VT Watershed Grants	WRWA

Dams and Impoundments

Project Name	**Description**	**Lead Agency* with Partnering Organizations**	**Timeframe**	**Potential Funding Sources**	**Contact Persons**
Annual Dam Operations Report	Public reporting of status USACE dam operations studies and agreements to improve flow regime	USACE* VDEC TNC WRWA WRC WCNRCD	Annually in November	N/A	USACE
Dams Inventory	Develop up-to-date all-inclusive dam inventory	VDEC* TNC WRWA WCNRCD WRC	2007 – 2009		TNC
Water Quality Sampling at USACE Whitewater Releases	Collect water samples during spring and fall water releases at Ball Mountain and Townshend dams	WRWA* USACE Town Health Officers	Twice yearly at spring and fall releases through 2011	CRJC Partnership Prog. NEGEF USACE	WRWA Water Quality Monitoring Program Director

Water Withdrawals

Project Name	Description	Lead Agency* with Partnering Organizations	Timeframe	Potential Funding Sources	Contact Persons
Groundwater Aquifer Mapping	Work with State geologist's office to conduct aquifer mapping in Basin 11 towns	VT Geological Survey* VDEC WRC SWCRPC Basin Towns	On-going through plan implementation period	VGS / STATE	TBD
Riparian Buffers for Source water Protection	Identify source waters in need of riparian protection. Work with landowners to plant buffers	Basin Towns VT Coverts Woodland Owner Association WRWA WCNRCD WRC SWCRPC NRCS	On-going through plan implementation period	USEPA Section 319 SEP USFS WHIP	TBD
Investigate Source Water Capacity Limits	Work with State geologist to develop ground water capacity limits for towns and planning commissions.	VGS* WRC SWCRPC WRWA Basin Towns	On-going through plan implementation period	VDEC/STATE	VGS

Watershed Education

Project Name	Description	Lead Agency* with Partnering Organizations	Timeframe	Potential Funding Sources	Contact Persons
WRWA WQ Monitoring Report Distribution	Find funding to expand WRWA's WQ annual reports distribution to broader audience in Basin 11	WRWA* WCNRCD VDEC CRWC	Annually	Town Funding	WRWA Water Quality Monitoring Program Director
Public & Farmer Outreach Project	Provide watershed information to the general public and to farmers throughout the Basin	WCNRCD* ONRCD NRCS SVNMP SWCRPC	On-going through plan implementation period	VAAFM NEGEF NRCS	WCNRCD - ARS
Multi-town River Festival	Consider and plan week-long river festival to help off-set reduction in tourism due to USACE white water release cutback	River towns USACE WRC WRWA FWRT VDEC	2007 - 2009	Community Development VCF	TBD
High School Watershed Projects	Continue and expand watershed project involvement with BUHS and other area high schools	WRWA* Basin schools BEEC WCNRCD NRCS	On-going through plan implementation period	Various private grants	WRWA Water Quality Monitoring Program Director
Continue ANS outreach workshops and trainings	Collaborate with L. Callahan and VDEC's VIP program	VDEC	On-going through plan implementation period	VDEC Aquatic Nuisance Species Grant-in-Aid program	Watershed Coordinator

Part II Essential Information

1. Introduction

1.1 The Basin 11 Planning Process

The basin planning process is best described in the *Vermont Watershed Initiative Guidelines for Watershed Planning, 2007* prepared through a collaboration of a public Statewide Watershed Framework Committee and the Vermont Department of Environmental Conservation (VDEC). Basin planning is an on-going process designed to be compatible with the Vermont Water Quality Standards and other applicable state and federal laws. In general, the planning process serves to integrate topics of special local concern with topics of special state importance, and make management recommendations on these topics. The planning process undertaken for Basin 11 differs from other watershed plans in that was begun locally, being coordinated by the Windham County Natural Resources Conservation District (WCNRCD).

The plan also addresses nine components required by the US Environmental Protection Agency 2004 Section 319 Guidelines designed to reduce non-point source pollutant loadings that contribute to water quality threats and impairments in the West, Williams, and Saxtons River watersheds. The State basin planning process includes the following steps:
1) Issue identification
2) Issue prioritization
3) Strategy and solution development
4) Allocation of resources and funding, and
5) Implementation
As specified in the Vermont State Guidelines, the planning process will occur on a five-year cycle, incorporating planning, implementation, monitoring and evaluation. Every fifth year, the renewed plan will steer a continually evolving course of watershed improvement activities for Basin 11.

1.2 Local Planning Efforts

The concept of watershed planning is not new to Basin 11. The *River Basin Water Quality Management Plan - West-Williams-Saxtons,* 1975 Report and the *River Basin Water Quality Management Plan - Upper West River,* 1989 Report have preceded this effort.

In November 1998, led by the Windham Regional Commission (WRC), a group of citizens, including representatives from over twenty state and local agencies and community organizations met to develop ideas for community-based water quality-related actions in the West River watershed. The West River Watershed Alliance (WRWA) was formed, and by 2000, well in advance of the State's planning initiative, the group had created an action plan setting out an ambitious role for the new grassroots organization that included stream habitat improvement, stream bank restoration, community education, and river advocacy in the West River watershed.

In 2003, the WRWA recognized the opportunity provided by the State's basin planning program

to form the Basin 11 Watershed Council and expand its work by developing a watershed plan for the West, the Williams and the Saxtons Rivers watersheds – the three watersheds that together are designated as Basin 11. With the committed assistance of its founder-partners, the Windham County Natural Resources Conservation District (WCNRCD), the Windham Regional Commission (WRC) and the Southern Windsor County Regional Planning Commission (SWCRPC), the WRWA took on the responsibility of the Watershed Council for the Basin 11 planning process as a grassroots project working independently, but with guidance and assistance from the Vermont Water Quality Division planners. The WCNRCD secured funding for an independent watershed coordinator rather than relying on a state-employed Basin Planner to coordinate the program and draft the plan. To drive the program forward, the WCNRCD and WRWA procured funding for project implementation. With encouragement and technical support from the State, the WCNRCD provided the organizational umbrella to harbor the collaborative partnering effort while the WRWA supported plan development by holding the public meetings and fostering the volunteer actions needed to sustain the project over the long-term.

From the beginning, the goals and objectives defined in the WRWA's original action plan have been consistent with those of VDEC's basin planning initiative. Because of this, the WRWA and its partners have not hesitated to implement activities that support both organizational and basin planning objectives.

Projects and activities identified within the WRWA Action Plan now being conducted by the Basin 11 Watershed Council and its partners within the context of basin planning include:

1) A three-phased water quality monitoring program;
2) Stream geomorphic assessments of the Ball Mountain Brook watershed, the Rock River and the West River;
3) Public access enhancements at the Dummerston Covered Bridge and Williamsville Station;
4) Raingarden installation and parking lot stabilization at the Dummerston Covered Bridge and Williamsville Station;
5) Visual stream assessments in the Williams River sponsored by the SWCRPC and the Chester Conservation Committee;
6) Trout egg-rearing project at Brattleboro Area Middle School sponsored by Trout Unlimited and the US Forest Service;
7) Watershed education projects nurturing school and community collaboration in southeastern Vermont sponsored by The VT/NH River Education Collaborative;
8) Educational kiosks at sites along the West River;
9) Basin planning public forums, watershed council and focus group development; and
10) The five-year Basin 11 Water Quality Management Plan.

Funds to support the Basin 11 program were successfully solicited from various sources. Among others, the Clean Water Act Section 319 funding program, the U.S Forest Service (USFS), the Vermont Fish and Wildlife Conservation License Plate Program, the Connecticut River Joint Commissions (CRJC), and the Windham Foundation provided grant funding to the WRWA and its partners to further basin planning goals. Funding to implement the basin planning process and write the plan was garnered from Section 319 grant funding awarded to the Windham County Natural Resources Conservation District for its Watershed Coordinator. The WCNRCD and the Vermont Agency of Agriculture, Food and Markets have provided staff assistance to write

relevant sections of the Plan, particularly those to address agricultural and **riparian** landowner issues. The WRC and SWCRPC have also contributed GIS capabilities and staff to draft sections concerning stream **classification** and **typing**, a regulatory aspect to be contained in the Plan. The Basin 11 Management Plan has been drafted in full cooperation with the Vermont Agency of Natural Resources to comply with State statutes regarding basin planning criteria.

Other assistance has been garnered for specific projects and elements required in the plan. The WRC and SWCRPC received 604(b) funding to plan and conduct public forums, review town plans, and implement stream re-classification discussions. The WRWA has also received assistance via the VDEC for the LaRosa Lab Assistance Grant which provides sample analysis for its water quality monitoring program. The Southeast Vermont Chapter of Trout Unlimited (TU) has given significant contributions toward the macroinvertebrate monitoring program. Many government agencies and local non-profit groups have also provided in-kind service contributions to the overall effort.

1.3 Public Participation in the Process

Following State basin planning guidelines, the WRWA, the WCNRCD, the WRC and the SWCRPC sponsored public forums to begin the Basin 11 planning program. The public forums were held in Newfane, Saxtons River and Chester. The events brought together members of the community who felt they had some stake in the watershed and were concerned about its issues. Participating stakeholders discussed various problems and offered ideas for sustaining or improving water quality in the three watersheds. Ultimately these public meetings propelled an on-going dialogue that spanned the full gamut of stakeholder issues and concerns.

The public forum venue allowed participants the opportunity to share their ideas for possible projects and activities that addressed key environmental problems. Working under a consensus-based decision-making model, the Watershed Council prioritized issues, selecting highest priority problems, threats, and opportunities upon which to focus planning efforts.

Jolene Hamilton, WCNRCD and John Bennett, WRC in Jamaica

Several issue-based focus groups were created around specific watershed problems. Each focus group examined one topic such as erosion control, storm water runoff, deforestation and buffer loss, flow regulation and flood control, or swimming hole issues. Ultimately, the focus groups made recommendations and proposed inclusions, many that are now contained in this document. More information about public participation during the basin planning process can be found in Appendix A.2.

1.4 Planning at the Watershed Level

The Basin 11 planning process has nurtured cooperation between federal, state, local agencies, towns, non-profit organizations, businesses, and interested residents to manage our resources in the West, Williams, and Saxtons River watersheds. The Watershed Coordinator has worked closely with the VDEC to draft the Basin 11 Management Plan. Watershed Coordinators are the VDEC's central contact in leading the Watershed Planning process. There are two tracks of the process for which the Coordinator is responsible; planning and implementation. Both are initiated at the outset of the watershed planning process in a watershed. Once a plan is completed, the Coordinator has a continuing responsibility to cause the strategies to take place by carrying some of them out directly and making necessary arrangements for others. The State has offered several management tools to assist with implementing projects contained in this plan. Examples of such tools are the current *Vermont Water Quality Standards (2006)* and their associated classifications/designations; identified **Best Management Practices** (BMP) and **Acceptable Management Practices** (AMP) used by the Vermont Agency of Natural Resources (VANR) and practices developed by other agencies (e.g. **Accepted Agricultural Practices** (AAP) by Vermont Agency of Agriculture, Food & Markets) to protect and restore surface waters throughout Vermont. Regional and municipal plans and permitting programs have also been researched and information incorporated into the planning elements.

1.5 Identifying Water Quality Problems

Basin planning is an ongoing process, designed to be compatible with the *Vermont Water Quality Standards* and other applicable state and federal laws. The primary focus of the Basin 11 Plan is to address surface waters, recognizing that a separate process exists for ground water protection. Within the context of this plan, findings contained in the *Vermont Water Quality Report (305)(b), the 2006 Section 303(d) List of Waters* and other pertinent documents and studies are presented and assessed relative to aspects of Basin 11 planning guidelines.

The *Vermont Water Quality Standards* (WQS) are intended to protect and enhance the quality, character and usefulness of surface waters and to ensure public health in that context (10 V.S.A. §1250). Beneficial uses range from drinking water and recreation to the support of **aquatic biota**. When water quality contaminants reach unacceptable levels in particular surface waters, those waters no longer support uses that Vermonters understand to be beneficial. At times, with differing preservation efforts for surface waters, diverse multiple uses may be in conflict. The State and local cooperators must seek to balance conflicting uses while sustaining each use in accordance with the Standards.

Impacts or threats to these protected uses are assessed by the basin planners and technical experts using chemical, physical and biological data, and best professional judgment. As reported above, the residents of the basin also provide helpful information to basin planners throughout the basin planning process by identifying problems on individual water bodies, expressing general concerns and providing local knowledge.

1.6 Partners in the Basin 11 planning process

The Vermont Agency of Natural Resources has supported and will continue to support and encourage the implementation of recommendations contained in the Basin 11 Plan by providing

funding and/or technical assistance for this local effort and through the VANR Basin 11 Watershed Coordinator. Over 30 federal, state, local agencies and non-profit organizations committed personnel to serve as technical resource professionals for the Basin 11 Watershed Council and its numerous issue-related focus groups.

Basin 11 Planning Partners

Antioch College
Bonnyvale Environmental Education Center
Brattleboro Area Chamber of Commence
Brattleboro Union High School Science Department
Bromley Mountain
Community College of Vermont
Connecticut Joint River Commissions
Connecticut River Watershed Council
Dummerston Conservation Commission
Friends of the West River Trail
George D. Aiken Resource Conservation and Development Council
Great River Arts Institute
Landmark College
Municipalities throughout the Basin
Nature Museum in Grafton
Rock River Preservation
Southern Windsor County Regional Planning Commission
Stratton Mountain Corporation
The Nature Conservancy
Trout Unlimited
University of Vermont Extension Service
US Army Corps of Engineers
US Environmental Protection Agency
US Fish and Wildlife Service
US Forest Service, Green Mountain National Forest
USDA - Natural Resource Conservation Service
Vermont Agency of Agriculture, Foods and Markets
Vermont Agency of Transportation
Vermont Back Roads Program
Vermont Coverts
Vermont Department of Education
Vermont Department of Environmental Conservation
Vermont Department of Fish and Wildlife
Vermont Department of Forests, Parks and Recreation
Vermont Land Trust
West River Watershed Alliance
Windham County Natural Resources Conservation District
Windham Regional Commission

1.7 Resources Reviewed and Consulted

There are many resources and assessments that contain large amounts of existing information that have been used in preparing this Plan. As the focus of the Basin 11 Plan is on surface waters, the Plan has taken into account the findings contained in the most recent *Vermont Water Quality Report (305)(b),* and the *Section 303(d) List of Waters* .

The Basin 11 planning effort works in full cooperation with the VDEC planners and their technical staff. Relevant data and watershed assessments have been provided to help the Basin 11 Watershed Council partnership identify potential areas of concern as well as existing informational gaps. The Watershed Council has also implemented a basin-wide chemical and biological stream sampling program to augment the work of the VDEC to monitor bacterial, nutrient, and sediment loadings. Of the nine locations within Basin 11 considered to be " Part C Waters" or "Surface Waters in Need of Further Assessment" that are found on *The State of Vermont 2006 List of Priority Surface Waters Outside the Scope of Clean Water Action Section 303(d),* eight are

currently being examined by the monitoring program.

Another critical resource is *The Basin 11 West, Williams, and Saxtons Rivers Assessment Report, 2001*. Most of the scientific surveys, studies, and data collected by the VDEC that relate to the West, Williams, and Saxtons Rivers have been reviewed and evaluated within the state's assessment report of Basin 11.

The Vermont Biodiversity Project (VBP) report *Vermont's Natural Heritage: Conserving Biological Diversity in the Green Mountain State* identifies and describes natural communities in the state and establishes long-term conservation goals. All VBP information and project data specific to the three watersheds in Basin 11 is available through The Nature Conservancy and the VANR. The report, because of its comprehensive scope has been a valuable resource for this Basin 11 planning document.

As over 70 percent of the watershed lies within Windham County, the *Windham Regional Plan* (WRC 2001b) has been an especially pertinent resource. The WRC's plan shows a reasoned and proactive approach to long-term planning that coincides with basin management concepts. It compiles much of the information that the WRC has collected about natural resources in the county, illustrating them with an expansive display of GIS mapping. The *Southern Windsor County Regional Plan* developed by the SWCRPC has also contributed much needed information.

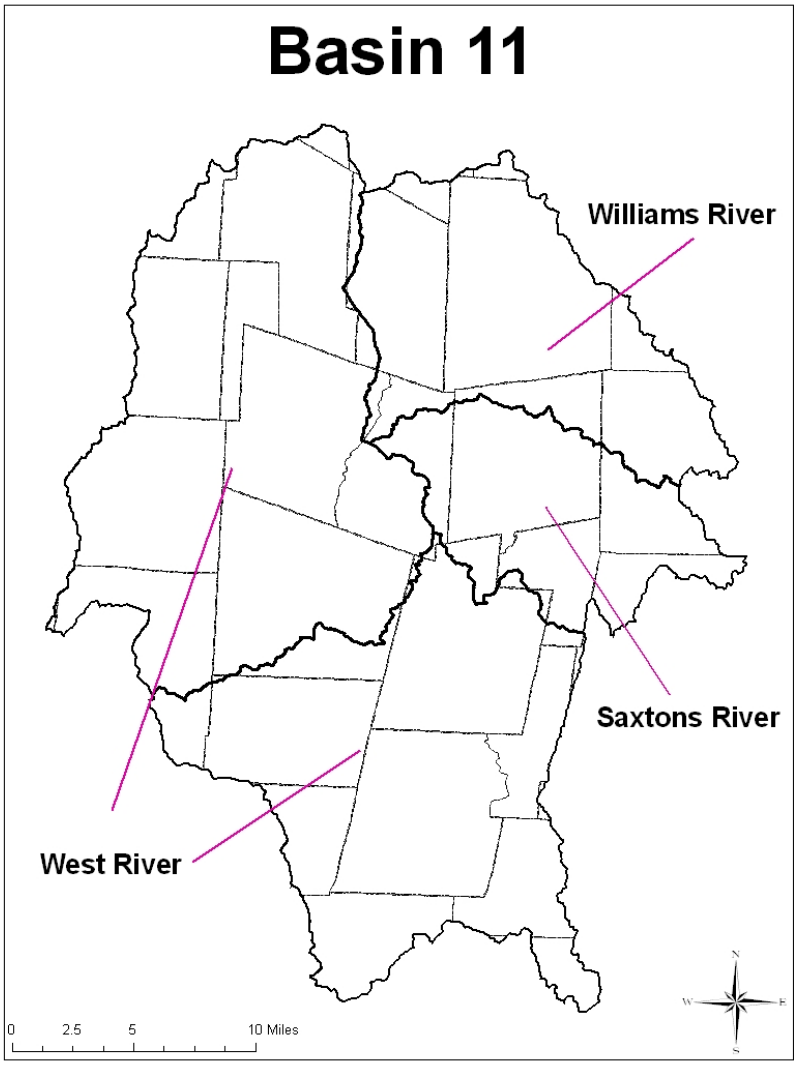
In addition to those mentioned above, pertinent assessments and reports that were used for the development of this water quality management plan for the West, Williams and Saxtons River watersheds are listed in the References and Resources section of this document.

2. Description of Basin 11

2.1 Three Watersheds in Basin 11

The Basin 11 planning unit includes three watersheds: the West, Williams, and Saxtons Rivers watersheds. Basin 11 is located in the southeastern corner of Vermont and drains the eastern slope of the Green Mountains. The Basin covers approximately 618 square miles or about 395,500 acres. The rivers and their tributaries flow down from the mountains through the foothills and across the Vermont Piedmont to the Connecticut River Valley where they join the Connecticut River. The Williams River joins the Connecticut River in Rockingham, the Saxtons River joins the Connecticut River in Bellows Falls, and the West River joins it in Brattleboro.

Figure 2 - Basin 11 Planning Unit



Most of Basin 11 lies within Windham County although portions are also within Windsor and Bennington Counties and a very small portion is in Rutland County. The basin is part of the Southern Green Mountain biophysical region of Vermont.

2.1.1 West River Watershed

The mainstem of the West River originates in the south part of Mount Holly, 2,400 feet above sea level. It flows generally south through the towns of Weston and Londonderry then southeasterly through Jamaica, Townshend, Newfane, Dummerston, and Brattleboro where it meets the Connecticut River. The length of the mainstem is 46 miles and the river drains a watershed that is 423 square miles.

The uppermost section of the West River flows through

forested then partially forested and partially open country. It has a stony bottom with extensive gravel bars in some places and is considered good trout and salmon habitat. The first major tributary, Greendale Brook, enters a mile and a half above Weston. The slope of the West is around 80-100 feet/mile near Greendale Brook and there is a "bouldery" cascade at Zion Chapel just above their confluence. The valley flattens about one half mile below Greendale Brook, and the river drops 10-20 feet/mile. Near Weston, there is a small mill dam with a backwater about one half mile long.

Three miles below Weston, Route 100 crosses the West River at a small settlement called the Island, where a sharp bend in the river was formerly cut by a short canal used to feed a mill. Below the Island, the river flows through rough meadows and thickets for two miles, before flowing under a side road bridge and entering the backwater of the Williams Dam at Londonderry.

Below the dam and just west of Londonderry, Utley Brook enters the West River and increases the drainage area by about 75 percent. Utley Brook is 10 miles long. After the Utley Brook confluence, the West River turns south and parallels Route 100 for 1.5 miles. It then flows over a set of ledges just before going under Route 100 and over another set of ledges after the road bridge. Flood Brook enters right below these ledges contributing another 11 square miles of drainage area.

Moderately heavy whitewater continues for a quarter mile below the ledges. The stream then enters a swampy flat area, much of which was formerly in the backwater of a dam at South Londonderry. For about three quarters of a mile, the river is away from the road and there are alder thickets along the banks. It then returns to the road and passes under the Route 100 bridge in the middle of South Londonderry. Below this bridge, the river has roads and houses on each side. It again becomes steeper and about a half mile below the bridge, it goes over a set of three ledges dropping a total of 15 to 20 feet in 50 yards.

The West River is medium-sized, averaging 50-70 feet wide, where it leaves the paved road in South Londonderry. It has a small floodplain bordered by steep hills to the west and the gentler lower slopes of Glebe Mountain to the east. The shores were formerly cleared for farming but are now reverting to woods.

About a mile below the confluence of Thompsonburg Brook and the West, the floodplain narrows and the river becomes steeper. The Winhall River, 16 miles long, then flows into the West River from the west. This large tributary drains a 62 square mile forested watershed that is largely higher elevation land.

At the confluence of the West and Winhall Rivers is the former Winhall Station. It is now the lower end of the USACE Winhall Campground, which extends up the Winhall River. The river continues in a southerly direction below Winhall Station with the valley narrowing substantially in the mile before the river flows into the Ball Mountain reservoir.

From Ball Mountain Dam to the bridge at Jamaica, the West River flows in through a wooded undeveloped area defined by a narrow, steep, wooded ravine. The river is fairly deep and rocky

with numerous large boulders. This section of the river is famous as a white water boating run. Below the Jamaica bridge, Ball Mountain Brook enters the West River. The Ball Mountain Brook originates in the Green Mountains in the Town of Stratton and is joined by the North Branch about one mile above the village center of Jamaica. Its total length is 27.5 miles and comprises a drainage basin of 21,600 acres that is mostly forested, although the upper drainage basin of the North Branch is highly developed. (WRC, 1998). Rapids end near the Route 100 bridge in East Jamaica.

Wardsboro Brook enters the West River from the west just below this bridge. Wardsboro Brook is a 12 mile long stream that drains a 37 square mile watershed. Below Wardsboro Brook, the river widens and enters a flat basin that is part of the backwater for Townshend Dam in the spring. The river winds and braids through this basin until it meets the permanent pool of the Townshend Reservoir.

From the Townshend Dam to Newfane, the river flows southwesterly through a relatively wide valley where the river has a quarter to half mile floodplain. At Williamsville Station, the Rock River enters from the west. From its headwaters in Dover, the Rock flows eastward into South Newfane where it is joined by the Marlboro Branch. From this confluence, the Rock continues running east to Williamsville where it is joined by Baker Brook. From here, the Rock continues east to connect with the West River. The Rock River itself is 12 miles long and drains a 60 square mile watershed.

Just downstream of the Rock River, the West River sweeps to the east for about a mile and then flows generally southeasterly again. From Williamsville Station to the mouth, the riparian corridor is more developed with Route 30 running along the riverbank for the last 8 miles. This lower section is fairly wide with a number of bedrock exposures, wooded banks coming down to the channel, and nice hills adjacent to the river. One mile above the mouth is a wetland area called Retreat Meadows, a backwater created by the Vernon Dam on the Connecticut River that has become a large marsh (VDEC 2001).

2.1.2 Williams River Watershed

The Williams River originates on the eastern edge of the southern Green Mountains and flows easterly then southeasterly through the Southern Vermont Piedmont before joining the Connecticut River at Herricks Cove in Rockingham. The Williams River has a stream length of 25 miles and drains an area of 117 square miles. Much of the upper basin is rugged, hilly land with steep slopes and poor drainage.

The Williams River headwater streams come off the slopes of Terrible Mountain and other nearby mountains to form the Williams River mainstem. The river flows easterly through Andover and into the southern portion of Ludlow where Wheaton Brook, Lovejoy Brook, and Bear Brook join in. It continues its easterly flow into Chester and is confined to a relatively narrow valley until it turns south-southeast. At that point it flows in a broad fertile valley down the length of the town of Chester. In the village of Chester, the Middle Branch of the Williams River joins the Williams River mainstem.

The Middle Branch originates in Windham and flows north for several miles before flowing east through Andover and Chester into the Williams River. Lymans Brook, Andover Branch, and South Branch are all tributaries to the Middle Branch. The Middle Branch is 13 miles in length and drains a watershed of 47 square miles.

From Chester village, the Williams River continues its southeasterly flow into the town of Rockingham where it flows through Bartonsville, over the Brockways Mills dam at the top of a dramatic gorge, and through a narrow valley before flowing out into Herricks Cove at the Connecticut River (VDEC 2001)

2.1.3 Saxtons River Watershed

The Saxtons River rises on the eastern slopes of the southern Green Mountains in the town of Windham and flows southeasterly across the Vermont Piedmont to the Connecticut River. Its length is 20 miles draining an area of 78 square miles with a total drop of approximately 1800 feet. The upper watershed is characterized by narrow steep gorges cut through rugged hilly uplands with outcropping bedrock and poor drainage.

The Saxtons River originates in an extensive wetland complex in the Lawrence Four Corners area in Windham from which it begins its easterly flow. Many headwater tributaries from the hills and mountains of the eastern part of Windham and the western part of Grafton flow northerly and southerly through narrow, forested valleys to join the Saxtons River. The Saxtons continues an easterly flow through Houghtonville where 1.5 miles downstream, the river turns south and flows in a somewhat wider valley to Grafton village.

In Grafton, the South Branch joins the Saxtons River from the south. The South Branch is six miles long and drains a watershed that is 20.3 square miles. From Grafton village and the South Branch confluence, the river flows northeasterly then southeasterly around the base of Kidder Hill then continues southeasterly to the Village of Saxtons River. Weaver Brook, Bull Creek, and Leach Brook all contribute to the river's flow in this stretch. From the Village of Saxtons River, the river continues its southeasterly journey until North Westminster where it bends back on itself, flows over Twin Falls then continues in a northeast direction for a little more than a mile before emptying into the Connecticut River (VDEC 2001).

2.2 Land Use

The health of the aquatic natural resources - the rivers, lakes, and wetlands - in the basin can be directly related to land cover types and their associated land uses. The level of impact on water quality is usually low in undisturbed forested landscapes and becomes greater as land uses intensify through the spectrum of timber harvesting, agriculture, housing, industry, and roads. These more intensive land uses, which are valued by the community, can still support a healthy watershed if stewardship practices reduce discharges to, and encroachments on, surface waters (VDEC 2002).

2.2.1 Agricultural Land

The most striking aspect of agriculture in the Basin 11 is the diversity of crops produced. What was dominated by dairy 20 years ago has today become the most diverse agricultural base in the state. Over 87 different field crops and animals are known to be grown in Windham County.[2]

Of the 618 square miles of land in the Basin, agriculture makes up only 3.2 percent of the land use (VDEC, 2001). Yet, in Windham County alone, agricultural products bring in over $18,321,000 to 397 farm operations. A total of 12,614 acres of the Basin are in some type of agricultural production. Crops as common as feed corn and sweet corn are complemented by plums, hazelnuts and chili peppers. Dairy and beef cows are complemented by horses, bison and alpaca. Windham County has the highest sheep count in the state. The county also boasts the second highest number of orchards in state.[3]

Unfortunately the reality of farm economics is brought to light in seeing that the total amount spent on production, $18,875,000, is over $550,000 less than the market value of what is produced. Many of these farms are struggling.

Agricultural activities have had an impact on the environment of the Basin for well over 300 years. The accumulated effects of animal and crop production have sent varying degrees of pollutants into the basin's waterways over the centuries. Today however, there are no agriculturally impaired river segments and only one stretch of river within the Basin that the VDEC has listed as "In Need of Further Assessment" because it may be impaired by agricultural activities. For this segment, from the mouth of the Williams River up to the confluence of the Middle Branch, VDEC has concerns about sediments, nutrients and temperature.

Agriculture also provides many environmental benefits. Farm owned fields, pastures and forestland maintain large tracts of open space often used by both local and tourist visitors. Fewer pollutants are released from an acre of agricultural land than from an acre of developed land. Unlike impervious surfaces, field and forest soils allow water to percolate into the ground rather than quickly running off into rivers. Farms recycle their farm-produced wastes as fertilizer, and actively work to prevent runoff of soil, nutrients and pathogens (LCBP 2003).

Agriculture in the Basin

USDA agricultural statistics are kept by county rather than by watershed. Therefore the following numbers reflect agriculture in Windham County and not the West, Williams and Saxtons Rivers watersheds. While the majority of the basin is within Windham County, the majority of the dairy farms in the county are not in Basin 11.

The most recent USDA data from 2002 show the diversity of farm types in Windham County. Cattle still outnumber other types of animals in Windham County and dairy animals make up the largest share. The 48 dairy operations and the farms raising heifers keep a large amount of land

[2] USDA 2002 Census of Agriculture, Vermont State and County Data, Windham County
[3] Ibid.

open and productive. Hay is produced on over 10,000 acres and corn products on over 2100 acres.

There are 6 certified organic farms in the Basin that encompass a total of 5,481 acres.[4] Additionally, while there are no Large Farm Operations in the Basin, there is one Medium Farm Operation.

Table 2 Windham County: Types of Farms - 2002[5]

	Number of Farms	Animals or Acres
Beef	32	614
Dairy	48	3764
Other Cattle	70	3594
Bees	6	39
Goat	19	319
Hog	22	179
Horse	111	747
Llama	28	175
Poultry-All	83	2942
Sheep	44	2544
Corn grain	3	NR
Corn silage	23	2110
Berries	22	73
Christmas Trees	13	74
Hay-Total	153	0357
Maple Sugar	123	49288 gal.
Nursery	65	52
Orchards	29	643
Potatoes	10	18
Vegetables	39	303

(NR = Not Reported)

[6] NOFA Vermont, Personal communication from John Cleary
[5] USDA 2002 Census of Agriculture, Vermont State and County Data, Windham County

2.2.2 Conservation Practices

There are currently 16 operating dairy farms in the Basin with approximately 1370 animal units. Only three of these farms have a manure storage facility that meets NRCS standards. Most stack manure in the field. Only four of the farms have improved barnyards. Each year several of these farms apply for USDA cost-share programs but are rarely selected to receive funding for a waste management system or an improved barnyard. Unless this lack of funding is addressed, there will be little improvement in agricultural impacts on water quality.

Animal walkways and drainage system – Putney

Farms in the basin have received cost share funding for other practices such as spring development, fencing, grazing plans, nutrient management plans and water diversions. These practices help reduce erosion, phosphorus runoff and pathogen loading of waterways and assist farmers in better managing nutrients on their farms.

Table 2.1 ***Basin 11: Best Management Projects 1999-2007***

Fiscal Year	Farms Funded	Completed Practices	Actual Total Cost	Actual Federal Cost	Actual State Cost	Actual Landowner Cost
1999	1	2	$3,300	$2,325	$0	$975
2002	2	4	$14,910	$10,813	$0	$4,097
2003	2	2	$31,178	$23,384	$2,759	$6,110
2004	1	3	$7,001	$6,500	$590	$1,501
2005	3	4	$36,515	$27,237		$12,763
2006	2	2	$3,600	$750	$2,000	$850
2007	1	1	$144,899		$50,000	$94,899
Totals	**12**	**18**	**$241,403**	**$71,009**	**$55,349**	**$121,195**

Best Management Projects IN-PROGRESS

Fiscal Year	Farms Funded	Remaining Practices	Estimated Total Cost	Estimated Federal Cost	Estimated State Cost	Estimated Landowner Cost
2003	1	8	$51,903	$38,926	$5,190	$7,787
2004	3	12	$68,991	$43,977		$25,014
2005	1	3	$12,609	$9,457		$3,152
2006	2	8	$370,000	$239,000	$75,000	$64,000
2007	1	3	$12,735	$10,188	$1,200	$3,183
Totals	**8**	**34**	**$516,238**	**$341,548**	**$81,390**	**$103,136**

* NC - Phosphorus reduction not calculated

2.2.3 Loss of Working Landscape

The most recent USDA agricultural data available from 2002[6] reveals that the number of farms in Windham County has increased by 100 over the past 20 years.[7] (See Table 2.1) While this is an encouraging trend when we look at the amount of land that is in some type of agricultural production, crop or pasture, we find that this has decreased by 30 percent over the same period. (See Figure 2.1)

Table 2.2. Land In Farms

Windham County	1982	1987	1992	1997	2002
# Farms	298	287	270	384	397
Total Acres in Farms	61243	53474	43987	50882	61596
Acres in Cropland	23423	19834	18467	19622	18042

The loss of open agricultural land has many implications. If it is lost to development, the land will never again be available for food and fiber production in the future. Development has been shown to have a greater adverse impact on water quality than does agricultural land. The increase in pavement and other impervious areas can increase runoff and which can then carry toxic pollutants into waterways (VTDEC and NYSDEC 1994)."

Increased development also means greater disturbance to soils, greater impact on natural resources and greater stress on existing farmland to both produce more on less land and to maintain the pastoral nature of the landscape. This becomes increasingly difficult with the concurrent increase in the cost of farming due to higher land costs and higher tax rates. Loss of Vermont's pastoral aesthetic may ultimately impact the State's tourism industry.

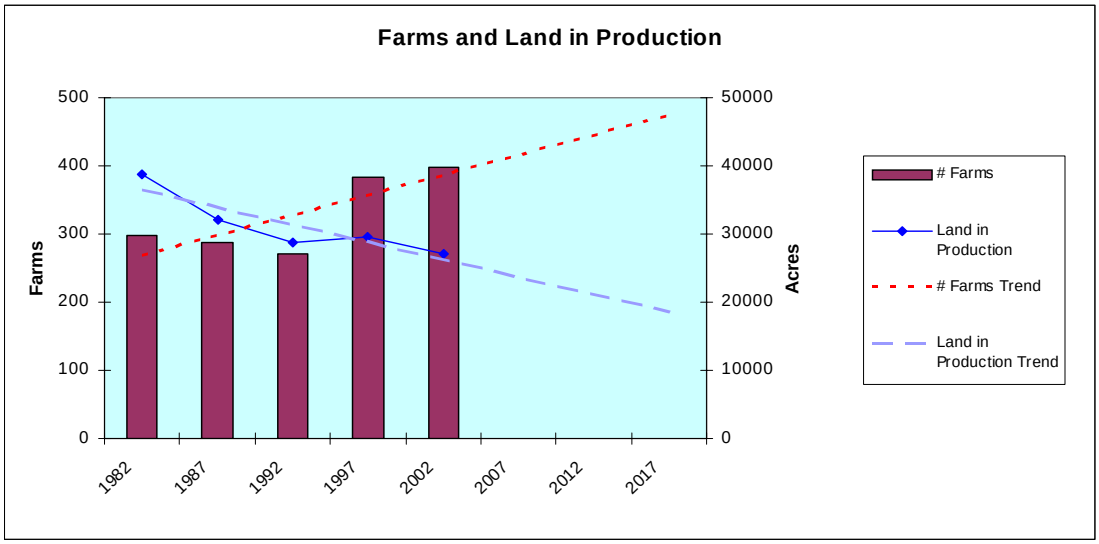
Projecting out at the present rate of loss, Windham County will have fewer than 20,000 acres in agriculture by the year 2017 (see Figure 2.1). This is only 4 percent of the land base of the county and would dramatically change the cultural and environmental qualities of the area. It is possible

[6] Data source: 1987, 1992 & 2002 Census of Agriculture, USDA

[7] USDA Census data is tracked on a county basis. The majority of Basin 11 is within Windham County so data for Windham County is used in all report statistics.

that the growth trend in the number of farms will come to a quick halt as agricultural land becomes scarcer.

Figure 2.1. Farms and Land in Production in Windham County



2.2.4 Agricultural Trends for the Future

Current trends indicate that in the coming decades it is likely that agriculture in the Basin will continue to diversify toward smaller operations with more vegetable and truck farms and specialty food operations such as cheese also increasing. More organic production is likely as the demand continues to grow for organic vegetables, fruit, meat and dairy products.

Recently, one of the largest and most widely known dairy farms in the area, the Retreat Farm in Brattleboro, has been forced to sell off its cows. It is hoped that the diary farm and petting farm well continue in some way, but its future is uncertain. The loss of this farm and its educational facilities could have long-lasting effects on the face of agriculture in the area.

It must be stressed that the trends seen today may not hold into the future. Climate change, tree diseases, exhaustion of fossil fuels, and the decline of winter recreation could all alter currently expected trends in agriculture and development pressures.

Successes

Now, more than ever, farmers are under considerable pressure to sustain economically viable and environmentally sound farming operations. Farmers must face labor issues, foreign competition, competing land use pressures, regulations concerning animal husbandry, genetics, food safety and stricter water quality regulations under the State's Accepted Agricultural Practices (AAP). In complying with these new AAP's, farmers must address five key water quality protection concepts:

- Riparian buffer development and stream bank management criteria
- Livestock impacts on stream banks
- Setbacks from wells and property boundaries
- Soil testing for manure spreading and record keeping
- On-site disposal or composting of animal mortalities

Federal, State and private agencies have taken steps to protect farmland and farm water quality through many of the programs listed in the 'Programs to Address Issues' section. This land protection ensures the availability of agricultural land for future food and fiber production and provides those presently working the farm with some financial assistance to help them succeed. These programs often include assistance for installing conservation practices on the farm that reduce non-point source pollution such as fencing animals out of streams to prevent damage to streambanks and providing them with alternative watering systems.

Within Basin 11, USDA's EQIP program is in the process of installing a waste storage facility, a roofed loafing area, streambank exclusion fencing and other BMP's on 3 farms. Many practices have also been implemented in past years such as walkways and access lanes, streambank stabilization and heavy use area protection on 4 farms. USDA's WHIP program has worked with 2 farms implementing practices such as wildlife food plots and invasive species removal. The NRCD's Southern Vermont Nutrient Management Program and the Land Treatment Planning services, which assist farmers with environmental issues, have developed nutrient management plans for 3 farms and land treatment plans for 1 farm in the basin. These programs often incur no cost to farmers due to funding from VAAFM's Nutrient Management Plan Incentive Grants or support of the Southern Vermont Nutrient Management Program.

2.2.5 Forested Land

As the major component of the Vermont landscape, forests form the environmental setting for human activity, furnish habitat for wildlife, contribute to water and air quality and provide a multitude of forest products. Forests are economically important to the region, providing employment to foresters, loggers, artisans, and forest-product manufacturers, while also supporting a thriving recreation and tourism industry. (WRC 2001b). Forestlands contain:

- Productive and non-productive forest soils;
- A variety of northern hardwood and softwood species of trees;
- Plant and wildlife habitats;
- Riparian areas and wetlands;
- Unique and fragile natural areas and communities;
- Recreational areas;
- Scenic vistas; and
- Historical/cultural/archeological sites (stone walls, foundations, stage roads, etc.).

Approximately 78 percent of Vermont is now covered with forests, the largest amount of woodland acreage experienced in decades. Vermont's forests have recovered from land clearing during the time when agriculture was the primary land use, followed by heavy logging of the second growth forests that had re-colonized the abandoned farmlands. With the maturing of

today's forest, a matrix of fields, pastures and woodlots in rural portions of the state increasingly has become unbroken forest. In a recent article, *Championing the Land* (2002), Arthur Westing notes that Vermont has an impressive and viable woodland ecosystem through "some past combination of intuitive respect for the land, reasonably low human numbers, resilience of the native biota, and relevant legislation." However, with populations increasing, there is more pressure to subdivide forestland to facilitate housing construction and associated transportation and infrastructure. The circumstances that have allowed forest to remain in large, unfragmented tracts of woodlands are rapidly changing. With the increasing potential for land use conflicts, there is a need for resource management that embodies sound silvicultural practices and conservation incentives while permitting multiple uses (WRC 2001b).

Questions about the acquisition of additional public land, the proper role of public and private land for environmental, economic, and recreational purposes, and policy and regulatory intervention to protect or advance social and environmental values all must be considered relative to each basin. Forests cover almost 85 percent of the total drainage area of Basin 11. In this basin, the headwaters of the major streams and rivers are mostly located within forestland, which preserves soils and water purity at the source. Long-range planning and assessment partnerships on public lands have established some conditions on timber harvesting which minimize disturbance of riparian areas and prevent soil erosion and sedimentation (VDEC 2002a).

Outside of the areas in the Green Mountain National Forest (GMNF) or lands owned by the State or municipalities, most forestland is privately owned by individuals pursuing diverse goals and often differing management strategies which may conflict with watershed protection objectives. Individual landowners can and have created no-cut zones on their properties, others harvest timber from all portions of their land. Some legislative intervention in the form of forest management regulations and creation of the Use Value Appraisal (UVA) program, commonly refereed to as the Current Use Program, (see Appendix B.13.8 for program description) for agricultural and forest lands have had a positive influence on practices which protect water quality on private forest land. Under the UVA program, private owners develop and implement long-term management plans that are professionally monitored in exchange for lower property valuation and taxes. Increased public land acquisition - federal, state and local - is also adding substantially to conservation of forestland in this region (WRC 2001b). Methods and goals for increasing ecologically sustainable working forests, nature preserves, and protected areas in our watersheds are considered within this basin plan.

Forest Fragmentation

Certain factors including increases in residential construction, road building, and parcelization have resulted in fragmentation of the landscape. Forest fragmentation is a growing concern in basin 11 as it has an impact on the quality and quantity of wildlife habitat, reduces the opportunities for forest management, potentially degrades ecological functions including water quality, and reduces recreational opportunities. For example the average home range of a flock of wild turkeys may vary from 1000 to over 4000 acres. When this habitat occurs in an area that is extensively subdivided it can drastically limit the resources needed to serve as effective turkey habitat (Westing 2002a). Similarly, results of the Stratton Mountain Black Bear Study "support the Vermont Fish and Wildlife Department's mitigation guidelines (VFWD 1992) for indirect

impact which are intended to protect a buffer zone of ¼ to ½ mile from essential black bear habitat" (VFWD 2002).

The use of conservation easements on ecologically valuable land can reduce forest fragmentation. Under an agreement between the State of Vermont and Stratton Mountain Corporation, 1499 acres of forestland in the town of Stratton has been conserved permanently as wildlife habitat. The agreement protects important bear and white-tailed deer habitat, and manages other areas for the protection of Bicknell's Thrush. Other lands within the Basin are conserved by private non-profit conservation groups like the Vermont Land Trust and The Nature Conservancy which will help maintain a more stable forest land base.

Forested Riparian Buffer Zones

Riparian ecosystems are lands connected with or immediately adjacent to the banks of a water body. They provide a transition between aquatic and upland habitats. Riparian forest ecosystems contain established trees, shrubs, and herbaceous vegetation. These areas vary in length, width, slope, and plant species composition. Functions of these ecosystems include wildlife habitat and travel corridors, water quality improvement and aesthetics (WRC 2001a).

A riparian **buffer zone** is meant "to provide a protective strip between a body of water and any adjacent land that has undergone human transformation to farmland, roadway, or other type of development; and to contribute to the well-being of the biota both in and adjacent to the body of water" (Westing 2003). Use of riparian buffers is being encouraged throughout the basin within the context of state, regional and municipal planning. The towns of Stratton, Newfane, Westminster, and Wardsboro have adopted planning policies and zoning set backs to protect streams and shorelines.

Forest Management Education

Land management activities can have a profound impact on the natural communities that constitute our forests, meadows, streams and lakes (WRC 2001b). The changing demographics of southeastern Vermont, particularly in woodland ownership, are beginning to have an effect on forest management practices, as well as on public perceptions, attitudes and influence on regional forest policies. Some research, applied to the Windham region specifically and Vermont in general, indicates that new woodland owners are younger and less traditionally land-connected than historic owners and that woodland transfers are more frequent (WRC 2001b). The knowledge base of newer landowners regarding good stewardship practices and fragmentation issues must be enhanced to ensure good land management in order to protect water quality, prevent further habitat impacts and provide a sustainable supply of forest products.

The education of the area's woodland owners has been provided since the late 1940's by the VDFPR County Forester program which offers technical assistance and information to landowners. The UVA program and the continued efforts over fifty years of the Woodland Owners' Association have also had a positive impact on forest landowners in the Basin. Forestland owners have also become more aware of management options to preserve and enhance wildlife habitat by educational programs sponsored by Vermont Coverts and other organizations and by cooperation between woodland neighbors. By educating landowners about the role that

their small parcel plays within the overall landscape, we can more effectively protect and increase wildlife habitat, protect biodiversity, and increase the flow of sustainable forest resources harvested from both large tracts of forestland and from small backyard forests.

Public interest has been increased by the actions of Vermont policy makers to begin both voluntary and regulatory efforts to improve forest management practices. Professional programs for loggers and other forest workers have increased safety levels and improved practices. The Vermont Department of Forests, Parks, and Recreation (VDFPR) of the VANR provides information and assistance to loggers and foresters within the context of Vermont Loggers Association workshops and the Logger Education to Advance Professionalism Program. The VDFPR further supports Acceptable Management Practices (AMP) training at bi-annual training sessions conducted by the Vermont Forestry Foundation (VDEC 2002a). Increased recreational use of forestland is enhanced by a variety of educational programs, such as those offered by the Bonnyvale Environmental Education Center (WRC 2001b).

Forest Regulation and Enforcement

Timber harvesting in Vermont is subject to the Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont (AMPs). The AMPs are designed to protect surface water quality by preventing silt, sediment, petroleum products and woody debris from entering streams and lakes near logging operations. The AMPs also require that protective buffer strips be maintained adjacent to surface waters, except at logging road crossings. The combination of educational initiatives to assist loggers and enforcement strategies emphasizing remediation, prompt most timber harvesters in Vermont to comply with AMPs (VDEC 2002a). Working under a memorandum of understanding with the VANR Enforcement Division, foresters with the VDFPR work in a cooperative effort to assist the timber industry and prevent AMP violations. The team then makes recommendations to address the problems. (See Appendix B.13.9 for information on AMPs or http://www.vtfpr.org/pdf/waterq.pdf).

In 1997, the Legislature enacted the “Heavy Cutting” law with the intent of limiting clear-cutting. A permit is needed for a heavy cut that exceeds 40 acres or 80 acres within a two-mile radius. The silviculture standards written into this legislation have helped to slow large-scale, indiscriminate liquidation and clear-cutting (WRC 2001b)

2.2.6 Developed Land

Over the last two hundred years, land has been developed as a natural response to the topography of the river and stream valleys that provide travel routes, fertile floodplain soils, hydropower and water supply. Historically, community development in each major valley encouraged mixed residential and commercial town centers interconnected by roads and railways. Today, a pattern of development with regional centers, villages, and rural lands, increasingly stresses public services and elicits greater energy demands while offering its own set of environmental challenges, needs and constraints. Over the last decade, the increase in residential growth away from regional centers into outlying rural areas, although less dramatic than large-scale suburban development, is contributing to greater impacts on water quality particularly when concentrated building occurs along roadways, stream corridors, or on steep and shallow soils (WRC 2001b). **Impervious** or semi-impervious surfaces in the form of roads, houses, and parking lots cover

approximately 5 percent of the entire Basin 11 (VDEC 2001). Because of the generally hilly nature of the West and Saxtons River watersheds, settlers old and new, built along the river corridors confined by the narrow valley floors. Development in these valleys often has resulted in removal of vegetation, the filling of flood plains and wetlands, and a general increase in untreated, pollutant-laden runoff into neighboring surface waters. The Williams River, with its broader valley, offers larger and more accessible tracts along the river's flood plain, but has similar development-related impacts (SWCRPC 2003a).

Population Growth

Census data reported in VDEC's Basin 11 water quality assessment report shows that town populations experienced moderate growth between 1970 and 2000. As presented in Table 2.2, figures for population growth within the three watersheds are quite variable during this time period. Compared to nearby watersheds, the West River in the last thirty years has experienced the greatest overall population increase adding approximately 28 percent more residents. Whereas population in the Williams River watershed grew at a little less than a third of that rate (8.3 percent) during those same three decades. The basin's three watersheds have experienced population growth from 36,610 in 1970 to 44,803 people in 2000 – an increase of 22.4 percent. (VDEC 2001).

Table 2.3 Population Growth in the Basin 11 Between 1970 and 2000*

Watershed	Population		Percent Change
	1970	2000	1970-2000
West River Watershed	19,860	25,469	28.2
Saxtons River Watershed	8,174	9,836	20.3
Williams River Watershed	8,576	9,291	8.3
Total Basin 11	36,610	44,803	22.4

* Some towns whose populations were tallied are not wholly within the watershed, but a substantial portion of the towns' land area is within the watershed boundaries.

Housing

Over the last five years, the greatest development trend has been single family homes and small subdivisions in the more rural towns. Development in these areas has been largely dependent on site limitations. Changes to state regulation of residential on-site wastewater systems have lifted many of the restrictions on the use of land with steep slopes and shallow depth to bedrock, increasing the amount of land available for residential use by as much as 50 percent (SWCRPC 2003a). Much of the land that was off-limits to development solely because of physical constraints is now open to on-site septic systems. Local planners should assess the possible consequences of these changes on land use patterns in their towns.

In the Windham region, the approximate number of year-round housing units constructed

increased by 18.4 percent between 1980 and 1990. Between 1990 and 2000 the growth rate fell to 10.9 percent (WRC 2001b). Though both the Windham Regional and South Windsor County Regional Planning Commissions have worked with town planners across the basin, few town plans and zoning ordinances contain language or regulations that protect surface waters from development impacts. Roads, highways, and other transportation conduits that support existing development cover nearly 25 square miles across the three watersheds in Basin 11 (VDEC 2001). If not carefully planned, the increasing numbers of houses, driveways, yards, roads, and people are likely to cause a significant reduction in water quality and aquatic habitat conditions (WRC 2001b).

The housing and population growth in some towns will alter water quality and aquatic habitat unless towns have strong, clear protection goals and strategies in the town plans and zoning regulations. New development (with accompanying land changes, soil exposure, encroachment on riparian areas, and increased impervious surfaces) will lead to more environmental threats and impacts (SWCRPC 2003). Currently the plans of the most rapidly growing towns address water resource protection. However, for many towns, zoning regulations and conservation programs that could help to locate development away from the river corridor are not in place (VDEC 2001). A review of municipal planning and water resources provisions in Basin 11 town plans and zoning is presented in Appendix A.14.

The WRC and the SWCRPC within their respective regional plans present cogent summaries of development issues with recommendations relative to sustaining and improving water quality, many of which have been incorporated into this basin plan.

2.2.7 State Land Use Protection

In 1970, the Vermont Legislature passed the Land Use and Development Law, since known as Act 250. It created nine District Environmental Commissions, whose members are laypersons, not government officials. Their decision-making process centers on 10 criteria for reviewing development and subdivision plans that involve significant environmental, aesthetic, and/or community impacts. This review of development by local Vermont citizens has been the center of the Act 250 process ever since.

Before granting a permit, the District Commission must ensure that the development or subdivision meets the following ten criteria:

(1) Will not result in undue water or air pollution.
This criterion deals with water and air pollution generally and such specific matters relating to water pollution as: (A) Headwaters; (B) Waste disposal (including wastewater and stormwater); (C) Water Conservation; (D) Floodways; (E) Streams; (F) Shorelines; and (G) Wetlands.

(2) Has sufficient water available for the needs of the subdivision or development.

(3) Will not unreasonably burden any existing water supply.

(4) Will not cause unreasonable soil erosion or affect the capacity of the land to hold water.

(5) Will not cause unreasonably dangerous or congested conditions with respect to highways or other means of transportation.

(6) Will not create an unreasonable burden on the educational facilities of the municipality.
(7) Will not create an unreasonable burden on the municipality in providing governmental services.
(8) Will not have an undue adverse effect on aesthetics, scenic beauty, historic sites or natural areas, and 8(A) will not imperil necessary wildlife habitat or endangered species in the immediate area.
(9) Conforms with the Capability and Development Plan which includes the following considerations: (A) The impact the project will have on the growth of the town or region: (B) Primary agricultural soils; (C) Productive forest soils; (D) Earth resources; (E) Extraction of earth resources; (F) Energy conservation; (G) Private utility services; (H) Costs of scattered developments; (J) Public utility services; (K) Development affecting public investments; and (L) Rural growth areas.
(10) Is in conformance with any local or regional plan or capital facilities program.

Of the 600-700 applications submitted each year across Vermont, over 80% are processed without a hearing and 95% are approved, with conditions. Because of the Act 250 process, the quality of development in Vermont is generally higher than in states without comprehensive land use laws. Act 250 continues to achieve a balance between economic development and the legitimate interests of citizens, municipalities, and state agencies in protecting the environment.

2.2.8 State and Federal Protected Lands

State owned lands in the Basin include Mollie Beattie (203 acres), John Dorand (518 ac.), Hapgood (118 ac.), Okemo* (2,366 ac.), Proctor- Piper* (670 ac.), W.C. Putnam (146 ac.), Townshend (1106 ac.), and Williams River (108 ac.) State Forests, Jamaica (773 ac.) and Lowell Lake (345 ac.) State Parks, and Gale Meadows Wildlife Management Area (707 ac.).

The **Green Mountain National Forest** (GMNF) was established in 1932 after uncontrolled logging, fire, and flooding ravaged the state of Vermont. Today, the Green Mountain National Forest has grown – tract by tract – to almost 400,000 acres that stretch nearly two-thirds the length of Vermont, 47,795 acres are in Basin 11. The mission of the Forest is to sustain, protect and enhance forest ecosystems. The Forest is within a day's drive of 70 million people.

The Green Mountain National Forest makes up a considerable portion of the western half of Basin 11. There are GMNF lands in the towns of Mount Holly, Mount Tabor, Weston, Peru, Landgrove, Londonderry, Winhall, Stratton, Jamaica, Wardsboro and Dover.

* Portions of these state lands fall in other basin areas.

The **Silvio O. Conte National Fish and Wildlife Refuge** encompasses the whole of the Connecticut River valley including the West, Williams, and Saxtons Rivers. Conte is a different kind of refuge, rather than having a single large land holding in the watershed the refuge conserves lands through acquisition and easements and works with private landowners to enhance and support wildlife habitat throughout the watershed. Part of the Refuge's land includes 278 acres on

Putney Mountain part of which drains to the West River.

The Refuge was set up to:

- Conserve, protect, and enhance the Connecticut River watershed populations of Atlantic salmon, American shad, river herring, shortnose sturgeon, bald eagles, peregrine falcons, osprey, black ducks, and other native species of plants, fish, and wildlife.
- Protect species listed as endangered or threatened, or identified as candidates for listing, pursuant to the Endangered Species Act of 1973, as amended.
- Conserve protect, and enhance the natural diversity and abundance of plant, fish, and wildlife species and the ecosystems upon which these species depend within the refuge.
- Restore and maintain the chemical, physical, and biological integrity of wetlands and other waters within the refuge.
- Fulfill the international treaty obligations of the United States relating to fish and wildlife and wetlands.

Provide opportunities for scientific research, environmental education, and fish and wildlife-oriented recreation and access to the extent compatible with the other refuge purposes.

The Conte Refuge has designated priority focus areas for future work. In Basin 11 these areas include:

Retreat Meadows - 55 acres: This is a marsh along the mainstem of the Connecticut River. It serves as important stopover habitat for migrating wood ducks, black ducks, mallards, hooded mergansers and a variety and abundance of shorebirds. The Service will work with the Vermont Department of Fish and Wildlife and local organizations to protect these wetlands through a cost share challenge grant for conservation easements or fee title acquisition.

West River, including Rock and Winhall tributaries and Wardsboro Brook - 710 acres: This focus area encompasses a stretch of riverine and riparian habitat. It provides spawning habitat for blueback herring and potential spawning habitat for Atlantic salmon. This river and its tributaries are used by juvenile salmon for rearing or nursery habitat. Adult searun salmon will use the river for natural reproduction. It is one of Vermont's premier Atlantic salmon restoration rivers. It is an important river system for a rare mussel. Several rare plants also occur within this focus area. The Service will work with the Vermont Department of Fish and Wildlife and The Nature Conservancy to protect riparian buffers through a cost share challenge grant for conservation easements.

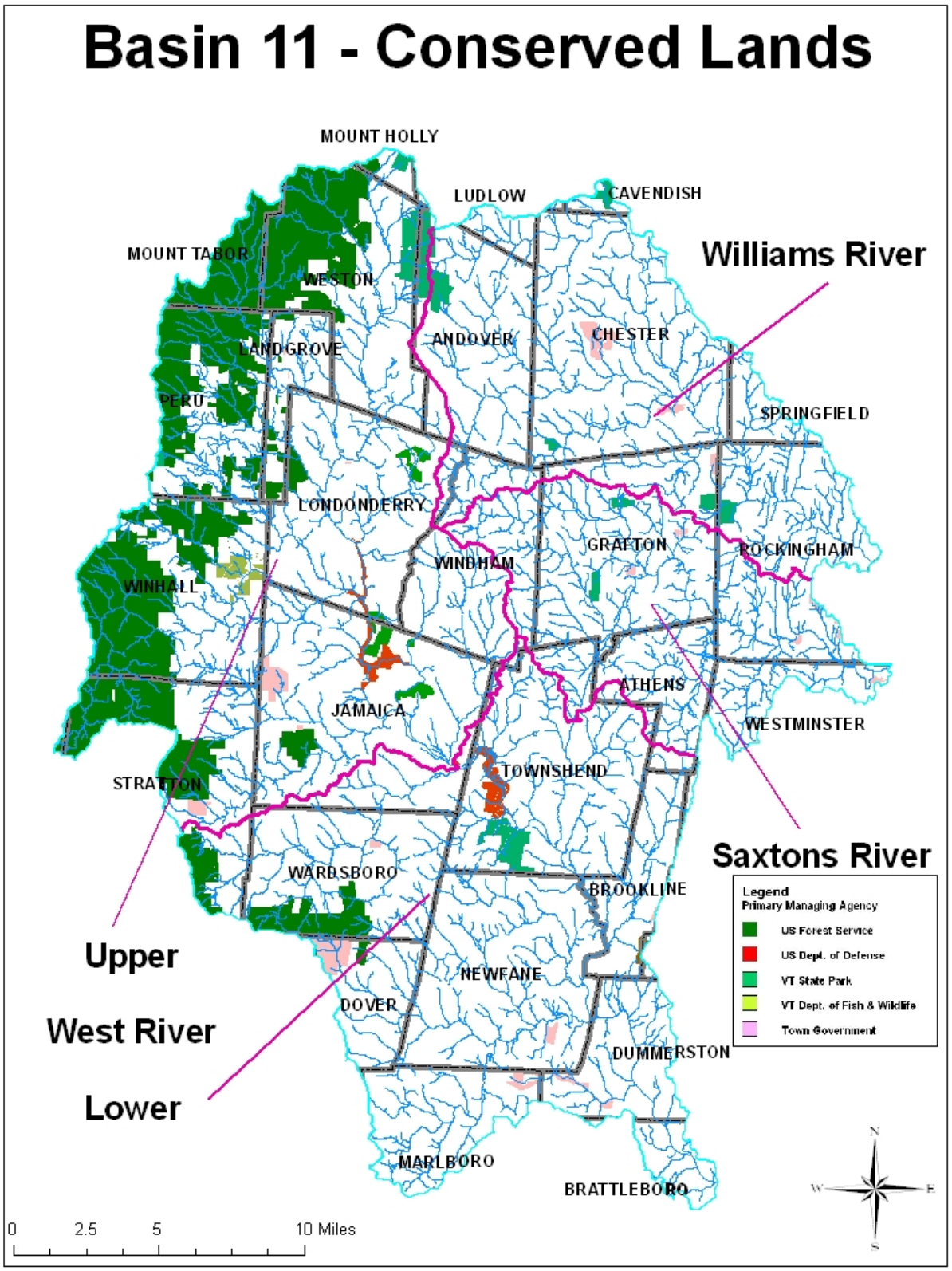


Figure 2.2 Conserved Lands

Williams River to Brockway Mills Dam - 30 acres: The Williams River provides nursery and rearing habitat for juvenile Atlantic salmon. The Service will work with the Vermont Department of Fish and Wildlife and The Nature Conservancy to protect riparian buffers through a cost share challenge grant for conservation easements.

The New England District of the **U.S. Army Corps of Engineers** provides service to Vermont within the Connecticut River Basin. New England District is responsible for all civil works activities, for the Regulatory and Defense Environmental Restoration Programs, all Emergency Operations and is the Corps' lead for the Planning Assistance to States Program. The missions of the New England District, U.S. Army Corps of Engineers, include flood damage reduction and control, emergency preparedness and response to natural disasters and national emergencies, environmental remediation and restoration, natural resource management, streambank and shoreline protection, navigation maintenance and improvement, support to military facilities and installations, and engineering and construction support to other government agencies. Through its Regulatory program, the district processes about 6,000 applications per year for work in waters and wetlands of the six-state region.
Corps biologists and rangers work closely with state and federal agencies to insure healthy fish and wildlife populations. Corps personnel manage the land, 965 acres at Ball Mountain Lake and 1,010 acres at Townshend Lake, to maintain a diversity of fish and wildlife habitats. Many programs are used to benefit the native wildlife species. The installation of bird boxes has created needed nesting sites for tree swallows, black-capped chickadees, and bluebirds. Rangers prune apple trees to improve the health and vigor of the apple trees and increase the amount of food produced for wildlife. Forest stands are managed to maximize benefits to both trees and animals. The management practices of brushhogging and prescribed burning are used to maintain important open field habitats.

2.3 Water-Based Resources

The West, Williams, and Saxtons Rivers, their tributaries and associated lakes, ponds, and wetlands support aquatic life and habitat and provide recreational opportunities through fisheries, swimming holes, boating, and aesthetics. In addition, the surface waters provide drinking water and irrigation supplies. The fundamental purpose of protecting the water quality in Vermont is to protect these and other beneficial uses and values of the waters.

The West River and its major tributaries have been designated as a "special focus area- high priority" by the United States Fish and Wildlife Service (US FWS), because of the watershed's rare species, potential for Atlantic salmon restoration, and contiguous habitat type. These features have also prompted The Nature Conservancy (TNC) of Vermont to consider the West River watershed as one of their highest priority areas for protection (TNC 1998). These organizations have identified specific threats to the water quality and aquatic habitat of the West River to include **sedimentation** and **thermal modification** resulting from **riparian vegetation** removal, erosion, flow alteration from flood control dams, and acidic conditions. Although no large flood control dams exist in the Williams or Saxtons Rivers, similar threats to water quality have been identified (VDEC 2001).

2.3.1 Lakes

The West, Williams, and Saxtons River watersheds are characterized by having relatively few lakes. There are 49 lakes and ponds in the three watersheds (13 with areas of 20 acres or greater), comprising 1,030 known acres. Twenty-nine of these lakes (1,005 acres) are tracked in VDEC's Lake Assessment Database. Of these 1,005 acres, 775 are monitored (11 lakes), while 18 smaller lakes (230 acres) lack monitoring data. The 5 largest bodies of water in Basin 11 are all in the West River watershed:

- Gale Meadows (195 acres)
- Lowell Lake (109 acres)
- Townshend Lake Reservoir (108 acres)
- Sunset Lake (96 acres)
- Ball Mountain Lake Reservoir (85 acres)

Vermont DEC's Lake Protection Classification System is one framework within which lakes can be evaluated for their special significance when compared to other lakes statewide. The Lake Protection Classification System identifies unique lakes based on: wilderness status; occurrence of scenic and natural features; existence of very high water quality; and/or the presence of very rare, threatened, and/or endangered species (VDEC 2001). The following Basin 11 lakes are significant in these respects:

Ball Mountain Reservoir, Jamaica: The steep-sided nature of the valley along this reservoir creates an interesting shoreline, which includes boulders, small cliffs, and waterfalls.

***Cole Pond, Jamaica:** Cole Pond supports a population of the rare pondweed *Potamogeton bicupulatus*.

Gale Meadows Pond, Winhall: This pond has a population of the rare native milfoil *Myriophyllum humile.*

Lily Pond, Londonderry: This small scenic pond supports both the rare *P. bicupulatus*, and the rare *M. humile*.

***Lowell Lake, Londonderry:** Lowell Lake supports three noteworthy aquatic plants: the rare *P. bicupulatus*; the rare *M. humile;* and the rare bladderwort *Utricularia purpurea.* Lowell Lake also has a particularly diverse assemblage of aquatic plants, as well as several undeveloped islands.

***Stratton Pond, Stratton:** Stratton Pond is a wilderness lake, with access by foot only. The primary access is via the Appalachian Trail, which runs adjacent to the pond.

Sunset Lake, Marlboro: Despite its status as an acid-impaired lake, Sunset Lake is an ultra-oligotrophic lake, meaning it supports extremely high water quality as related to nutrients. The lake has a very scenic lake bottom, and supports three rare species, *P. bicupulatus*, the quillwort *Isoetes tuckermanii* and *M. humile.*

* indicates ponds in the Vermont Lay Monitoring Program.

Aquatic biologists from the VDEC's Lake Assessment Program monitor Vermont's lakes to detect water quality problems and threats while also providing assistance in lake management and protection to municipalities, lake associations, and individuals. There are 29 lakes that are monitored or evaluated by the state, 11 of which were monitored in 2001. Under the program the

following information is collected: depth survey, aquatic **macrophyte** survey; selected **water quality parameters** including **transparency**, **total phosphorus**, **pH**, temperature, **dissolved oxygen**, **conductivity**, **total suspended solids**, and periphyton (algae). Intensive studies have also been conducted to determine the impacts of mercury in fish (VDEC 2004b).

2.3.2 Waterfalls, Cascades, and Pools

West River

As noted in the 1989 *Upper West River Basin Water Quality Management Plan*, swimming occurs throughout the West River watershed in deep river and stream pools and in ponds. Wherever there is easy access to an inviting pool, someone is likely to take a plunge from time to time. The plan lists and maps 25 river or stream swimming sites including sites on the reservoirs and 17 pond sites in the upper West River watershed. In addition, there are 17 other swimming holes in the West River watershed described in the 1992 Vermont Swimming Hole Study. Four stream sites with waterfalls or cascades in the West River watershed are described in the 1985 *Waterfalls, Cascades and Gorges* report. These include Jelly Mill Falls on Stickney Brook in Dummerston, Hamilton Falls on Cobb Brook in Jamaica, the Rock River Cascades on the Rock River in Dover, and Pikes Falls on the North Branch Ball Mountain Brook in Jamaica. Salmon Hole on the West River, Indian Love Call on the Rock River, Winhall Brook campground beach and Townshend Reservoir beach are also very popular swimming areas, but there are numerous other locally known and enjoyed swimming holes throughout the watershed. A few notable swimming holes are described in more detail below.

Hamilton Falls is located on Cobb Brook, a small mountain stream about 10 to 15 feet wide with very clean water. The main falls are a steep cascade 40-50 feet high. Below the main falls, about a mile of steep wooded ravine shelters a series of smaller falls, pools, and cascades. The site, much used by local residents for swimming and picnicking, is a designated State Natural Area of the Vermont Department of Forests, Parks, and Recreation (VANR 1988). The Water Resources Board in 1992, classified Cobb Brook as a Class A stream (see below). The swimming hole remains a favorite local spot and is considered one of the most beautiful in the West River Watershed.

Pikes Falls rests in a second-growth hemlock hardwoods forest in hilly countryside on the North Branch of the Ball Mountain Brook near the base of Stratton Mountain. The stream flows through a ledge, then funnels into a channel splitting into three cascades. In all, the cascade is about seven feet high, but the water channels into a narrow chute and spills into a large 50 foot-wide pool. This stretch of stream has the distinction of being the first to be designated among the State's Outstanding Resource Waters. Through the years Pikes Falls has been a very popular, local swimming hole, but more recently, because of its proximity to the Stratton Mountain Resort, the area has developed wide appeal for both local residents and out-of-state visitors. Pikes Falls is owned by the Town of Jamaica.

Rock River, a chain of deep pools along the lower reaches of the Rock River have become a magnet for swimming hole lovers across the New England area and beyond. Listed and mapped on an internet website and described in a recent book on Vermont swimming holes, the Rock River with its Indian Love Call merging with the West, are in many people's minds synonymous

with unspoiled beauty and serenity. As many as a hundred parked cars will stretch along side Route 30 during warm summer weekends – an indication of the numbers of people willing to make the more than ½ mile trek up an uncertain trail to reach the ledges, intimate beaches, and deep pools that the area offers. The environmental stresses and traffic safety issues associated with this particularly lovely area are concerns identified in later sections of this basin plan.

Jelly Mill Falls at the lower end of Stickney Brook is a series of step falls cascading over broad flat stone slabs. A popular swimming spot with very clean water, the brook is 30 – 50 feet wide, the cascades over 100 feet long with a drop of about 30 feet. The rocks form a series of cold clear pools. Being very accessible to Route 30 traffic and running along a dirt road the adjacent woods are somewhat trampled but the overall area is in good condition and the falls stunning.

Williams River

The Williams River is relatively shallow in the summer and there are few known swimming holes. The river was not explored during the VDEC's 1991 *Vermont Swimming Hole Study* although two sites are listed but not described in the study's report. Rainbow Rocks located in Chester are ledges with a deep hole below. Brockway Mills, in Rockingham, is an 80-foot gorge with pools, potholes, and small cascades. The gorge is described in the VDEC publication *Waterfalls, Cascades and Gorges of Vermont* although the investigators describe the site before a hydro power facility was developed there. The WRWA monitored water quality at three identified swimming holes in the Williams watershed – Bartonsville Covered Bridge, Gassetts Talc Mine, and near the North Street/Church Street Bridge (in Chester). In 2005 monitoring was begun at a fourth swimming hole near the Rockingham Trestle bridge.

Saxtons River

On the lower Saxtons River just above the Route 5 bridge in Westminster is the area called Saxtons River Falls. Extending from the falls upstream approximately 100 yards, there are rocks and a sandy beach for sitting and sunbathing and ledges for jumping. Another popular local swimming and gathering site is Twin Falls that has a nice pool, the falls, and ledges. The Saxtons River Falls (named Bellows Falls Sandy Beach) and another spot along the river upstream from the Saxtons River village center identified as a local swimming hole are sampled by the WRWA during the summer. At the mouth of the river is a sandy area that appears to be used as a picnic or gathering spot.

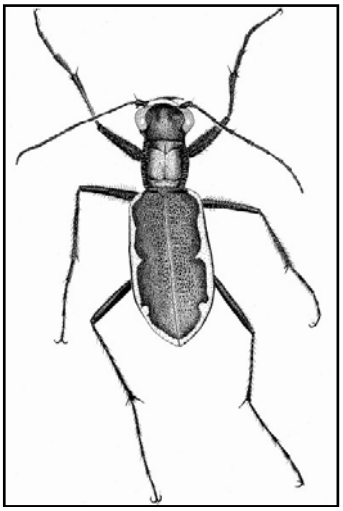
Barbed-bristle Bulrush
(*Scirpus ancistrochaetus*)
Photo by B. Popp

2.3.3 Threatened and Endangered Species and Significant Natural Communities

Fourteen animal species, 14 plant species and 15 important natural communities have been identified as endangered, threatened or of special concern in Basin 11. Of these, the West River hosts six endangered and nine threatened species, the Williams hosts two endangered and two threatened species, and the

Saxtons, three endangered and three threatened species. The barbed-bristle, or northeastern, bulrush (*Scirpus ancistrochaetus*), which is found in all three watersheds is listed as endangered by both the State of Vermont and the US Fish and Wildlife Service.

Two surveys were conducted in 1996 along the West River. One by the VANR Nongame and Natural Heritage Program found rare freshwater mussels, tiger beetles, barbed-bristle bulrush, and significant natural communities primarily at the USACE Ball Mountain and Townshend Dam project areas. Three rare invertebrate species were found either in the West River or on its shores. The cobblestone tiger beetle (*Cicindela marginipennis*) was reported for the first time from the West River as a result of this inventory. Both the brook floater mussel (*Alasmidonta varicosa*) and the eastern pearlshell mussel (*Margaritifera margaritifera*) were found at a site between the dams and then at several other locations on the mid-West River (VANR 1997). The West River has some of the best examples in the state of two shoreline natural communities: river cobble shore is a rare community and rivershore grassland is uncommon. Both of these natural communities are kept open and free of trees by the West River's high energy currents, tumbling rocks, and floating spring ice.



Cobblestone tiger beetle (*Cicindela marginipennis*)
Illustration by Jonathan Leonard
From Wetlands, Woodland, Wildlands

The second study was done at the Ball Mountain and Townshend Dam Project Areas. Jim Andrews of Middlebury College conducted the survey of vernal pools and rare or protected reptiles and amphibians. Nineteen species of reptile and amphibian were located in the areas searched: six salamander species, seven frog or toad species, three turtle species, and three snake species. Thirty-three locations of vernal pools or areas that serve as amphibian breeding sites were identified and mapped. Seven of the thirty-three sites are considered classic vernal pools being natural, temporary pools in forested areas with no inlet or outlet (VDEC 2001 and Andrews 1997). A complete listing of Threatened and Endangered Species found in Basin 11 is presented in Appendix A.8.

2.3.4 Wetland and Water-dependent Wildlife

An important aspect of basin planning involves collecting information about existing wetlands and wildlife communities and their habitats. Federal and State protection efforts have preserved many important wetlands in the Basin over the years. However, there is still a general lack of understanding by the public of the important functions and values of wetlands. The wildlife habitat values of wetlands are better understood and appreciated than most others aspects.

Wetlands serve a variety of functions and values beneficial to the health, safety, and welfare of the general public. Some of the functions and values that wetlands provide include: flood control, water quality protection, wildlife habitat, endangered species habitat, hydrophytic vegetation habitat, educational resources, aesthetics, recreation, fisheries habitat, and erosion control. While the degree to which a wetland serves these functions and values varies from wetland to wetland, each wetland works in combination with other wetlands as part of a complex integrated system.

The watersheds of Basin 11 support a wide array of wildlife species, all of which are dependent on clean water to survive. Some live all or part of their lives in streams, rivers, lakes, and wetlands. Wildlife and the landscapes that support them are part of Vermont's rural culture and character. Results from a 2001 public opinion survey conducted by the USFWS show that Vermont ranked first in the nation for having the highest percentage of residents that actively viewed wildlife (60 percent). Today, over 290,000 Vermont residents engage in wildlife associated activities including viewing, hunting, fishing, and photography. Interestingly, this is 43 percent more residents than ski in Vermont.[8] Interest in wildlife and related activities in 1996 created over $341 million dollars in revenue for Vermont businesses. This represents a significant contribution to the state's economy and illustrates the strong connection Vermonters have to the land and its wild inhabitants. Maintaining high quality surface waters is critical to the continued survival and health of wildlife that live in the West, Williams, and Saxtons watersheds (VVMR 2004).

Although beavers have a poor reputation among some, they are a key species in the establishment and preservation of many of Vermont's wetlands. Beaver ponds serve all the functions of other natural wetlands and in southern Vermont provide habitat for a federally endangered plant. Beaver ponds provide flood protection, act as nutrient sinks and enhance groundwater recharge. Peacefully co-habitating with beavers is an important step toward enhancing our wetland resources.

West River

The VANR Nongame and Natural Heritage Program in July 1996 conducted an ecological inventory of wetland natural communities in the West River watershed. Wetlands cover only 1 percent of the West River watershed according to the 1991-1993 satellite photograph analysis. A report summarized the results of the wetland inventory. The following selected information about the West River and its significant aquatic communities has been excerpted from the report to relate their unique features (VANR 1996).

> *The riverine wetlands along the West River, especially those associated with relatively high-gradient streams, are of particular significance in the state. The floodplain forests along the West River differ from floodplain forests in most other areas of Vermont in that they contain sycamore. Also unique to the West River and nearby sections of the Connecticut River is the presence of big bluestem and dwarf sand cherry in the rivershore grassland community. Furthermore, the examples of river cobble shore community along the West River are some of the most outstanding in the state. Five rare plants are associated with this community in several locations along the West River.*
>
> *Wetlands resulting from beaver impoundments, so-called beaver meadows, are by far the most numerous wetland type. An impressive example of such a series is described for the Winhall River Headwater Beaver flowage site in Stratton. Although functionally very important as wetlands, beaver meadows are so common in Vermont that they rarely register as significant on a state level. However, the northeastern bulrush, a federally-listed species is restricted in Vermont to beaver wetlands in the southeastern portion of the state.*

[8] **Vermont and the Vermont Market Region**, March 2004

Williams River

In the Williams River watershed, areas identified as wetland cover 1 percent of the area. There are 17 occurrences of plant species that are of statewide importance in the watershed and most of these plants are found in wetlands associated with the river. Two bird species of importance are also found along the river. There are four occurrences of natural communities: three shallow emergent marsh communities and one riverside outcrop community. All of these significant natural communities are part of the river ecosystem (VDEC 2001).

Adams Wetland, Chester – Williams River

Saxtons River

Saxtons River wetland areas cover less than 2 percent of the watershed. In the Saxtons River watershed, there are four occurrences of plant species, two occurrences of birds, and two significant natural communities of statewide importance. One of the natural communities is a river cobble shore and the other is a sugar maple - ostrich fern riverine floodplain forest (VDEC 2001a).

2.3.5 Dams

There are numerous small and large dams constructed on streams and rivers in the basin, providing a variety of benefits including flood control, power generation, and recreational opportunities such as swimming and boating. The Vermont Dam Inventory maintained by the VDEC lists over 1200 dams statewide. There is substantial inventory information on 625 dams listed. But of the 600 remaining, many are known to be breached or essentially gone. Recent fieldwork also suggests that there are numerous dams around the state that are unregulated and not included on the state's inventory (VANR 2003b). The inventory lists 29 dams on the West River, five on the Williams River and four on the Saxtons River. (See Appendix A.9)

There are two significant USACE flood control structures on the West River. The dams were built to provide protection to downstream communities in Massachusetts and Connecticut as well as Vermont and offer many recreational opportunities. Their operation is coordinated with other dams in the Connecticut River Basin to obtain the maximum reduction in overall flood damage. An annual report issued by the USACE is available (http://www.nae.usace.army.mil/) to the public outlining the activities and accomplishments pertaining to reservoir regulation and water management of the various projects in the New England District. These reports offer an accounting of "damages prevented" for each state showing cost figures that often run into millions of dollars saved as the result of USACE flood control measures enacted during any given year

(USACE 2001).

Townshend Dam is located on the West River about 19.5 miles upstream from its mouth at the Connecticut River at Brattleboro. The site is about two miles above Townshend Center. This project features a rolled-earth and rock-fill dam, 133 feet high and 1,700 feet long. There are outlet works founded on bedrock under the dam and a side channel spillway 439 feet long at the left abutment. The dam was completed in 1961. The Townshend Lake Reservoir has a holding capacity of 11 billion gallons of floodwater. When full, the 730-acre pool would extend 4.5 miles upstream in Townshend and into Jamaica (USACE 1972).

The reservoir at Townshend Dam, so-called Townshend Lake, affords a scenic public recreation area for swimming, boating, and picnicking during the summer season. The USACE project includes managing approximately 1,010 acres as wildlife habitat. USACE personnel plant wildlife food plots and set up nesting boxes to encourage and maintain wildlife populations.

Ball Mountain Dam is located about 9.5 miles upstream from the Townshend Dam. The site is two miles north of the village of Jamaica at a point where the river flows through a narrow, steep-sided valley on the north flank of Ball Mountain. The earth and rockfill dam is 265 feet high and 915 feet long, with a blasted bedrock spillway 235 long at the right abutment of the dam. The outlet is tunneled in rock under the dam. The dam construction was completed in 1961. Ball Mountain Reservoir can store 54,600 acre-feet or about 17.8 billion gallons of floodwaters. At full flood, the 800-acre pool would extend 6.5 miles upstream in Jamaica and into Londonderry. (USACE 1972).

Winhall Campground is a recreational area operated by the USACE as part of its Ball Mountain Project. The campground is located at the confluence of the Winhall and West Rivers upstream from the dam. The campground is a gathering area for hundreds of whitewater boating enthusiasts on weekends when the USACE schedules its annual water releases from the dams (See below).

Weston Mill and Dam

Weston Village Dams consist of three dams, one on the West River and two on the Wantastiquet Lake stream. The Weston Mill dam on the West River is 68 feet long and 15 feet high. This historic dam has been restored as has the grist mill that it again supplies with power. The mill and waterwheel are run only occasionally for educational programs. The Upper and Lower Weston dams on the tributary are small but significant as they

create small impoundments and block fish passage up the stream. Also on the stream, a 400 foot long, 22 foot high dam impounds Wantastiquet Lake. Upstream aquatic organism passage is blocked by this dam. Unfortunately downstream passage is not blocked and the introduced population of invasive Rusty Crayfish (*Orconectes rusticus*) may be able to escape and spread to downstream areas.

Brockways Mills Dam on the Williams River in Rockingham is the only hydroelectric operation in the Basin. The dam is 125 feet long and 20 feet high. The current operators have installed seasonal downstream fish passage and the facility is undergoing a redesign. The project generally operates in instantaneous run of the river mode.

Williams Dam on the West River in Londonderry was constructed in 1900. This stone masonry dam is 117 feet long and 20 feet high. The reservoir contained covers approximately eight acres. The dam is an old mill dam with no current use but causes significant impacts to the West River including increased water temperature, disruption of sediment transport, and blockage of aquatic organism passage. This dam has been mentioned for potential hydro-power production however no formal proposal has been made.

All dams cause changes in the **riverine** system. The habitat and water quality impacts of dams include conversion from a flowing water system into lake-like habitat. This increases water temperature due to prolonged exposure to sunlight which in turn can decrease the level of dissolved oxygen in the water. Both of these impacts convert the impounded area to a warm water fishery and eliminate many of the **lotic** macroinvertebrates. Cold water trout species are often excluded while warm water species such as bass and walleye replace them. Dams impede fish passage preventing them from accessing needed upstream spawning habitat, blocking seasonal migration routes and preventing downstream migration of young **anadromous** fish.

Upstream habitat flooded by the dam's impoundment is lost to riverine wildlife; floodplains adjacent to the river are either permanently flooded or permanently de-watered due to the lack of natural water level fluctuations. This can cause riparian wetlands to disappear along with their associated wildlife.

Many dams, for either hydropower production or flood control protection, alter the natural flow of the river. By holding back water to fill reservoirs, downstream water levels are reduced, aquatic habitat de-watered and water temperatures altered. The high flows of subsequent water releases may cause downstream erosion, de-stabilize streambanks and can flush aquatic species downstream.

Sediment transport in a river is also impacted by dams as sediments settle out in slow moving water of the impounded reservoir. Every river has a certain hydraulic capacity to transport sediment. When that capacity is reached, and the river is "full" of sediment during a high water event, the water will not take on, or transport, other sediments in its path even though those sediments may be erodible. If the water has a certain sediment transport capacity, but sediments have been trapped behind a barrier such as a dam or culvert, the water is said to be "starved" for

sediment and will easily scour and displace downstream any sediments that are encountered below the barrier. If rivers are not starved for gravel during high flows they will be less likely to take gravel from the bottom of the channel. It is the down-cutting of the channel below a dam that threatens to undermine bridges and rip-rap.

2.3.6 Fisheries Resources

Submitted by Jay McMenemy, Fisheries Biologist, VDFW

The upper portions and smaller tributaries of the West, Saxtons, and Williams River watersheds support healthy populations of wild brook trout, and in some cases wild brown trout. However, high summer water temperatures limit trout populations in the lower mainstems and larger tributaries. Yearling brook, brown, and rainbow trout are stocked in portions of these watersheds for "put and take" fishing where stream temperatures are warm in the summer and wild trout populations are low or nonexistent. Atlantic salmon can survive in significantly warmer water than trout. Salmon do well in most of these watersheds from upland tributaries to the lower mainstems. The one exception is the West River below Townshend Dam where temperature conditions are marginal even for salmon in most years. A variety of non-game fish species occur throughout the watersheds. Several species of warmwater fish occur in lakes and ponds in the basin and the lower portions of the West (below Townshend) and Williams (below Brockways Mills) rivers.

High water temperatures are due to large portions of these watersheds lacking adequate riparian buffers resulting in lack of shade. Roads are built on or close to river banks and there is additional commercial, residential, and agricultural development near streams. This situation is exacerbated on the West River by the presence of four mainstem dams which result in significant additional warming. The lower two dams, which are operated by the U.S. Army Corps of Engineers (COE) for flood control, have substantial additional habitat impact from flow fluctuations, reservoir fluctuations, and sediment releases.

A Local Fishing Guide's View of Fishing the Waters of Basin 11

By David.Deen, Fishing Guide and CRWC River Steward

" In my experience the West and Williams are a mixed cold and cool water `fishery. By that I mean the rivers offer a combination of trout and small mouth bass (and related species) from the Connecticut River up stream to the first natural (Brockway Mills gorge on the Williams) or man made (USACE dam at Townshend) barrier to further up stream migration. Beyond those points they are trout rivers with the population being a mix of native brook and introduced rainbow trout. You, of course, see salmon parr and smolt throughout the watershed. On any given day on these rivers in their lower reaches you can catch two - three - or four different species of fish.

The Saxtons has a dam at the down river end that stops bass migration right at the Route 5 bridge so if I were to classify it it would be a cold water stream. It has erosion problems in many of the lower reaches (Cambridgeport downstream) so much of the water is flat and warms early in the season. Trout fishing is a challenge all the way up stream until you are up towards Grafton where the stream maintains its natural form. The headwaters support a wild brook trout fishery all the way to Windham. You of course see salmon parr and smolt throughout the watershed.

On almost all Vermont rivers you see loss of habitat due to erosion. It is slow but persistent in the lower reaches of all three of these rivers. Wild fish have been reduced over the years because of this loss of habitat. Stocking has made up some of the loss of trout but most of us would rather have wild fish to angle for and in fact even as a trout fisher I rather prefer a wild small mouth bass to a stocked rainbow.

Continued

However, with the above exceptions, physical habitat is generally in good shape in these watersheds with some exceptions. ANR staff work to protect and improve habitat through Land Use (Act 250), Stream Alteration, and Wetland permitting processes. The U.S. Forest Service has an active habitat restoration and protection program on their lands in the headwaters of the West River watershed.

Atlantic salmon fry (less than one inch long) are stocked annually into streams in the West, Saxtons, and Williams River watersheds as part of the cooperative interstate/federal program to restore salmon to the Connecticut River basin. Salmon fry are stocked with the assistance of a large dedicated contingent of volunteers. Salmon were extirpated from the basin in 1798 when a dam was built across the mainstem of the Connecticut River in Turners Falls, Massachusetts. Salmon have been stocked in the West River since 1981, the Saxtons River since 1988, and the Williams River since 1993. Initially, stocking in all three watersheds was small scale and experimental. Since the mid-1990s, annual fry stocking has been at or near desired levels. In 2007, 948,000 fry were stocked in the West, 177,000 fry were stocked in the Saxtons, and 274,000 fry were stocked in the Williams watersheds. Annual electrofishing assessments throughout Basin 11 have shown generally good survival and growth of stocked salmon. Most salmon spend two years in freshwater before migrating to the ocean as smolts.

Continued:

Access to these rivers is being constricted due to ownership changes from Vermonters to others who do not feel the historic open lands philosophy of those of us from the north country. Private ownership in more urban areas has a different feel with limits on access not usually felt up here. These new landowners also mistakenly feel that they own the river because it flows through or by their land, not understanding the long legal and community tradition of the public trust nature of our waters.

The other problem leading to loss of access is people leaving trash on lands that have always been open right up until the landowner can't stand the trash any more and the land gets posted. VTrans is not helpful in this area either. They have over the past twenty years closed off more and more fishing parking sites with their steel fences leaving no way to park and gain reasonable access to the river. Its not that you can't jump their fence but if there is not another parking place for a mile or 2 you just have to give up the old site."

Currently, most adult salmon returning from the ocean are trapped at the Holyoke Dam in Massachusetts for broodstock. However, since the mid-1980s about ten percent of the salmon have been released to continue upstream and spawn naturally. Beginning in 1998, most of the released salmon have been radiotagged, which has greatly facilitated monitoring of their movements. It is likely that adult salmon have been present in the West River almost annually since 1985, but monitoring was limited to snorkeling surveys and other incidental reports. Since 1998, adult salmon have been located in Basin 11 almost annually including the West River and tributaries, the Saxtons River, and the Williams River.

Salmon and other anadromous fish (migrate from the ocean to freshwater to spawn) and the catadromous (migrate from freshwater to the ocean to spawn) American eel have access to the West River and tributaries below Townshend Dam. Anadromous sea lampreys spawn in the mainstem West and some of the lower tributaries. American eels historically occurred throughout the West River watershed and were common in tributaries below Townshend as recently as the early 1990s, but have dramatically declined here and throughout much of their range.

Anadromous American shad are occasionally seen in the lower West, but their numbers are low and declining.

A salmon track and truck facility is operated by the USACE at Townshend Dam for the purpose of providing salmon passage in the West River basin. Traditional fish ladders are not feasible at the flood control dams because of their large size and normally nearly empty pools. Currently, salmon are trapped and transported above Townshend Dam for release. As run sizes increase, salmon will also be transported above Ball Mountain, Londonderry, and Weston Dams for release. Without this facility, all four mainstem dams would be complete barriers to upstream fish migration. This facility was destroyed by flooding in 1998 and was not operational for salmon passage that year. The facility was repaired in 1999 and upgraded in 2001. The USACE maintains the winter pool level of 25 feet at Ball Mountain during the spring migration season to facilitate passage of smolts downstream through this bottom discharge reservoir. Radiotagging studies have indicated good smolt passage at moderate to high flows, but no evaluation has been done at lower flows. Water storage for whitewater releases and flood control can result in significant migration delay and mortality to smolts. Passage through Townshend Dam is much easier because it is a top-spill operation. The USACE has installed stop logs at the base of the dam to provide a pool for smolts to safely land in. Weston and Londonderry dams are not thought to be major impediments to smolt migration but some minor improvements might be needed in the future to maximize smolt survival.

Twin Falls on the lower Saxtons River is a barrier to upstream fish migration at most flows, but it may be passable by salmon at certain flows. It is near the upper limit for salmon leaping ability of 10-12 feet. It presents no problem to outmigrating smolts. No other significant barriers to fish migration occur in the watershed. Salmon have been documented passing the remnant dam and natural falls at Route 5 and it is also likely passable by sea lampreys and American eels.

Brockways Mills Dam and falls on the Williams River is currently impassable to upstream migrating fish. Historical passage status is uncertain, although it is likely that this series of small falls could be negotiated by salmon at certain flows. A temporary bypass facility to allow safe downstream migration of smolts has been operated annually and construction of a permanent facility is planned for 2008. An upstream fish ladder may be required in the future. There is excellent spawning, rearing, and holding habitat for salmon from the dam to the Connecticut River. This area is also accessible to sea lampreys and American eels.

Culverts at road and driveway stream crossings are often a barrier to movement of fish and such culverts are located throughout Basin 11, mostly in small streams.

2.3.7 Boating

West River

The West River is well-known for canoeing and kayaking and for the spring and fall Ball Mountain Dam whitewater releases.* There are a number of challenging and scenic boating runs on both the West River mainstem and its tributaries. The stretches described and/or mapped in the VDEC publications 1987 *Whitewater Rivers of Vermont* or the 1988 *Guide for Evaluating the*

Outstanding Rivers and Streams of Vermont include: the stretches on the West River mainstem from Weston to Londonderry; Londonderry to Ball Mountain Dam backwater; below Ball Mountain Dam to the Route 100 bridge; below Townshend Dam to the Connecticut River; as well as the Winhall River from Kendall Farm Road to the West River, and Wardsboro Brook from Wardsboro to Jamaica. All but one of these stretches are rated as "Highly Important" for boating, the one from Weston to Londonderry being rated "Important."

*In 2004 the USACE and the Vermont ANR reached agreement on several points regarding operations of the Ball Mountain and Townshend Dams geared to improving stream habitat conditions in the West River including modifications to minimum flows and ramping rates during whitewater releases. More information about this agreement is presented in Chapter 4.

Williams River

There are three whitewater boating stretches in the Williams River watershed described in the 1992 *Whitewater Rivers of Vermont* report. One boating run is a five mile stretch of the Middle Branch from five miles above Chester down to Chester center. This reach is judged to be primarily Class II whitewater at medium water and at least half Class III whitewater at high water levels and has been described as "demanding and pushy."

The other two boating stretches are both on the Williams River mainstem with one stretch from Gassetts to Chester and the other from Chester to Brockways Mills. The uppermost stretch has only mild whitewater as the stream at this point has a small watershed and moderate slope. For the approximately seven mile stretch from Chester down, the Williams is a medium-sized stream with mostly quickwater, scattered Class II rapids, and one Class IV drop. While the Gassetts to Chester stretch is not rated, the other two are rated "Highly Important" for boating (VDEC 1989b).

Saxtons River

The only identified boating reach on the Saxtons River is an 8-mile stretch from Grafton to Saxtons River. It is popular with local kayakers and experienced open boat paddlers. It can be run after snowmelt and rain events. At medium water, it is mostly Class II whitewater. It is rated Highly Important for boating and "one of the best small technical rivers in the southern part of the state" (VDEC 1989b).

3. General Water Quality Concerns

The 1972 amendments to the Federal Water Pollution Control Act, commonly referred to as the Clean Water Act, prohibit the discharge of any pollutant to navigable waters of the United States from a **point source** unless the discharge is authorized by a National Pollutant Discharge Elimination System (NPDES) permit. Efforts to improve water quality under the NPDES program traditionally have focused on reducing pollutants in industrial process wastewater and municipal sewage treatment plant discharges. Much progress has been made in this area with the installation of wastewater treatment facilities throughout the country and improvement in septic system design and function. Over time however, it became evident that more diffuse sources of water pollution, such as stormwater runoff from roads, urban and residential developed areas and construction sites – all considered nonpoint sources, also contribute significantly to water quality problems. (USEPA 2003). See Appendix B. 2 for detailed information on permitted discharges in Basin 11.

Table 3 Permitted Direct and Indirect Discharges

Facility	Discharge	Town
Bear Creek Inn & Condominiums	Indirect Discharge - Sewage	Rawsonville
Birch Hill Apts; Black Birch & White Birch Bldgs	Indirect Discharge - Sewage	Winhall
Birch Hill Apts; Post Oak & Chestnut Oak Bldgs	Indirect Discharge - Sewage	Winhall
Birch Hill Apts; Red Hickory & Shagbark Hickory Bldgs	Indirect Discharge - Sewage	Winhall
Birch Hill Apts; Red Maple & Moose Maple Bldgs	Indirect Discharge - Sewage	Winhall
Birch Hill Apts; Sugar Maple & Rock Maple Bldgs	Indirect Discharge - Sewage	Winhall
Bromley Mountain	Indirect Discharge - Sewage	Peru
Chester WWTF	Direct - Municipal Discharge	Chester
Cool Edge Laundry	Indirect Discharge - Sewage	Londonderry
Eagle River Mining, Inc	Direct - Industrial Discharge	Newfane
Flood Brook Union School	Indirect Discharge - Sewage	Londonderry
Grace Cottage Hospital	Indirect Discharge - Sewage	Townshend
Grafton Village Cheese Company	Indirect Discharge - NonSewage	Grafton
Intervale at Stratton	Indirect Discharge - Sewage	Winhall
Leisure Lodge Condominiums	Indirect Discharge - Sewage	Winhall
Leland & Gray UHS	Indirect Discharge - Sewage	Townshend
Magic Mountain WWTF	Indirect Discharge - Sewage	Londonderry
Maple Valley Ski Area	Indirect Discharge - Sewage	Dummerston
Mountain Marketplace	Indirect Discharge - Sewage	Londonderry
Newsbank, Inc	Direct - Pretreatment Discharge	Chester
Old Tavern at Grafton	Indirect Discharge - Sewage	Grafton
Piper Ridge Condominiums- East	Indirect Discharge - Sewage	Winhall
Piper Ridge Condominiums- West	Indirect Discharge - Sewage	Winhall
Saxtons River WWTF	Direct - Municipal Discharge	Saxtons River
Stratton Mountain Ski Area	Indirect Discharge - Sewage	Winhall

The 1987 Water Quality Act Amendments to the Clean Water Act (CWA) added section 319, which established a national program to assess and control nonpoint source (NPS) pollution. Under this program, all states are asked to assess their NPS pollution problems and submit these assessments to the US Environmental Protection Agency (USEPA). *The Basin 11, West, Williams, and Saxtons Rivers Assessment Report* by the VDEC in 2001 was drafted as part of Vermont's state-wide assessment program to comply with USEPA regulations. As required, the Basin 11 assessment report includes a list of navigable waters within the basin which, without "additional action to control **nonpoint source pollution**, cannot reasonably be expected to attain or maintain applicable **water quality standards** or the goals and requirements of this [CWA] Act". The Basin 11 assessment also identifies the different types of pollution that contribute to the impairment of waters, describes the procedures for identifying and implementing control measures for reducing pollution, and identifies some of the state and local programs currently working to abate pollution.

General **causes** and potential **sources** of listed impairments from nonpoint source pollution to the rivers and lakes in the basin are identified in the Basin 11 Assessment Report. Causes are the pollutants or conditions that threaten or have an impact on the aquatic biota, the aquatic habitat, the fishery, swimming, fishing, boating, drinking water supply, fish consumption or other uses of the river or stream. The report identifies the top causes of riverine water quality or aquatic habitat problems in Basin 11. These are listed in Table 3.1 along with the miles of river or stream that they affect. Sources are the land uses, human activities, or occurrence of conditions responsible for the causes named above and that are the origin of the impacts on river or stream water quality or aquatic habitat. For example the cause of a poor fishery may be heavy sedimentation of the river bottom, while the source of the sediment is a washed out riverbank along a dirt road. Table 3.2 lists the primary sources of river and stream impacts and threats in the basin identifies in the report* (VDEC 2001).

Table 3.1. Causes of Impacts to Rivers in Basin 11

CAUSES	Total Miles of Impact
Thermal Modification	106.5
Siltation/Sediments	69.1
Physical Habitat Alteration	56.8
Flow Regulation/Alteration	36.2
pH	12.1
Nutrients	11
Pathogens	7
Metals	0.5

Table 3.2. Sources of Impacts to Rivers in Basin 11

SOURCES	Total Miles of Impact
Riparian Vegetation Removal	92.5
Streambank Modification/Destabilization	60.4
Channelization	44.8
Flow Regulation/Modification	34.4
Upstream Impoundment	29.4
Road / Bridge Runoff	20.8
Developed Land Runoff	19.9
Atmospheric Deposition	12.1
Agricultural Activities	10.5
Channel Instability	9.5
Septic Tanks	7
Floods	6.7
Hydromodification	4.3
Golf Courses	2.8
Land Development	2

*Please note that the specific water quality problems, their causes, sources and solutions in Basin 11 that were identified in the many public meetings and focus group and watershed council meetings held throughout the West, Williams, and Saxtons River watersheds, will be more fully described in Chapter 4.

The top causes of lake water quality or aquatic habitat problems in Basin 11 are listed in Table 3.3 along with the total lake acres that they affect. Sources are similar to riverine impacts involving land uses human activities.

Table 3.3 Causes of Impacts to Lakes in Basin 11

CAUSES	Total Acres of Impact	Acres Stressed
pH	181	626
Flow Regulation/Alteration	92	
Siltation/Sediments	85	41
Noxious Aquatic Plants – Native		25
Organic Enrichment – DO		15
Nutrients		10
Salinity		9

The two principal causes of impairment to 177 acres in these watersheds, flow alteration and siltation, are both related to operation of flood control reservoirs, which affects aquatic life uses. The critically low pH exhibited by several ponds impairs aquatic life uses on 181 lake acres. An additional 626 acres are stressed by acidification due to their low buffering capacity, which renders lakes susceptible to episodic low pH events.

Table 3.4 contains the sources of impairment and threats to lakes in Basin 11.

Table 3.4 Sources of Impacts to Lakes in Basin 11

SOURCES	Total Acres of Impact	Acres Stressed
Atmospheric Deposition	181	626
Natural Sources	181	626
Flow Regulation/Modification	92	
Habitat Modification	85	
Removal of Riparian Vegetation	85	
Streambank Destabilization	85	41
Construction		41
Land Development		41
Highway Maintenance and Runoff		9
Source Unknown		10

The most important source of impairment to lakes in the West, Williams, and Saxtons Rivers watersheds is atmospheric deposition, which has critically acidified 181 lake acres, and presently stresses an additional 626 acres. Flow alteration, which impairs 92 lake acres due to habitat modification and partial loss of aquatic life uses. Shoreline destabilization, related to flow modification, impairs 85 acres on one flood control reservoir. It is noteworthy that the forested landform and calcium-poor bedrock geology surrounding these three basins is such that surface waters are naturally susceptible to acidification, owing to low acid buffering capacity. This condition means that in some lakes, precipitation of acid-forming sulfates and nitrates has either chronically or even critically acidified the waters, thereby impairing aquatic communities. Finally, general land development, construction, and associated shoreline destabilization threatens 41 lake acres.

The following sections describe the impacts and major threats to eleven specific lakes, ponds, or reservoirs in the West, Williams, or Saxtons Rivers watersheds as reported in the *Basin 11, West, Williams, and Saxtons Watershed Assessment Report* (VDEC, 2001).

Ball Mountain Reservoir, Jamaica: This is one of two flood control reservoirs built and operated by the USACE along the West River. The operational regime of the reservoir is such that the water level fluctuates widely. The severity of these fluctuations precludes the establishment of a stable **littoral** community. Indeed, the reservoir's littoral zone is characterized by barren stone, with alder the only visible vascular plant above or below the water's surface. Returning to a dry bed reservoir, as originally designed, is being considered as one of many options to address flow, temperature, and sediment problems.

Burbee Pond, Windham: This 50 acre pond is threatened by acidic precipitation due to its low acid buffering capacity.

Burbee Pond

Cole Pond, Jamaica: This 41 acre pond is threatened by acidic precipitation due to its low acid buffering capacity. Rapid development of the lakeshore and watershed also threatens the quality of the lake water, which could impact not only biological communities, but also aesthetics, swimming, and boating enjoyment as well. Interestingly, available data show that the acid buffering capacity of the lake has increased, coincident with development. This **alkalization**, which is likely attributable to inputs of **terrigenous** material, may actually lessen threats posed by acidification over the near term.

Forester Pond, Jamaica: This nine acre pond is critically acidified, and thus cannot support a stable aquatic community. VDEC data also show a clear trend of rising chloride concentrations in the water, which may be attributable to road salt runoff from the adjacent town road. The potential impacts of this change in water chemistry are presently unclear.

Gale Meadows Pond, Winhall: This 195 acre pond is threatened by acidic precipitation due to its low acid buffering capacity. Gale Meadows Pond also supports Eurasian watermilfoil, an invasive species with serious potential impacts to native plants.

Little Pond, Winhall: This 18 acre pond experiences episodic acidification due to acid precipitation, which impedes the establishment of a stable aquatic community.

Lowell Lake, Londonderry: This 109 acre lake is threatened by acidic precipitation due to its low acid buffering capacity. In addition aquatic biota are also considered threatened in 15 acres of the lake due to low **hypolimnetic** dissolved oxygen, and swimming and boating uses are threatened on 15 acres due to heavy growth of the rare bladderwort *Utricularia purpurea*.

Moses Pond, Weston: This 12 acre pond experiences episodic acidification due to acid precipitation, which impedes the establishment of a stable aquatic community.

Stratton Pond, Stratton: This 46 acre lake experiences chronic acidification due to acid precipitation, which impedes the establishment of a stable aquatic community. Moreover, based on several visits, it is apparent that the lake water is far too clear and green in hue for an episodically acidic lake. Despite being in an identical setting as other Lye Brook Wilderness lakes, this is the only lake in the Wilderness which is not naturally **dystrophic. Trophic** data show strong algal stimulation given the relatively moderate total phosphorus concentrations at the

pond, and in the summer, the bottom-most waters become depleted of dissolved oxygen and enriched with hydrogen sulfide. Stratton Pond's phytoplankton community only barely meets biological **reference conditions** for acidic small lakes. This is because plankton community density is quite high relative to the reference conditions, even if other biological measurements are within acceptable limits. It is reasonable to hypothesize that the pond has experienced significant nutrient inputs at some prior date, from which it is presently recovering.

Sunset Lake, Marlboro: This 96 acre lake experiences episodic acidification due to acid precipitation, which impedes the establishment of a stable aquatic community. Sunset Lake and its watershed is the main source of drinking water for the Town of Brattleboro.

Townshend Reservoir, Townshend: This is the second USACE operated flood control reservoir. Extreme water level fluctuations had previously impacted the aquatic community. However, changes to the flow regime at this facility has now stabilized water levels in the summer.

Stormwater

The management of stormwater runoff is at once a simple concept and a complex problem. Precipitation runs off impervious surfaces rather than infiltrating naturally into the soil. The cumulative impact resulting from the increased frequency, volume, and flow rate of stormwater runoff events can lead to destabilization of downstream channels and can also result in increased wash-off pollutant loading to receiving waters.

Water that falls on the land as precipitation may infiltrate into the ground, evaporate, be taken up by plants, or flow over the land as surface runoff. The amount of runoff that occurs in an area will depend on the soil type, soil moisture, slope, intensity of precipitation, and type of land cover, as well as other factors. In general, areas of the landscape that are naturally vegetated have much less surface runoff than urban areas. The greatest amount of runoff occurs in urban areas with high percentages of impervious surfaces, such as paved roads and parking lots.

Stormwater runoff from urban areas typically contains many contaminants, including oil, grease, gasoline, road salts, fertilizers, pesticides, and trace metals. Phosphorus and contaminants may be bound to the soil particles of the sediments carried in the runoff. All of these components of stormwater runoff can have serious negative impacts on the water quality and biota of streams, rivers, ponds, and wetlands.

The impacts of stormwater discharge to surface waters can be minimized by carefully designing a project and implementing stormwater management techniques. The objective of stormwater management is to maintain the pre-development hydrology and water quality of a site after development. The management techniques can be generally categorized as volume control, peak discharge control, groundwater recharge, and treatment of water quality. The appropriate technique(s) will depend on the actual site conditions. These may include: detention basins, infiltration areas such as raingardens and grass swales, pervious pavement,

3.1 Thermal Modification

Thermal modification, or water temperatures that are too high or too low to fully support appropriate aquatic life, impacts 107 river miles in Basin 11, more than all other pollutant causes. High temperatures are having negative impacts on coldwater fisheries in the Basin (see Table 3.1). Human removal of trees and shrubs and the cooling shade they provide along riverbanks results in higher water temperatures. Dams and their resulting impoundments expose large surface areas of water to sunlight causing higher downstream water temperatures. (VDEC 2003a).

Temperature is a primary regulator of biological activities and an increase in the temperature regime of small streams may have an adverse impact on fish populations by increasing their rate of metabolism while, at the same time, reducing the amount of dissolved oxygen in the water. Elevated water temperatures may reduce the vigor of cold-water fish species and make them more susceptible to disease or parasites. Small headwater streams are most likely to be affected by the clearing of streamside vegetation.

Temperature is one of the most important factors in limiting trout abundance. Temperatures of 77 ºF can be lethal to trout. Directly related to temperature is dissolved oxygen. As temperature increases, dissolved oxygen levels decrease. Because trout require high oxygen levels, they require low temperatures. Once temperatures have reached the low 70s ºF, the amount of dissolved oxygen is low enough to drive trout out of marginal waters and into coldwater refuges, such as deep holes or groundwater seeps. They may stay in these protected enclaves as long as water temperatures remain high. Over prolonged periods of high temperatures, fish kills can occur (VFWD 1993).

3.2 Sedimentation

Sedimentation has been identified as the second greatest cause of impacts to the rivers and streams of Basin 11. It is also the largest threat to aquatic habitat, biota, and other uses of these waters. Deposited sediments can smother **macroinvertebrate** communities, destroy fish spawning and habitat areas, deplete dissolved oxygen, reduce storage and lower design life for reservoir impoundments and ponds, increase channel **aggradation**, increase streambank erosion, reduce channel conveyance capacity under bridges and culverts, and diminish recreational and aesthetic uses of waterways (CWP, 2001). A direct consequence of sedimentation is associated nutrient enrichment. Nutrients commonly bind to soil particles and result in nutrient loading as soil erosion and subsequent nutrient liberation takes place. The sources of much of the sedimentation and subsequent nutrient enrichment can be traced back to specific land use practices and transportation infrastructure including: gravel back roads, eroding streambanks, construction sites, and runoff from urban as well as agricultural areas.

Excessive sedimentation in streams can lead to stream instability as the channel bed builds up or aggrades. Resulting suspended sediment can reduce plankton and aquatic plant growth, decrease native fish populations and species diversity and increase water treatment costs.

Construction activities result in the disturbance of vegetation during the building of homes, roads, bridges, and businesses. Although construction activities are usually temporary, erosion from

construction sites can cause significant amounts of sediment to enter adjacent waterbodies. Erosion from construction activities can also cause loss of topsoil, contamination of water by heavy metals, and phosphorus pollution and algae blooms in lakes and ponds. This type of runoff from construction sites during the urbanization process is the largest source of sediment deposition into streams. On a unit area basis, construction sites without erosion control practices in place export sediment at 20 to 2000 times the rate of other land uses (WPT #86).

3.3 Physical habitat alterations and adjustments

Physical habitat alterations can result from changes in the riparian area, flow regulation, channelization/instream modification, road and bridge work, and channel instability. The relatively new science of **fluvial geomorphology** - fluvial (water) geo (earth) morphology (land shape) – tries to explain these physical processes and describes the shape and form of the river system within a particular landscape setting. Stream geomorphic assessments seek to identify and/or describe a stream's condition (as compared to a reference stream of the same type); the stage of adjustment, or physical change, (if any) underway in the channel; and the sensitivity of the stream valley, floodplain, and channel to human or natural changes. The term "in adjustment" is used to describe a river that is undergoing change in its channel form outside the range of natural variability (VDEC 2003a and VDEC 2001b). The VDEC Rivers Management Program, has developed fluvial geomorphic assessment protocols for conducting assessments of rivers and streams in Vermont.

A geomorphically "stable" or balanced river channel is one that maintains a predictable form over time. This balanced form is governed by the inputs of water and sediment, climate, and the physical attributes of the watershed and valley setting including soils, hydrology, land use, and valley confinement. Flooding is a natural phenomenon that in many areas greatly conflicts with human land use. Rivers and flood plains have been extensively modified over time forcing the river system to be out of balance. Flood and erosion damages have been exacerbated as the river systems seek to re-establish a geomorphically balanced condition (VDEC 2003a and VDEC 2001b).

The fluvial geomorphic adjustments that occur in response to disturbances are part of a predictable process that often results in conflicts with human investments along riparian corridors such as roads, bridges and culverts, railroads, agricultural lands, and residential and commercial structures. As these conflicts build, traditional channel management activities contribute to a vicious cycle of ever-increasing conflict and instability. Similarly, existing floodplain land management mechanisms inadequately protect against encroachments that directly or indirectly lead to greater channel instability and increased magnitude of sediment discharge (VDEC 2003a and VDEC 2001b). Current riparian corridor assessment and protection strategies try to minimize future potential conflicts.

Riparian cover is recognized as an essential component of trout habitat (VFWD 1993). It provides areas where fish can find shelter to rest and seek refuge from predators. In streams, cover can take many forms, including water depth, surface turbulence, changes in velocity, coarse substrate such as cobble and boulders, undercut stream-banks, aquatic and overhanging riparian vegetation, log

snags and roots, and any other structures that provide fish with a secure place to evade threats or conserve energy. Adult trout are very dependent on the presence of cover and are largely confined to it unless spawning or feeding (VFWD 1993).

3.4 Flow and Water-Level Regulation

Another important condition affecting the rivers or streams in Basin 11 is alteration of the natural flow regime. In general, dams and hydroelectric operations change the physical, ecological and social characteristics of a river. Dams have multiple effects on rivers and riverine habitat. These changes range from a minor alteration of depth and velocity in the case of low-head, run-of-the-river dams, to a complete change from river to lake characteristics in the case of large dams.

Dam operations often alter the natural flow regime in a way that can reduce downstream habitat quality and quantity. In addition to channel adjustments that may affect the structure of in-stream habitat, additional flow diversion from the bypassed reach of the stream can expose streambed substrates, effectively reducing the amount of habitat area available for aquatic organisms. In high-gradient streams, cobble and gravel substrates in riffles are exposed; in low-gradient streams, the decrease in water level exposes logs and snags and lowers the water away from the near-bank cover, thereby reducing available habitat. Dams can flood upstream habitat and also act as barriers to upstream and downstream movement of aquatic organisms. Dams also block sediment transport, a major function of our rivers and streams. This causes sediment to build up behind dams as well as causing sediment "starvation" downstream (VANR 2003b). A table of dams located in the three watersheds is presented in Appendix A.9.

3.4.1 Hydroelectric Power Development

During the course of developing this plan the issues around global climate change and use of fossil fuels has emerged as a concern among many involved in the process. This has led to increased interest statewide in hydroelectric power production and concerns about both dam construction and dam removal. To address these issues the Vermont legislature required the Agency of Natural Resources to develop a report on a number of issues related to the development and permitting of small hydroelectric projects. The following are excerpts from *The Development Of Small Hydroelectric Projects In Vermont:* A *Report To The Vermont General Assembly*, prepared by the Vermont Agency Of Natural Resources, Waterbury, VT January 9, 2008. This document is available at: http://www.anr.state.vt.us/dec/fed/damsafety/docs/smallhydroreport.pdf

> From a policy perspective, the Agency of Natural Resources supports hydroelectric projects that are environmentally and economically sound. Producing electricity through the responsible use of Vermont's renewable natural resources will help support Vermonters' long-term energy needs while protecting the health of Vermont's waters.
>
> Any discussion of small hydropower must take place within the context of dams and their benefits and drawbacks. Almost all hydropower facilities involve the construction of a dam or use of an existing dam.
>
> The Vermont Dam Inventory contains approximately 1,200 records. At one time, each of these dams provided some societal benefit: power, water supply storage, flood control, recreation,

wildlife habitat or aesthetics. Several hundred still do and they are valued and properly maintained. Many others have been essentially abandoned and are slowly deteriorating.

All extant dams – whether serving useful purposes or not – cause ecological impacts, as illustrated and described in Figure [3]. While all of these impacts are important considerations, two that are especially significant merit further elaboration: flow and water level manipulation and sediment regime alteration.

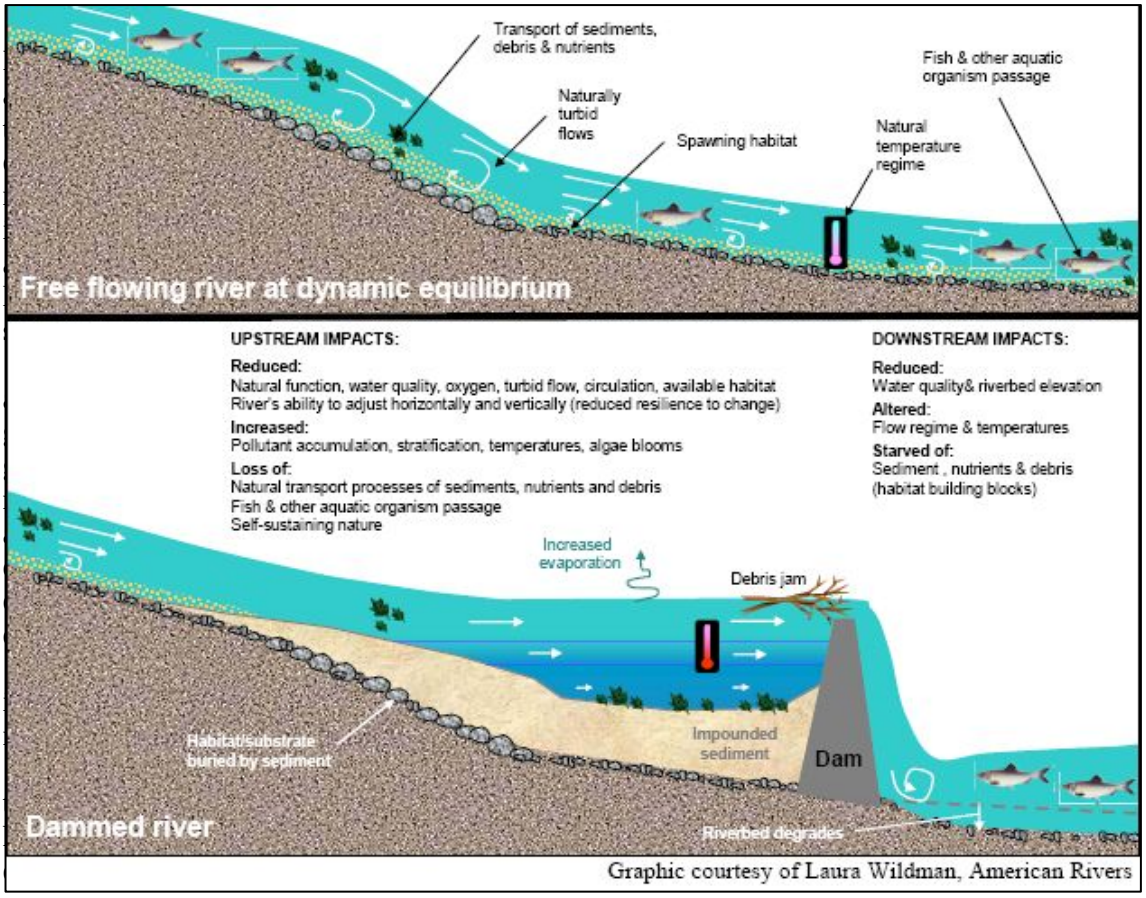
Instream flow, or the flow of water in a stream or river, is an essential component of a riverine ecosystem. Today there is an understanding that the full range of natural hydrologic conditions shapes a stream and its aquatic community. Artificial flow manipulation is usually the major environmental issue at hydroelectric projects of all sizes. It has two components: modification of downstream flow, or flow below the tailrace, and the amount of flow that remains in the bypass.

With respect to downstream flow, most hydroelectric projects, especially small projects, are operated as "run-of-river." That is, the volume of water released below the dam and powerhouse is equal to the volume of water flowing in the stream or river above the dam on a continuous, real-time basis. Put another way, water is not stored in the impoundment to be released at a later time. For these projects, downstream flow manipulation is not an issue as long as the project is carefully operated

In addition to run-of-river projects, there are projects that operate in "peaking" mode, where water is stored in the impoundment when the demand for electricity is low and released to generate power during high demand periods. These projects regulate downstream flows, potentially resulting in impacts to aquatic organisms and their habitat, dissolved oxygen and water temperature. In addition, the impoundment elevations at peaking projects tend to fluctuate, resulting in upstream impacts to aquatic habitat and wetlands. The second aspect of flow manipulation is the amount of flow that remains in the bypass.

Dams and diversion structures that change the depth and slope of a stream significantly alter the size and quantity of bed sediments and how they are moved, sorted, and distributed along both the cross-section and profile of the channel (MacBroom, 1998). In a natural system, a river's bed sediments (substrate) and eroded riverbank materials are transported downstream during high-flow periods, but there is an equilibrium where the material that is lost from a reach of river is normally replaced, as flows recede, through deposition of material transported from upstream reaches. When the transport of sediments, e.g., gravels and cobbles, is interrupted in an impoundment, the channel may become vertically unstable. The instability takes two forms. The impoundment becomes a sediment "sink" as the sediments from upstream hit the flattened river reach and deposit, resulting in *aggradation*, or raising of the natural riverbed. The downstream instability is essentially the opposite effect. The river channel becomes *incised*, or downcuts, as the materials naturally eroded from the streambed during a flood event below a dam are no longer being replaced by an equivalent amount of sediment from upstream. This mode of sediment regime alteration (i.e., sediment discontinuity) has been observed above and below dams, diversions, and undersized culverts throughout Vermont.

Figure 3 Effects of a dam on a free-flowing river



slower and deeper water behind the dam alter habitat structure, typically by finer sediments covering or embedding the larger substrates that provide cover for aquatic organisms. In watersheds with high sediment loads, the aggradation process behind a dam during storm events may lead to significant changes in flood stage, bed and bank erosion, and in some cases an avulsion, or change in course of the stream. When channel incision occurs due to sediment starvation downstream of a dam, the streambed may drop in elevation until annual flood flows no longer access the floodplain. The erosion/deposition processes and channel evolution that ensue as new floodplains are created often lead to significant habitat and water quality impacts and fluvial erosion hazards over a period of decades.

During discussions and debates of small hydropower, the terms "small" and "low-impact" are sometimes used interchangeably. They are not the same. Small hydroelectric facilities that are added to existing dams and properly operated can certainly provide benefits with limited additional impacts on fish, aquatic habitat, water quality and geomorphic processes. However, this is not true of all facilities, and whether a facility is low-impact must be determined on a case-by-case basis.

There is a program in place to certify "low-impact" hydroelectric facilities. The Low Impact Hydroelectric Institute (LIHI), based in Portland Maine, has developed eight low-impact certification criteria that address the following issues: river flows, water quality, fish passage

and protection, watershed protection, threatened and endangered species protection, cultural resources protection, recreation and facilities recommended for removal.

Because of their small size, the cumulative impact of developing multiple facilities in a watershed might not be obvious. Even facilities that meet the low-impact criteria discussed above are not impact free. If they are located at existing dams, the impacts resulting from dams described earlier in the report are present. Bypassed reaches are impacted when water is diverted – the aquatic base flow standard does protect habitat, but the quality of the habitat is degraded relative to natural flow conditions.

There are many dams in Vermont that are not currently serving a useful purpose and, for both economic and ecological reasons, are unlikely to be developed for hydroelectric power. However, these dams will continue to fragment habitat, degrade water quality and cause other impacts on rivers and streams. With the prospect of a long-term increase in water temperature as a result of climate change, restoring watershed continuity by removing dams and other obstructions will become increasingly important.

The Agency has developed the following conclusions

1. **Additional hydroelectric capacity:** There are opportunities to develop additional in-state hydroelectric capacity at existing but undeveloped dams.
2. **Information for prospective hydroelectric developers:** A comprehensive guide to small hydropower development is needed.
3. **Low-impact standard:** Agency policy should specify that any new hydroelectric power facilities meet a "low-impact" standard based on the criteria developed by the Low Impact Hydropower Institute.
4. **Permitting process:** The existing permitting process, with FERC maintaining jurisdiction over hydroelectric projects, should be retained.
5. **Prefeasibility assessments:** Subject to availability of resources, the Agency should continue its practice of conducting prefeasibility assessments for all public and private projects and resource assessments (i.e., electrofishing) for municipal/public projects.
6. **Definition of small hydro:** A new definition of "small hydro" is not needed.
7. **Increased production at existing facilities:** The Department of Public Service should work with Vermont utilities to investigate additional opportunities for increasing hydropower production at existing operating sites.
8. **Agency flow procedure:** The Agency should retain its existing flow procedure for establishing conservation flows at hydroelectric projects.
9. **Dam Removal:** The Agency should commit additional resources to removal of dams that are not serving useful purposes and are unlikely candidates for hydropower development.

As this discussion reveals, hydroelectric power development has both positive and negative aspects for the State's rivers and streams. The discussion is continuing, projects are being proposed and evaluations are being done. One very positive outcome is the new VANR program providing the prefeasibility assessments which provide preliminary information to project developers and give a sense of a project's environmental feasibility early in the process before large financial investments are made.

The potential for hydropower development in Basin 11 has not been evaluated and the State has no plans for a statewide evaluation. Individual projects will be evaluated as they are proposed

3.5 Pathogens

Pathogens are any disease-causing organism, including bacteria, viruses, and protozoa. The pathogens that are of concern in Vermont surface waters are those that come from fecal matter of humans and other warm-blooded animals. These pathogens cause gastrointestinal problems and become a more serious health risk to people who have weakened immune systems. Surface waters containing this waste pose a risk to human health when ingested through drinking water or inadvertent ingestion through contact recreation. (VDEC 2002d)

In surface waters, the most likely source of human waste or sewage is from malfunctioning wastewater treatment plants and septic systems. Sources of animal waste are highest in urban areas due to pet wastes and agricultural areas due to fertilizing with manure. Wildlife that resides in the water, such as beaver and waterfowl, may also contribute pathogens.

The primary indicator used to monitor fecal material in freshwater is *Escherichia coli (E. coli)*. The presence of *E. coli* indicates that there may be pathogens in the water that have the potential to make humans sick, but it is not a direct measurement of those pathogens. Vermont has adopted a water quality standard for *E. coli* bacteria for Class B waters that is more restrictive than USEPA's standard. Vermont's Class B standard is 77 *E. coli*/100 ml in a single sample (VDEC 2002d).

Generally, *E.coli* results from water quality sampling conducted in Basin 11 as part of the WRWA's summer monitoring programs confirm that most areas monitored during dry weather conditions are safe for swimming. A few sites, however, have shown consistently high bacteria levels during dry weather conditions. Most sites experienced high levels of bacteria, to the point of being unsafe for swimming, during and even several days after storm events. Runoff from storm events similarly prompted higher concentrations of the other pollutants at sites that were monitored. (WRWA 2004)

Future monitoring efforts are likely to include optical brightener testing of stormwater discharge pipes. This test can reveal if illegal wastewater connections are discharging sewage into the stormwater system.

3.6 Nutrient Loading

When plants and animals die and decompose, ammonia is produced. Bacteria usually turn the ammonia into nitrate (NO_3). Nitrate is the form of nitrogen available for plant growth. Pollutants such as sewage or manure, contain higher levels of nitrates which may get into groundwater or streams from fertilized fields, lawns, and golf courses, from septic system effluent, or from runoff of manure.

Phosphorus is another plant nutrient that can also be a pollutant. Excess phosphorus in water contributes to the growth of algae, similar to nitrates. The number of aquatic plants growing in a particular area is limited by the amount of phosphorus available. Adding more phosphorus to a body of water can accelerate plant growth and eventually damage an ecosystem by draining the oxygen levels when the plants decompose. In a freshwater aquatic ecosystem, excess inorganic

phosphate is rapidly taken up by algae and larger plants, resulting in algal blooms, increased biochemical oxygen demand and significant impacts on water quality. Phosphorus is introduced into the environment from human activities such as human and animal wastes, fertilizers, industrial wastes and disturbance of the land and its vegetation (WRWA 2003).

Although nutrient monitoring on the state level is limited, nutrients have been identified in the Basin 11 Assessment Report as a cause of pollution. Of the three watersheds in Basin 11, the Williams River has the most land in agricultural production. In some areas, where agricultural activities have occurred in close proximity to rivers and streams, there has been a loss of riparian vegetation leaving nutrients and other pollutants more likely to reach the water with storm runoff. Along many streambanks adjacent to crop and pasture land, however, buffers are now being left to grow or are actively being replanted. In the future, as more farmers implement Vermont's newer Accepted Agricultural Practices (AAPs) and participate in programs sponsored by the USDA/Natural Resources Conservation Service and the U.S. Fish and Wildlife Service Partners for Fish and Wildlife program, more buffers will be established. As riparian vegetation grows and matures, assessments will likely find nutrient loading from agricultural activities to be less of a threat to surface waters.

3.7 Atmospheric Transport and Deposition

Acidic Conditions

Acid deposition is rain, snow, fog, or dust that is acidified in the atmosphere and damages the environment as it returns to the surface. Two common air pollutants acidify the water and dust particles: sulphur dioxide (SO2) and nitrogen oxide (NOx). When these substances are released into the atmosphere, they can be carried great distances over land by prevailing winds before returning to earth as acidic precipitation. When the environment cannot neutralize the acid being deposited, damage occurs. The most apparent features in the natural environment affected by acid precipitation are lakes and ponds.

In 2006 there were five lakes and ponds in Basin 11 that were included on the State of Vermont's List of Priority Surface Waters, Part D that are "impaired" by acidic deposition. These will be discussed further in Chapter 5. This "impaired" designation is based on the Vermont WQS which established both general and specific criteria for acid related parameters – pH and alkalinity. Section 3-01(B)(9) of the "List" states that "pH values shall be maintained within the range of 6.5 and 8.5. Both the change and rate of change in pH values shall be controlled to ensure that full support of aquatic biota, wildlife, and aquatic habitat uses." For alkalinity the criterion reads "no change from reference conditions that would prevent the full support of the aquatic biota, wildlife and aquatic habitat uses" (VTWRB 2004).

Mercury Contamination

Atmospheric transport and deposition of mercury and the incorporation of mercury into the food chain is an issue in this basin as in other basins in Vermont. Fluctuating water levels have also been shown to increase mercury accumulation in fish. Fortunately, no lakes or ponds in Basin 11 have been specifically identified as having a greater level of risk from fish consumption beyond the statewide consumption advisory. However, conclusions from a recent state study (VDEC

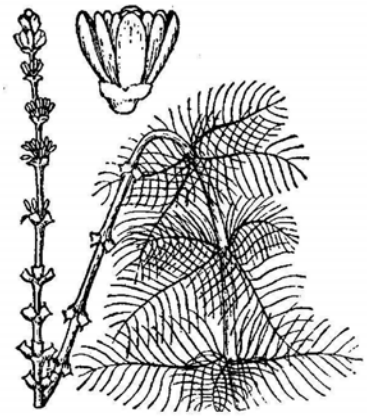
2004b) indicate that existing standards for mercury in state waters may not be sufficiently conservative to protect human health and aquatic biota. The report authors request that these criteria be reviewed and revised during each water quality standards review. Vermont has enacted legislation requiring the labeling of all mercury-containing products as well as recycling of mercury in those products by the manufacturers, however, portions of this legislation are currently being challenged in court.

The issue unfortunately cannot be addressed solely on the state level. To attain a serious reduction of mercury releases and eventually mercury impacts will require the influence and involvement of the federal agencies. Several federal initiatives are presently under consideration for controlling mercury emissions, with numerous states already reducing emission sources and disposal of mercury products. Because of these measures, levels of mercury contamination are expected to decline over the next decade or so (VDEC 2004b).

3.8 Exotic Invasive Species

Though not identified in this area as an issue at the time that VDEC drafted its assessment of Basin 11, the introduction of non-indigenous invasive plant and animal species is a significant concern in the basin. Habitat alteration and destruction associated with the spread of invasive plants and animals has become the primary cause of species extinction in many freshwater aquatic ecosystems throughout the country. The major cause of the spread of nuisance non-native aquatic species from one area to another is by boats and recreational equipment that have not been adequately cleaned.

The *Nonindigenous Aquatic Nuisance Prevention and Control Act* of 1990 defines an aquatic nuisance species (ANS), as "a nonindigenous species that threatens the diversity or abundance of native species or the ecological stability of infested waters, or commercial, agricultural, aquacultural or recreational activities dependent on such waters." Eurasian watermilfoil (*Myriophyllum spicatum* L.), curly leaf pondweed (*Potamogeton crispus*), phragmites (*Phragmites australis*), and purple loosestrife (*Lythrum salicaria*) are already established. Water chestnut (*Trapa natans*) has been found nearby in the town of Springfield but is being well controlled. These species crowd out native species and impede recreational activities, such as fishing, boating and swimming, by forming dense monotypic stands. They provide unsuitable habitat and are a poor food source for a wide range of native wildlife. They negatively impact water quality, fish spawning and may impact flow regimes. Their populations threaten the diversity and stability of native populations and cause major economic damage due to their impact on recreation and the expense of management and control efforts.



Eurasian watermilfoil (*Myriophyllum spicatum*)
Courtesy of USDA

In the summer of 2002, Eurasian watermilfoil and curly leaf pondweed were discovered in the

Retreat Meadows area of the lower portion of the West River in Brattleboro. A VDEC survey conducted that summer determined that the Eurasian watermilfoil was present mostly in scattered locations throughout the survey area, whereas the curly leaf pondweed was present only in the small cove area of the Retreat Meadows. Since 2002, densities and distributions of these two species have changed in the Retreat Meadows and there are colonizing patches in the lower portion of the West River before it converges with the Connecticut River. Both species have been found in several areas along the Connecticut River – including convergence with the Williams River at Herrick's Cove. European naiad (*Najas minor*), another aquatic nuisance plant, may pose a future problem for the West River as it has been found across the Connecticut River in Hinsdale, NH. Eurasian watermilfoil has also been found in Gale Meadows Pond in Winhall, where VDEC manually harvested plants that were found and the town will monitor the site in the future.

Basin 11 is plagued with the invasion of Japanese knotweed (*Fallopia japonica*), often called false bamboo. While technically a terrestrial species, Japanese knotweed is commonly found around water sources and has become a dominant species along substantial stretches of rivers and streams throughout the region. This fast-growing perennial spreads vegetatively by even tiny plant fragments. Its rapid early spring growth out-competes native plants creating an almost impenetrable monoculture along large stretches of all three rivers in the Basin. Japanese knotweed is a major water quality concern due to its perennial life cycle. Dying back completely in the winter, knotweed leaves no substantial vegetation to protect the streambank from erosion during spring high water. The resulting severe erosion and bank undercutting exposes the roots and breaks off fragments which travel downstream and start new infestations Habitat impacts of Japanese knotweed result as it displaces native plants depleting wildlife food sources and degrading streambank habitat. The lack of insects feeding on streamside vegetation also depletes fish food supplies. The dense stands formed prevent taller trees from becoming established along banks preventing their growth for shade and their roots for stabilization.

Japanese Knotweed (*Fallopia japonica*)

The newest aquatic invasive plant threat comes in the form of didymo (*Didymosphenia geminata*), more commonly called rock snot which has taken hold in the upper Connecticut River upstream of Basin 11. This invasive freshwater diatom species (microscopic algae) can form extensive 'blooms' on the bottoms of rocky river beds, essentially smothering aquatic life forms such as macroinvertebrates (aquatic insects), native algae, and other organisms. Great care must be taken by all recreationalists - anglers, boaters and others - to prevent the spread of didymo into the rivers and streams of Basin 11 by carefully using HOT tap water and lots of soap to scrub boats and other "hard" items thoroughly and soaking clothes, felt-sole waders and other "soft" items in it for 30 minutes.

In 2005, a fish disease from Europe was discovered in Lake Ontario, after a fish kill involving thousands of freshwater fish. Viral Hemorrhagic Septicemia (VHS) is an untreatable fish disease that affects a wide variety of fish species. **VHS HAS NOT YET BEEN FOUND IN VERMONT.** However, it has caused massive fish kills in the Great Lakes, the St. Lawrence River, and several inland lakes in New York, Michigan and Wisconsin since 2005.

VHS poses a great risk to the health and well-being of Vermont's fish populations and to recreational fishing in this state. There is no vaccination or cure for the disease, thus it cannot be controlled - only contained. Containing the spread of this deadly fish virus and preventing it from entering Vermont requires restrictions on the movement of live fish and water, and fish testing and surveillance programs. VDFW is taking action to slow or prevent the arrival of VHS to Vermont.

Fish infected with VHS may exhibit minor external hemorrhaging in the form of red pin-point spots or larger patches, particularly around the head. However, some infected fish may not exhibit any external signs at all. Sick fish often appear lethargic, swim in circles, or lie motionless just below the water surface. Although not all infected fish develop the disease, they can be carriers and have the ability to spread the disease to other fish. There are 24 fish species in Vermont that are susceptible to this disease.

As of April 25, 2008, a permanent baitfish rule will be in effect. The new rule affects baitfish use in Vermont and is designed to proactively head off the spread of VHS and other fish diseases to the state's waters. The Permanent Baitfish Rule can be found at: http://www.vtfishandwildlife.com/newrules/Fishing/Final%20Adopted%20VHS%20Baitfish%20Regulation.pdf

To help protect Vermont's wild fish populations and to ensure that sport and recreational fishing in Vermont continues to thrive and exist for everyone's enjoyment in the future, it is crucial that all anglers and water users help stop the spread of all invasive species and fish diseases such as viral hemorrhagic septicemia, whirling disease, didymo, Eurasian watermilfoil and others.

To help stop the spread of invasive species and fish diseases:

- Understand and follow all VDFW regulations pertaining to baitfish use, fish importation and fish movement.
- Inspect boats, trailers and all equipment and remove any visible aquatic plants, animals, and mud.
- Drain all water from boats, motors, bilges, live wells, and bait containers before leaving the waterbody.
- Do not move live fish, including baitfish, from one water to another.
- Never leave waters with any live fish or fish eggs.
- Kill leftover baitfish and discarded them on the ice or in the water prior to leaving the waterbody.
- Buy baitfish only from licensed Vermont bait dealers.

- Wash boats and equipment with high pressure or hot water, or let dry for five days between waterbodies.

3.9 On-going Monitoring Programs

Much of the current information and project data collected about Basin 11 is found in the VDEC's *Basin 11 West, Williams, and Saxtons River Assessment Report* (2001). The state's report describes the results of a rotational watershed assessment process where all rivers and streams in each of the state's designated basins are evaluated on a recurring basis. The assessment itself involved identifying, compiling, analyzing and evaluating all water quality data and information as well as point and non-point source pollution impacts. The Basin 11 assessment identified many of the water quality issues addressed in this basin management plan.

Results and analysis from other surveys and sampling programs were also considered. From the information gathered via the WRWA West River Organizational Inventory (2003), of those monitoring programs currently being conducted that year, some were site-specific and industry-specific chemical monitoring for regulatory or permit compliance (wastewater discharge, effluent monitoring from point sources, or landfill closure), others conducted chemical sampling in certain reaches of the watershed, monitoring parameters specific to area usage or assumed impact only. The VDEC's chemical monitoring studies had been focused mainly on lakes and ponds. Although there had been or were many different efforts undertaken, some notable ones are outlined below. Monitoring programs cover physical (P), chemical (C) and biological (B) parameters.

- VANR Department of Environmental Conservation – P, C, B

The VDEC Water Quality Division is responsible for monitoring surface water of lakes, ponds, rivers, and streams across Vermont. Long-term monitoring programs are designed to assess trends in water quality as well as to generate baseline water quality information. Major VDEC monitoring programs include:

- Biomonitoring Sampling Program
- Spring Phosphorus Program
- Acid Precipitation Program
- Citizen Lake Water Quality Monitoring
- Lake Assessment Program

These programs have accumulated many years of data over the past decades. Although much of VDEC's long-term chemical sampling programs focus on lake monitoring data also exists for many rivers and streams.

The monitoring program for lakes and ponds in Basin 11 is comprised of several elements, which are described in detail by the Vermont Ambient Water Quality monitoring Program Strategy (see www.vtwaterquality.org). The Spring Phosphorus Monitoring Program tracks nutrient levels over time, providing an indication of lake trophic state. Nine lakes are monitored by this program, with lakes ranging in total phosphorus concentrations from the ultra-oligotrophic Sunset Lake (Marlboro), to the mesotrophic Forester Pond. The Acid Lakes Monitoring Program tracks the acidification status of selected lakes in the watershed, including Forester, Little (Winhall), Moses, and Stratton ponds, and Sunset Lake. The Lake Assessment, Aquatic Plant Survey and Aquatic

Nuisance Species Programs have tracked the distribution of native and non-native aquatic plants for years, and provide data for many of the ponds in the watershed.

As part of its Biomonitoring Sampling Program, VDEC routinely surveys the macroinvertebrate and fish communities of lakes, wetlands, rivers, and streams in order to evaluate the biological health, or **biological integrity**, of the resource surveyed. The program has led to the development of two Vermont-specific fish community **Index of Biotic Integrity** (IBI) for small coldwater streams and wadeable streams and guidelines for determining water quality classification using macroinvertebrate community biological integrity metrics. Biological information can help provide an ecologically based assessment of the status of a waterbody and as such can be used to decide which are impaired or stressed and need restoration and which are ecologically healthy and need protection.

Three lakes are also part of the Lay Monitoring Program in which volunteers sample for total phosphorus, chlorophyll-a concentration, and water clarity. The monitored lakes are Cole Pond in Jamaica, Lowell Lake in Londonderry and Stratton Pond in Stratton. Data on these lakes is available at: http://www.vtwaterquality.org/cfm/lakerep/lakerep_select.cfm.

- VANR Department of Fish And Wildlife – B

Vermont's fisheries biologists are engaged in a wide variety of activities aimed at ensuring that Vermont's valuable fisheries resources will be sustained and enhanced through time. Biologists inventory and monitor the abundance, distribution, diversity, and health of Vermont's fish and the habitat they live in. Data collected from inventory and monitoring efforts are used to assess the impacts of fishing pressure, predation, disease, parasites and habitat changes. Once information is analyzed, biologists determine what management actions will be needed to keep fish populations physically healthy, fishable, and productive.

- Wastewater Management Division – C

The Wastewater Management Division of VDEC issues indirect discharge permits for land-based sewage treatment systems larger than 6,500 gallons per day, such as septic tank leach field systems and treatment facility-spray field systems. Each water quality permit requires monitoring both upstream and downstream from the discharge area where both chemical and biological sampling are conducted on a regular basis. A list of permitted municipal and industrial wastewater management facilities and programs are presented in Appendix B.2.

- West River Watershed Alliance Water Quality Monitoring Program – P, C, B

In 2003, the WRWA Stream Action Committee (SAC) planned and implemented a water quality monitoring program on the West and Williams Rivers to evaluate the overall health and sustainability of the river. Aquatic biologists with DEC, in discussion with the WRWA Watershed Coordinator, planned a monitoring program that would fill the chemical monitoring "data gaps" that had been identified in the West River Organizational Inventory. Because of the successful completion of the first year of monitoring, the monitoring program was expanded into the Saxton's River and into the upper reaches of the West in 2004.

WRWA macroinvertebrate sampling in the West, Williams, and Saxtons Rivers was developed to screen for potentially impaired stream habitat. The so-called “Phase 3” of the WRWA water quality monitoring program, designated volunteers to sample 11 stream sites in the fall of 2003 and 2004. Some samples were processed at temporary labs housed at the Brattleboro Area Middle School and Landmark College respectively, others are being processed voluntarily by professionals. The results will be made available once processing and analysis are completed.

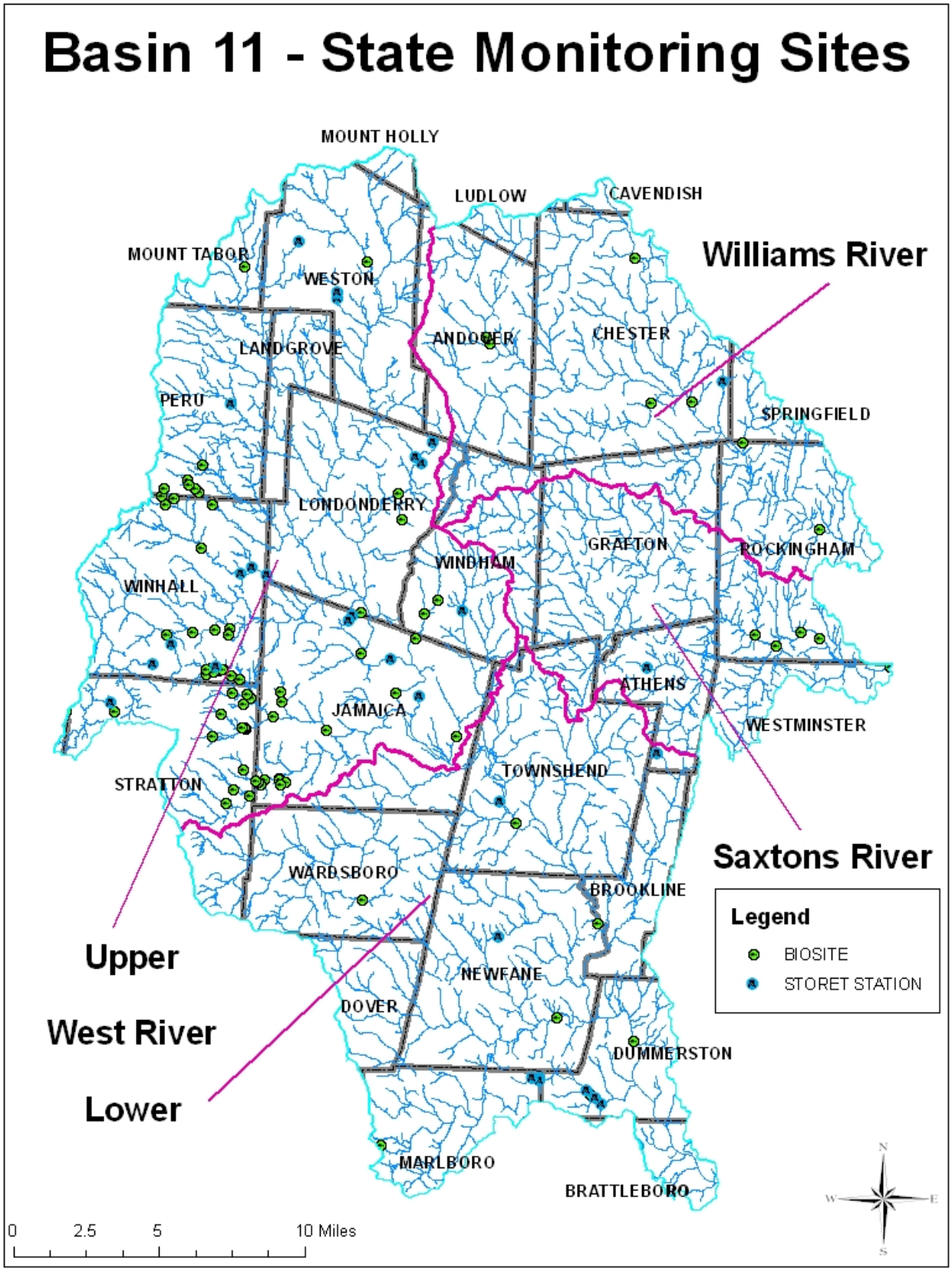


Figure 3.1 State Bioassessment Monitoring Sites 2006

•

- Stratton Mountain Corporation – C,B

In 1999, the Stratton Mountain Corporation prepared a Water Quality Monitoring Plan to track improvements from baseline conditions resulting from implementation of the *Stratton Master Plan Water Quality Remediation Plan*. Long-term sampling for nutrients, metals, total suspended solids (TSS), and **turbidity** is being conducted at 30 locations on eight sub-watersheds of the North Branch of Ball Mountain Brook. Monitoring reports have been issued annually since 2000 by Pioneer Environmental Associates for Stratton Mountain Corporation.

- Newfane Landfill– C

The Town of Newfane conducts regular, semi-annual (spring and fall) water quality monitoring at three sites along Bruce Brook near the town's closed landfill. The water quality sampling is part of a 20-year post closure environmental monitoring program mandated by the state. Parameters monitored include: chemical oxygen demand, volatile organic compounds, hardness, total sodium and total chloride, and metals - arsenic, cadmium, chromium, copper, iron, manganese, nickel, lead, and zinc. Tests for temperature, pH, and specific conductance are done at each location.

- Bonnyvale Environmental Education Center - C, B

The BEEC coordinated the West River Watch Program, a water quality monitoring program from 1994 to 2001. Over fifty volunteers monitored sites in four watersheds, including the West River. Water samples were tested in BEEC's laboratory for pH, *E.coli*, water temperature and phosphorus. The data generated have provided a valuable base of information on conditions of the West River.

- U.S. Army Corps of Engineers (USACE) - C, B

The USACE regularly monitors water quality at the Townshend Dam Reservoir and Ball Mountain Recreational areas as well as several stream sites along the West River, Wardsboro Brook and the Winhall River. A total of sixteen sites have been monitored at various times since 1971. Typically, USACE personnel perform stream sampling at project sites in three to four year intervals. USACE personnel sample each station three times during the course of a "summer season" (April through September). Parameters sampled as part of the USACE instream monitoring program include *E. coli*, alkalinity, ammonia, nitrate, nitrite, phosphorus, hardness, mercury, and chlorophyll.

- U.S. Geological Survey (USGS) - C, B

The USGS has been sampling water quality at various sites within the West River watershed for many years; some USGS water quality data collected are from as early as 1954. The USGS collects data for 40 rivers and streams in Vermont. Location and site information about specific sampling USGS sites in Vermont and specifically the West River are available through the USGS Water Resources of Vermont website's "Site Inventory".
http://pubs.usgs.gov/wdr/2005/wdr-nh-05-1/

- US Forest Service - P, C, B

GMNF fisheries biologists are engaged in a wide variety of activities aimed at protecting, restoring and enhancing natural resources especially riparian and stream habitats in the Basin.

Biologists conduct annual fish inventory and monitoring projects in many basin streams to determine species composition, abundance, distribution, and overall health of fish populations. The GMNF also participates in a multi-agency effort to restore native Atlantic salmon in streams throughout the Basin as part of the Connecticut River Atlantic Salmon Restoration Program. In addition, biologists also inventory and monitor fish habitat and stream channel stability. Data collected from these inventory and monitoring efforts are used to assess population and habitat changes and trends, as well as identify opportunities to enhance and restore fish habitat and stream ecosystems processes. Several fish habitat and stream restoration projects have been implemented by the GMNF and its partners over the past decade or so, and plans are to continue this work in the future.

3.10 Recent Projects Implemented in Basin 11

Projects Addressing Physical Habitat Alterations and Adjustment Issues:

Many projects to abate erosion and reduce sedimentation in area streams were begun within the context of basin planning. Listed below are several recent stream bank restoration projects that combined interagency efforts with private landowner cooperation and have been implemented concurrent with the development of the Basin 11 management plan.

- In 2000, the WRC and Connecticut River Conservation District Coalition (CRCDC) conducted a riparian inventory of the Rock River sub-basin in the West River watershed. The CRCDC developed the survey and provided expertise to train volunteers. Data was collected along ten segments of the river from September 2000 to August 2001. The WRC prepared the final report, *Riparian Forested Ecosystem Inventory: West River Watershed (Rock River sub-Basin)* (WRC 2001a) under Clean Water Act 604(b) funding.

- During the summer of 2001, with funding from the USDA/Natural Resources Conservation Service WHIP Program and U.S. Fish and Wildlife Service Partners for Wildlife Program, BEEC followed up on WRCs non-point source study (1998). Seventeen BEEC volunteers worked on this stream bank stabilization project that restored a privately-owned section of stream bank on either side of the Rock River. Re-grading and stabilization work was followed by the planting of live willow bundles and stakes to stabilize the bank and establish a forested buffer.

Streambank stabilization on the Rock River funded through USDA's WHIP and USFWS PFW program in partnership with Bonnyvale Environmental Education Center.

- The town of Brookline, in the spring of 2000, applied for Federal Emergency Management Agency (FEMA) Hazard Mitigation grant money to protect the only evacuation route for the town of Brookline during the winter months. Funding was approved in 2001 and NRCS submitted a design for protecting the bank from further erosion. Construction began in August 2005. Large rock (rip rap) 12 to 24 inches in diameter, was placed along the bank where historic flooding had eroded the bank up to a height of 5 or 6 feet. This was done with minimum disturbance to the river as well as to the vegetative community along the stream bank.

Town of Brookline - completed 750 foot stretch of bank stablization along the West River using FEMA funds to protect the evacuation road

- Two landowners along an actively eroding section of the Saxtons River applied to NRCS for stream bank stabilization funds to protect eroding farmland. Agricultural Management Assistance (AMA) and Conservation Technical Assistance funds from NRCS were used to protect approximately 600 feet of riverbank. Work was conducted in August 2005. Like the Brookline project, large rock was placed along the bank to protect the soil from heavy flooding and scouring of the stream bank.

Stream bank stabilization and riparian forest buffer on the Saxtons River

- In concert with basin planning, stream geomorphic assessments were conducted in the Ball Mountain Brook watershed, one of the most erosion-sensitive watersheds in Basin 11. Results of the Ball Mountain Brook SGA are being used to gain landowner and decision-maker acceptance for proposed restoration, development, or protection initiatives. To date Phase 1 and Phase 2 surveys have been completed in the watershed, and the results submitted to the towns of Jamaica, Stratton, Winhall and the Stratton Mountain Resort Corp. A Corridor Project Plan is underway. The SGA of Ball Mountain Brook serves as a template to conduct in-depth geomorphic assessments of the major rivers in the basin and their tributaries. This will lead to the planning

and design of projects to control erosion, stabilize streambanks, and ascertain flood hazard zones.

- Flooding in the Saxtons River from several intense storm events in recent years have been cause for concern in this watershed as well. Although not a project specifically identified within the context of basin planning, the re-construction of Route 121 between the villages of Saxtons River and Cambridgeport has resulted in new culverts, drainage structures, and bank revetments – including a rebuilt bridge spanning the river in the town center where roads and river converged. The dynamic nature of the Saxtons River makes it, along with other highly erodible streams in the basin, a priority candidate for stream geomorphic assessment.

Work by the WRC in a series of studies, identified public access trails along the river as also contributing to bank erosion and sedimentation. The following projects concurrent to developing and drafting this basin plan were implemented by the WCNRCD Watershed Coordinator in 2005:

- The Dummerston Covered Bridge, a scenic wooden covered bridge spanning the West River in Dummerston, Vermont, was totally reconstructed in 1998 and serves as major travel conduit over the West River on to Route 30. Adjacent to the covered bridge, an informal public access trail to the river beach carved into the steep riverbank had evolved into a severely eroded gully. During rain storms runoff from the west side of the parking area ran down through the gully conveying brown silty water into the river. An enhanced access trail was formed by constructing a set of stone steps leading down to the beach level with stabilized banks running along the side of the steps. The implementation of the combined project design will significantly reduce storm water runoff and sediment input.

Dummerston Covered Bridge “Steps” gully restoration

- The Williamsville Station beach trail enhancement was conducted as part of the basin planning initiative to curb sediment entering the West River. The WCNRCD with Section 319 funding and SEP funds from the Vermont Environmental Board initiated a project to improve the access trail to the popular swimming area located on private property along Route 30. The Student Conservation Association trail professionals and volunteers from WRWA and the School of International Training in Brattleboro came together to design the access, fill in eroded gullies and create a new erosion-resistant trail.

Project Addressing In-stream Habitat and Fisheries Issues:

- Brockways Mills Dam Fish Passage, temporary downstream passage is installed each spring and fall for salmon smolts to leave the upper river reaches. Permanent downstream passage is planned for 2008. Upstream passage may be required in the future, but is not currently planned.

Project Addressing Aquatic Invasive Species:

- In 2003 through 2007 the Town of Brattleboro, with funding from a VDEC Aquatic Nuisance Species Grant-in-Aid program, worked with a consulting aquatic biologist to implement an invasive species education and management program for the Retreat Meadows and lower West River. In 2004, scuba divers hand-harvested Eurasian watermilfoil while volunteers provided "watcher/searcher" harvesting and fragment collection functions. Curly leaf pondweed has also been manually harvested from the Retreat Meadows and the lower portion of the West River. Each year aquatic invasive plant informational tours have been conducted on the Retreat Meadows, the lower portions of the West River and other locations of interest in the Basin. Tour participants were apprised of the threats from aquatic invasive plants present, while learning how to recognize them and minimize their spread. Management options were discussed and removal techniques demonstrated. Educational workshops are offered each year to provide updates on project activities and to provide educational outreach to the local community about invasive aquatic plant information and concerns.

Projects Addressing Agricultural Non-point Source Pollution:

- Through USDA's EQIP program NRCS is in the process of installing a waste storage facility, a roofed loafing area, streambank exclusion fencing and other BMPs. Many practices have also been implemented in past years such as walkways and access lanes, streambank stabilization and heavy use area protection.
- NRCD's Nutrient Management Planning and Land Treatment Planning services which assist farmers with nutrient management and environmental issues have worked with three farms on nutrient management plans and one farm on a land treatment plan since the programs began in 1999 and 2005 respectively. Often these services are at no cost to the farmers due to funding from VAAFM's Nutrient Management Plan Incentive Grants.

A listing of other available State and Federal Programs is found in Appendix B.1.

Projects Addressing Swimming Hole Use and Public Access Issues:

- Dummerston Covered Bridge - The Town of Dummerston and the Dummerston Conservation Commission (DCC) in a combined effort with WRWA, WCNRCD, WRC, VTrans and technical professionals, community businesses, and volunteers worked to address river access and erosion issues at the site. Adjacent to the covered bridge, an informal parking area and public access trail to the river has become a well-used gathering spot. The trail was a three foot deep gully created by foot traffic and lot runoff. With funding from USEPA Section 319 and the Connecticut River Joint Commissions, the gully was graded, stone steps laid and plantings installed to allow safe clean access to the river. The lot was graded and paved allowing more and safer parking, and an educational kiosk installed. Small un-permitted

enterprises such as flea markets and used car sales, were addressed by the Town which has developed and enforced a vendor permitting program.

Raingarden installation at Dummerston Covered Bridge

Stormwater runoff from the parking lot and Route 30 were discharging directly into the West River through a drainage culvert just upstream from the swimming area. To collect the runoff and allow it to infiltrate into the ground a raingarden was installed at the north end of the parking lot. The culvert was removed and drainage flow is now diverted into the 70' x 30' garden where the sediments are trapped and pollutants filtered by natural soil filtering activity.

- Williamsville Station - The Williamsville Station beach trail enhancement was conducted with Section 319 funding and SEP funds from the Vermont Environmental Board. The access trail to the popular swimming area located on private property along Route 30 was eroded and runoff from Route 30 and the parking area was entering the West River. The Student Conservation Association trail professionals and volunteers from WRWA and the School of International Training in Brattleboro came together to design the access, filled in eroded gullies and created a new erosion-resistant trail. Plans are in process for improving public safety along Route 30.
- The Connecticut River Watershed Council sponsors an annual river clean-up day in late summer. In 2005 and 2006 volunteers on the West and Saxtons rivers participated.

Trail erosion control project

- The WRWA has sponsored Round Table Discussions with a consortium of landowners, town officials, local and state agencies and private organizations to develop and coordinate a long-term comprehensive program plan specific to Rock River issues.

- Volunteers under the WRWA Adopt a Swimming Hole Program in 2003 and 2004 compiled information about overall usage of high use swimming holes in the West River. Surveys of swimming hole users and car counts were conducted during high-use times. Changing environmental conditions, developing erosion problems, and possible wildlife and vegetation impacts were recorded.
- In 2003, five higher use swimming holes were selected for modification and enhancement activities to reduce runoff along river trails and facilitate public access. Access problems at the first two of the areas have been addressed:
    1) Dummerston Covered Bridge
    2) Williamsville Station trail enhancement activities
    3) Rock River – Indian Love Call Access
    4) Deyo's Swimming Hole
    5) Wardsboro Town Center
- The Windham Regional Commission (WRC) assisted the Town of Dummerston road maintenance crew in addressing access management and parking issues that are of concern at Covered Bridge site. The WRC also assisted the Town with project permit applications required from the Vermont Agency of Transportation (VTrans). In the summer of 2004, the Town, VTrans, and WRC conducted a Road Safety Audit Review (RSAR) at the intersection of East-West Road and Route 30 and Route 30 and Williamsville Road, in order to detail potential traffic safety issues at these locations.
- Since 1992, the Friends of the West River Trail have moved forward in their mission to establish a safe, scenic trail in the West River Valley along what could be Vermont's oldest transportation pathway. The remnants of the West River Railroad bed served to begin the work of linking three state parks, and two federal reservations through public and private properties to create a public access trail from South Londonderry to Brattleboro. Although much of the trail's 13 miles is publicly accessible in the Upper Section, the group is still working to obtain access permission and easements with several landowners within the lower section through Brattleboro. In 2004, the Vermont Youth Conservation Corps completed a switchback trail over Ball Mountain for canoe portage and hiking past the USACE flood control dam. In 2002, the Friends purchased the old South Londonderry depot with grant funding and donations. The South Londonderry Depot Visitor Center building restoration project is expected to be completed in spring 2008.
- Through grant funding from the Vermont Heritage Grant, Southern Vermont Regional Marketing Program, Riverbank Media has produced an informational brochure, *Windham County Rivers,* that highlights the three rivers flowing through southeastern Vermont into the Connecticut – the Deerfield, Saxtons, and West Rivers. The brochure features a map showing recreational areas and points of interest, such as public beaches, boat landings, fishing access, swimming holes, hiking and cross country ski trails and historical points in Windham County. This independent project was not done in conjunction or consultation with the basin planning process.

Programs Addressing Road and Road Maintenance Issues:

- The **Vermont Local Roads "Circuit Rider"** provides education, training, and technical assistance to municipal officials and road crews on the topics of roads, bridges and related issues. The circuit rider is available to review difficult road problems and provide on-site training, coordinate regional monthly meetings of road foreman throughout the state and conduct short workshops on a variety of topics.
- **Regional Road Foreman Meetings** provide the opportunity for road foreman to discuss issues, learn practices, share information with other road professionals.
- **Sodium chloride studies** are being conducted by VTrans/VANR/USGS through on-going monitoring of chloride levels in Chittenden County streams.
- **Automated Road Weather System (RWIS)** stations provide road condition information to highway managers on road condition and maintenance needs.
- The **Better Back Road Grants Program** provides up to $7000 to town and private road associations to correct existing road erosion problems or to conduct road erosion inventories and create capital budget plans to fix identified problems.

4. Basin 11 Local Watershed Issues, Recommendations, and Strategies

In the Basin 11 planning initiative, a watershed approach has been used to integrate and include recommendations and strategies derived from public input in order to more effectively protect and manage surface water and ground water resources. Such an approach attempts to achieve broader water quality protection objectives by using the entire watershed as the management unit for assessing and addressing issues within a planning and implementation process. Thus, for a watershed, the approach encompasses not only the water resource, such as a stream, river, lake or wetland, but all the land from which water drains to the resource.

The Vermont WQS state "Public participation shall be sought to identify and inventory problems, solutions, high quality waters, **existing uses** and significant resources of high public interest." In the basin planning process, citizens who make their living from the land have a special opportunity to contribute to water quality protection through implementing approaches that balance environmental considerations in protecting and restoring water resources with economic interests.

Watershed issues identified at public forums and discussions held as part of the Basin 11 planning process between 1999 and 2005 were prioritized and further examined by interested watershed stakeholders and technical professionals within the structure of the Basin 11 Watershed Council. Small discussion groups were then created to discuss specific issues. These "focus groups" were comprised of technical experts and representatives from pertinent state and local agencies, organizations and watershed residents. The focus groups investigated each issue, giving adequate time to reach a level of shared learning that allowed effective and meaningful problem-solving interaction.

At the end of their discussions, the focus groups presented to the Basin 11 Watershed Council recommendations and suggested strategies to address respective watershed issues. Technical professionals and government agencies participating in the Basin 11 planning process have also made recommendations and offered strategies which have been incorporated into this chapter of the management plan. For some issues, roundtable discussion groups were organized within the context of a watershed council meeting to develop strategies for the basin plan. All identified watershed issues are categorized under seven topics:

4.1 Water Quality,
4.2 Land Use,
4.3 Public Access,
4.4 Road Maintenance,
4.5 Dams and Impoundments,
4.6 Water Withdrawals and
4.7 Watershed Education.

A total of 61 recommendations and 173 strategies for improving water quality in Basin 11 are presented.

4.1 Water Quality

The WRWA Stream Action Committee was formed in the fall of 2003 and eventually became an ad hoc water quality focus group for the Basin 11 Watershed Council. To facilitate investigations and discussions on the various issues, the Stream Action Committee drew heavily from the results of scientific studies conducted by both State agencies and private organizations, results from the WRWA's water quality monitoring program, as well as from anecdotal evidence and local knowledge. Specific threats to Basin 11 rivers have also been identified by U. S. Fish and Wildlife Service, the VANR, VDEC, VFWD, and The Nature Conservancy of Vermont (TNC).

4.1.1 Existing Stream Water Quality Conditions

Pathogens

Information gathered from regular monitoring at swimming holes helps reduce human exposure to pathogens by calling attention to waters with regular or episodic increases in pathogens. Frequent monitoring and posting of results at public swimming holes has increased the data and subsequent understanding of episodic events, like septic system failures and runoff from storm events. In addition, regular monitoring of surface waters at other locations is being used to identify potential sources of pathogens. (VDEC 2002a)

Nutrients

Phosphorous is introduced into the environment from human and animal wastes, fertilizers, industrial wastes, and human disturbance of the land and its vegetation. Research asserts that phosphorous concentrations of 0.01 mg/L (10µg/L) or less may have measurable impact on nutrient poor upland streams, similar to those rivers and streams in Basin 11. Larger rivers could respond when concentrations near 0.1 mg/L (100 µg/L) (Behar 2000). Of all the phosphorous samples collected by WRWA volunteers during the first three summers, more than a third exceeded the 10µg/L guidance level.

Similar to other WRWA sampling results, there is a marked increase in total phosphorous levels during increased flows caused by large rain events. Sites on tributaries had notably lower phosphorous concentrations overall, but with respect to the above-mentioned cautionary levels the results are still of concern.

Total Suspended Solids

The amount of total suspended solids (TSS) found in water serves to determine its relative clarity. Suspended solids are varied, ranging from clay, silt and plankton, to industrial wastes and sewage. Similar to other sampled parameters, marked increases in TSS levels occurred during the high flow conditions during and after storm events. However, during dry weather conditions all TSS levels in all watersheds were very low – usually less than 1 mg/L.

pH

The range of pH levels measured from sites across the basin corresponds well to recorded historical levels. The main stem of the West seems unusually well buffered in many areas. Only those sites located on tributaries at higher elevations seemed to show levels that indicate acidification concerns. Similar to *E. coli* levels, lower pH readings on some occasions

corresponded to higher river flows caused by rain events. Storm-related impacts to pH levels were more pronounced at sites located on tributaries. Waters impaired by acidification found in Basin 11 will be further discussed in Chapter 5.

Temperature

Vermont WQS do not set a specific range or value for temperature, however, as pointed out in the *West River Watch Project Report, 2001* (BEEC 2001), prolonged temperatures above 20°C (68°F), for a coldwater fishery like many of the rivers and streams in Basin11, are harmful to coldwater fish habitat. More recent WRWA sampling data shows high water temperatures occurring during the summer months in the lower mainstems of all three rivers and in the West especially below the USACE dams (WRWA 2006).

Recommendations to Address Existing Water Quality Issues

1. Recommendation: Identify surface waters with elevated levels of pathogens and other pollutants and disseminate this information to public.

Strategies:

1) Continue water quality monitoring program and report results to the public via local news media postings, on-site kiosks and distribution of reports, brochures, and newsletters.
2) Continue public outreach with articles to local newspapers and other media outlets.
3) Continue collaboration with USACE monitoring program at Winhall Campground and Townshend Reservoir.
4) Expand the VDEC Lay Monitoring Program to more lakes and ponds to gather baseline data on lake water quality.

Lead Agencies: WRWA, USACE
Funding options: LaRosa Lab grant, CRJC, New England Grassroots Environmental Fund
Timeline: On-going

2. Recommendation: Work with towns, local agencies and organizations to eliminate sources of harmful bacteria influx.

Strategies:

1) Present/report monitoring results to town officials and health officers highlighting areas of chronic concern.
2) Enlist local agencies, such as the Natural Resources Conservation Districts and Regional Planning Commissions, and town conservation commissions to assist town governments with developing strategies and finding solutions to the bacterial water quality problems.
3) Conduct bracketed water quality sampling of suspected pollutant sources to determine impact.
4) Conduct landowner education workshops to encourage riparian landowners to maintain vegetated buffers.
5) Target sensitive streambank areas characterized by a lack of riparian vegetation that would benefit from the re-establishment of a vegetated buffer. Encourage riparian landowners (with incentives, if possible) to maximize the width of buffer zones adjacent to the tributaries and the river.
6) Conduct outreach to landowners on the need for septic system maintenance and its relationship to water quality.

Lead Agencies: VDEC, WRWA, NRCDs, RPCs, municipalities
Funding options: CRJC, New England Grassroots, CREP, WHIP
Timeline: 2008 - 2010

3. Recommendation: Reduce pollutants that enter surface waters from agricultural land uses from the application of manure.
Strategies:
1) Assist farm operators through the process of entering into cost-share and other conservation programs that will help sustain the working landscape in the basin while implementing best management practices.
2) Encourage agricultural practices such as nutrient management planning, conservation tillage, riparian area protection, fencing, incorporating manure after spreading and the development of alternative livestock watering facilities.
3) Implement riparian buffer planting and streambank stabilization projects based on River Management SGA Alternatives Analysis, and geomorphically-viable streambank stabilization practices.
4) Encourage the composting of animal manure and animal mortalities, which has not been widely adopted.
5) Provide incentives to farmers to fence livestock out of surface waters to curtail the amount of pathogens and erosion entering surface waters.
Lead Agencies: NRCS, VAAFM, NRCDs, UVM Extension, farmers
Funding options: EQIP, AMA, VT BMP, CREP, VT NMP, Partners for Fish & Wildlife – USFWS (PFW)
Timeline: On-going

4. Recommendation: Reduce pollutants that enter surface waters from urban and residential areas.
Strategy:
1) Hold a suite of best management practice workshops for municipal officials and landowners in the basin.
2) Encourage the implementation of stormwater BMPs where stormwater has an impact on surface waters.
3) Promote residential stormwater controls to local landowners, such as rain gardens and small on-site retention ponds.
4) Assist towns with incorporating of goals, strategies and standards that protect water quality into municipal plans and zoning regulations.
Lead Agencies: NRCDs, RPCs, VDEC, WRWA
Funding options: VT Clean & Clear, CWA Sec. 319 grants, Vermont Watershed grants
Timeline: 2008 - 2011

4.1.2 Physical Habitat Alterations and Adjustments

Physical habitat alterations are often a result of flow regulation, channelization/instream modification, road and bridge work, and channel instability. Areas of Basin 11 where these alterations and adjustments are increasingly evident have been the focus of basin planning focus

group discussions. Stream bank instability that precipitates erosion and sedimentation impacts was also a priority issue previously identified in the WRWA's Action Plan.

Sedimentation resulting from channel instability can often be traced to human sources, such as development within floodplains (including dwellings, roads, and bridges), channel management activities (including gravel mining, bank armoring, dredging and channelization), removal or suppression of vegetation in the riparian zone, and changes in watershed hydrology, such as increased stormwater runoff or water diversions.

Review of aerial photographs and topographic maps of rivers and streams in Basin 11 shows instances of stream straightening using berms, dikes, and roads to redirect the course of the channel to accommodate transportation, agricultural and development needs throughout the decades. Anthropogenic changes to the streams have created unstable river dynamics which in turn have led to erosion and increased sedimentation in stream beds, some to the extreme.

While Basin 11 planning was in its initial stages, the WRWA, the WRC and WCNRCD, recognized problems occurring in the West River from changes in physical habitat. With 604(b) funding from the Vermont DEC, the WRC produced the *West River Tributaries Non-point Source Pollution Stream Assessment* (1997), which outlined the results of the commission's survey conducted on the Rock River, Winhall River and Ball Mountain Brook. The report, while identifying and evaluating erosion sites as to their priority for stream bank stabilization work, also underscored the highly erodible and sensitive nature of the tributaries of the West River. It has since become the guide post for interagency efforts to address erosion and sedimentation occurring in Basin 11.

Physical Geomorphic Assessments

Because of the urgency to address difficult erosion and stream bank stability issues, projects have been implemented without the benefit of survey data from physical geomorphic assessments. Data collected during geomorphic assessments foster a better understanding of the physical processes shaping a watershed, identifying high quality aquatic habitats while characterizing erosion and flood hazards. Once completed, results of such stream studies help in making strategic decisions about how to best protect, manage, and restore streambanks and other watershed features. Reduction of total sediment load, protection and restoration of aquatic and riparian habitat and enhancement of recreational values is dependent in part upon identification of the root causes of channel instability. Ultimately, streambank restoration projects with their implementation based on stream geomorphic data will be more likely to have long-term success in improving physical conditions in the stream channel and reducing sedimentation impacts.

Flooding Potential and Fluvial Erosion Hazard Mapping

Of all the natural hazards experienced in Vermont, flooding is by far the most frequent, damaging, and costly. Over the last 50 years, flood recovery has cost Vermonters an average of $14 million a year. During the period of 1995-1998 alone, flood losses in Vermont totaled nearly $57 million.

Some flood losses are caused by inundation (i.e. waters rise, flood, and damage low-lying structures). In Vermont, most flood damage is caused not by inundation but by the dynamic and

catastrophic changes in stream channels during flood events. The term "fluvial erosion" is used to describe these adjustments in stream channel dimension and location.

Vermont's **fluvial erosion hazard** problems are largely due to the pervasive, human-caused alteration of the landscape which has occurred over the past several centuries. By end of the 19th century, forests had been cleared from many watersheds, resulting in major changes in hydrology and sediment input. In addition, many Vermont rivers have been extensively straightened and channelized to accommodate roads and railways, and to control flooding. The legacy of this landscape manipulation is rivers and streams that are disconnected from their floodplains. Without floodplain access, which serves the essential purposes of slowing floodwaters and storing sediment, streambanks are subjected to the full power of flood flows, leading to extensive fluvial erosion.

The reaction to erosion-related flood losses has historically been additional channel and floodplain manipulation: dredging, armoring and straightening in an attempt to limit flood losses through engineering works. These efforts often exacerbate the problem by further limiting floodplain access and encouraging even more encroachment. The destabilized rivers inevitably break through these human-made barriers and inflict further extensive and costly flood damages. For decades we have been trapped in this cycle of escalating costs and risk to public safety.

Vermont has recently developed a new, science-based system to delineate river corridors based on fluvial erosion hazards. Information produced using the VANR Stream Geomorphic Assessment Protocols is used to conduct a Fluvial Erosion Hazard (FEH) risk assessment which, in conjunction with new National Flood Insurance Program (NFIP) maps, more comprehensively define erosion hazards. These maps can be valuable tools to help Vermont towns limit flood damages, protect pubic safety, and plan for future growth and development.

Fluvial erosion hazard maps and their accompanying database reports may be used to advise towns and property owners on existing and future land use investments and infrastructure development within river corridors. Regional Planning Commissions, with technical assistance from the River Management Program, will support municipalities in generating fluvial erosion hazard maps and advise local boards in the development of flood hazard mitigation strategies for consideration and adoption by the town. In addition to these local maps, towns also have the ability to produce "all hazards" maps to include inundation-based flood hazards (FEMA National Flood Insurance Program data) and other information such as landslide hazards where studies have been completed and data is available (personal communication, Mack 2005).

Recommendations to Address Physical Habitat Alterations and Adjustments

5. Recommendation: Complete stream geomorphic assessments in all areas of Basin 11 to better understand the physical processes and features shaping the watersheds.
Strategy:
1) Coordinate VANR technical professionals and local planners to prioritize Basin 11 sub-watersheds for stream geomorphic assessments.
2) Conduct VANR Phase 1 and 2 stream geomorphic assessments in sub-watersheds throughout

the basin to identify stable and adjusting reaches.
Lead Agencies: VDEC, NRCDs, RPCs
Funding options: DEC River Corridor grants, FEMA – PDM grants, VT Watershed grants
Timeline: 2004 - 2010

6. Recommendation: Plan and implement in-stream and river corridor restoration and protection measures that are consistent with SGA findings.
Strategies:
1) Work with the towns of Jamaica and Stratton to identify and implement stream corridor protection and restoration projects using results from the Ball Mountain Stream Geomorphic Assessment.
2) Work with towns in the Ball Mountain Brook watershed to create and interpret new GIS mapping layers for flood control and erosion site identification.
3) Facilitate a consortium of Rock River landowners, municipal governments, and local and state agencies to address access trail streambank erosion issues along the Rock River.
4) Work to inform landowners and local and state decision-makers on the benefits of and need for shoreland protection.
5) Continue to coordinate access trail restoration and maintenance projects.
6) Assist farmers, loggers, developers and landowners in complying with current AAPs and BMPs for agriculture and Acceptable Management Practices (AMPs) for silviculture and Erosion Prevention and Sediment Control (EPSCs) guidelines for development to ensure they are implemented and maintained to lessen land use impacts to river stability by providing training and assistance.
7) Work with USDA/NRCS and VAAFM to develop and install alternative strategies to replace bank armoring and river alterations on farmland where alternative practices are appropriate.
Lead Agencies: VDEC, NRCS, VAAFM, NRCDs, municipalities
Funding options: 319 grants, DEC River Corridor grants, Transportation Enhancement grants, VT-BMP, EQIP, WHIP, PFW, VT Watershed grants, municipal budgets, private foundations
Timeline: 2008 - 2012

4.1.3 Aquatic Biota and Fish

Since 1985, the VANR Biomonitoring and Aquatic Studies Section (BASS), has used standardized methodologies for sampling aquatic communities, evaluating physical habitat, processing samples, and analyzing and evaluating data for sites across the state. BASS has created an effective and thorough biological monitoring program that surveys the macroinvertebrate and fish communities of lakes, wetlands, wadeable rivers, and streams. Evaluating the biological health, or biological integrity, of these resources helps with required reporting under CWA Section 305(b), increases the effectiveness of pollution prevention efforts, and documents the progress of mitigation efforts.

Macroinvertebrate and fish assemblages are good indicators of localized conditions. Because many benthic macroinvertebrates and many small fish have limited ranges, they are particularly well-suited for assessing site-specific impacts of pollution. Degraded conditions can often be detected by an experienced biologist with only a cursory examination of the biotic community.

Benthic macroinvertebrates serve as a primary food source for fish, including many recreationally and commercially important species. These studies determine water quality impairments for aquatic life support (ALS).

Table 4 State Macroinvertebrate Sampling Sites

Waterbody ID	Location	Station	Town	Community	Overall Rating
VT11-01	Williams River	3	Rockingham	MF	V Good
VT11-01	Williams River	11.9	Chester	M	Good
VT11-03	South Branch, Williams River	1.3	Chester	M	Excellent
VT11-03	Andover Branch	4.4	Andover	MF	Good
VT11-03	Andover Branch	4.8	Andover	MF	Excellent
VT11-04	Williams River	18.7	Chester	M	Excellent
VT11-05	Saxtons River	0.1	Westminster	M	Good
VT11-05	Saxton's River	3.8	Rockingham	M	V Good
VT11-05	Saxtons River	4.5	Rockingham	M	Good
VT11-05	Saxtons River	6.2	Rockingham	MF	Good
VT11-05	Leach Brook	0.1	Rockingham	MF	Poor
VT11-07	West River	6.2	Dummerston	M	Good
VT11-08	Stickney Brook	2.4	Dummerston	F	V Good
VT11-09	Rock River	1.5	Newfane	M	Excellent
VT11-10	West River	19.1	Townshend	M	V Good
VT11-10	West River	26	Jamaica	M	Excellent
VT11-13	Turkey Mtn.Brook	1	Townshend	M	Excellent
VT11-13	Cobb Brook	0.9	Jamaica	MF	Excellent
VT11-13	Cobb Brook	2.6	Windham	M	Excellent
VT11-14	Wardsboro Brook Trib # 5	3.9	Wardsboro	MF	Excellent
VT11-15	Ball Mountain Brook	7.8	Stratton	F	Good
VT11-15	Ball Mountain Brook	8.4	Stratton	M	Good
VT11-15	North Branch Ball Mt. Brook	0.4	Jamaica	MF	V Good
VT11-15	North Branch Ball Mtn. Brook	2.2	Stratton	M	Excellent
VT11-15	North Branch Ball Mtn. Brook	3.9	Stratton	MF	Good
VT11-15	North Branch Ball Mtn. Brook	4.3	Stratton	M	Good
VT11-15	North Branch Ball Mtn. Brook	4.7	Stratton	MF	G-Fair
VT11-15	Kidder Brook	0.9	Stratton	M	Good
VT11-15	Brazer Brook	0.7	Stratton	M	Good
VT11-15	Styles Brook	0.3	Stratton	M	G-Fair
VT11-15	Styles Brook	0.8	Stratton	MF	V Good
VT11-15	Stratton Pond Trib-1	0.1	Winhall	M	G-Fair
VT11-15	Stratton Pond Trib-1	0.2	Winhall	M	Fair
VT11-15	Stratton Pond Trib-1	0.3	Winhall	M	Fair
VT11-15	Stratton Pond Trib-1	0.4	Winhall	M	Fair
VT11-15	Brehmi Brook	0.1	Jamaica	M	Good
VT11-15	Brehmi Brook	0.8	Stratton	M	Fair

VT11-15	Bear Mountain Brook	0.7	Stratton	M	Fair
VT11-15	Sunbowl Brook	0.3	Stratton	M	V Good
VT11-15	Ball Mountain Brook Trib9a	0.2	Jamaica	M	Good
VT11-16	Winhall River	6.3	Winhall	M	Excellent
VT11-16	Winhall River	6.4	Winhall	M	Excellent
VT11-16	Winhall River	7.1	Winhall	M	Excellent
VT11-16	Winhall River	8.1	Winhall	MF	Excellent
VT11-16	Cook Brook	8.1	Peru	M	Excellent
VT11-16	Eddy Brook	1.9	Winhall	M	Excellent
VT11-16	Eddy Brook	5.5	Peru	M	Good
VT11-16	Bromley Brook	1.9	Winhall	M	Fair
VT11-16	Bromley Brook	2.2	Winhall	M	Fair
VT11-18	Mount Tabor Brook	1.9	Mount Tabor	MF	Excellent
VT11-18	Greendale Brook	0.9	Weston	M	V Good

M-macroinvertebrates F-fish

Additionally, 11 sites were sampled by trained WRWA volunteers in 2003 & 2004. The WRWA macroinvertebrate sampling sites are shown in the WRWA's 2004 and 2005 *Water Quality Monitoring Program Reports* found at:
http://www.vacd.org/wnrcd/BasinPlanning/BasinPlanning.html

Fishery Resources

The Fisheries Division of the VDFW is responsible for the conservation and management of all fish and fish habitat within the State of Vermont. Fisheries biologists are engaged in a wide variety of activities aimed at ensuring that Vermont's valuable fisheries resources will be sustained and enhanced through time. Biologists inventory and monitor the abundance, distribution, diversity, and health of Vermont's fish and the habitat they live in. Data collected from inventory and monitoring efforts are used to assess the impacts of fishing pressure, predation, disease, parasites and habitat changes. Once information is analyzed, biologists determine what management actions will be needed to keep fish populations healthy, balanced, and productive.

Management actions such as fishing regulations, fish stocking, nuisance species control, and habitat improvement are examples of active measures routinely taken to improve and enhance fish populations, aquatic communities, and the fishing in Vermont.

Fisheries resources are discussed in detail in Section 2.3.6.

Recommendations that Address In-stream Habitat and Fisheries Issues

7. Recommendations: Identify in-stream and river corridor reaches that would benefit from improvements to fish and aquatic habitats and develop improvement and demonstration projects for these areas.

Strategies:

1) Work with VFWD and USFWS to carry out Rapid Habitat Assessments in areas of degraded fish habitat and determine restoration actions needed.

2) Continue WRWA volunteer macroinvertebrate sampling program to augment VDEC's on-

going efforts to assess areas of concern in Basin 11.
3) Identify riparian landowners, based on geomorphic/habitat assessment results, willing to implement streambank restoration projects that will improve in-stream habitat including woody debris installations.
4) Work with landowners to increase shading along stream corridors by planting riparian buffers to help lower water temperatures and improve in-stream and riparian habitat.
5) Promote the WHIP culvert replacement program to towns to replace, upgrade or retrofit stream crossings which pose a barrier to aquatic organism passage.
Lead Agencies: VFWD, USFS, USFWS, WRWA, NRCDs
Funding options: WHIP, 319 grants, River Corridor grants, Partners for Fish & Wildlife, Trout Unlimited, private foundations
Timeline: On-going

8. Recommendation: Coordinate the efforts of Federal, State, and local agencies to address fish passage issues and natural flow regimes at dams in the West and Williams Rivers.
Strategies:
1) Meet with USACE, VFWD, VDEC, CRWC, RPCs and municipal boards to determine potential dams for removal.
2) Coordinate with these agencies to seek funding for dam removal projects.
3) Coordinate assessment information from VDEC and VAOT that assists with bridge and culvert replacement prioritization and provide this to towns for implementation.
4) Remove at least one dam on the West or Williams to allow fish passage upstream.
Lead Agencies: VDEC, USACE, private dam owners
Funding options: NOAA, USFWS, NFWF, American Rivers, Trout Unlimited, 319 grants, VT Watershed Grants
Timeline: 2008 - 2011

9. Recommendation: Support federal and state salmon restocking programs and promote volunteer involvement at local level.
Strategies:
1) Involve town conservation commissions, local schools, Trout Unlimited and other interested groups as volunteers and educators on fish habitat, stocking and restoration efforts
Lead Agencies: VDEC, USFS, USFWS, WRWA, TU
Funding options: USFS grants, private foundations
Timeline: On-going

10. Recommendation: Improve fishing access with additional parking pull-offs.
Strategies:
1) Work with municipal and state road departments to maintain and enhance parking areas along rivers and streams to provide better and safer access.
Lead Agencies: TU, WRWA, VTrans, municipal road departments
Funding options: Private foundations, Better Backroads Program grants
Timeline: On-going

4.1.4 Invasive and Nuisance Species

The introduction of plants and animals not native to Vermont has been occurring for centuries. Most of these plants and animals pose little or no harm to the environment. Some, however, have significant environmental and economic consequences. In Basin 11, these are mostly plant species that have escaped cultivation and spread throughout the basin.

The species of greatest concern in Basin 11 include: Eurasian watermilfoil (*Myriophyllum spicatum* L.), curly leaf pondweed (*Potamogeton crispus*), phragmites (*Phragmites australis*), purple loosestrife (*Lythrum salicaria*), didymo (*Didymosphenia geminata*), and Japanese knotweed (*Fallopia japonica*).

Exotic invasives are discussed in detail in section 3.8.

Recommendations that Address Invasive Species Issues

11. Recommendation: Increase public awareness and involvement in aquatic and streambank invasive plant issues.
Strategies:
1) Locate or create and distribute educational materials and information about invasive plants to the public.
2) Coordinate educational and outreach activities with other interested groups and local businesses.
3) Conduct training for volunteers to search for and remove invasive aquatic plants.
4) Provide information about invasive species to nursery and landscaping professionals.
Lead Agencies: NRCDs, Municipalities, VDEC, WRWA
Funding options: VDEC Aquatic Nuisance Species Grant-in-Aid program, Vermont Watershed grants, CRJC, NFWF, private foundations
Timeline: On-going

12. Recommendation: Develop locally-based initiatives designed to identify, assess and control aquatic invasive plant communities.
Strategies:
1) Organize an invasive plant task force to focus on both aquatic and streambank species.
2) Research federal, state and private sources of funding and solicit project support.
3) Establish a Vermont Invasive Patrollers (VIP) program in Basin 11 to monitor aquatic plant growth (especially Eurasian watermilfoil and curly leaf pondweed) in areas where populations are present or have a high probability of becoming established.
Lead Agencies: Municipalities, NRCDs, WRWA, VDEC, local watershed groups

Aquatic biologist Laurie Callahan doing invasive plant survey on Lowell Lake

Funding options: VDEC Aquatic Nuisance Species Grant-in-Aid program, Vermont Watershed grants, private foundations
Timeline: On-going

13. Recommendation: Continue control efforts in the lower West River and Retreat Meadows and expand these to other infestation locations.
1) Develop a long-term aquatic invasive plant management plan for the Basin and for individual sites and implement it.
2) Post ANS spread prevention information at all boat launching areas throughout the Basin to prevent the spread of ANS to new locations.
2) Develop a long-term Japanese knotweed management plan for the Basin and seek resources to implement it.
3) Support the inclusion of Japanese knotweed in the list of invasives considered to create the List of Priority Waters Part E: Surface Waters Altered by Exotic Species.
Lead Agencies: Town of Brattleboro, NRCDs, WRWA, VDEC, other municipalities
Funding options: VDEC Aquatic Nuisance Species Grant-in-Aid program, Vermont Watershed grants, private foundations
Timeline: On-going

4.2 Land Use

4.2.1 Agriculture

Within the context of the Watershed Council's roundtable discussions, information and issues pertaining to agricultural land use in Basin 11 were addressed by the Agency of Agriculture, Food and Markets (VAAFM), the WCNCRD, the Farm Bureau, the Windham Regional Planning Commission (WRC), the Southern Windsor County Regional Planning Commission (SWCRPC), local farmers and others with an interest in agriculture.

While significant strides have been made over the years to reduce agricultural nonpoint source pollution through the voluntary implementation of soil, manure, and fertilizer management practices, agriculture remains a significant source of nonpoint source pollution. Inadequate nutrient and animal waste management has resulted in nutrient loading to surface waters and ground waters and is a major source of agricultural nonpoint source pollution in the State.

As stated in the newly adopted (2/7/2006) Accepted Agricultural Practices Regulations:

> *Recognizing the need to protect and improve water quality through improved agricultural practices, the Vermont legislature charged the Agency of Agriculture, Food and Markets with creating a comprehensive Agricultural Nonpoint Source Pollution Reduction Program including Accepted Agricultural Practices and Best Management Practices. The legislature also recognized the need to balance water quality improvements with the need to sustain a healthy, economically viable agricultural industry. To achieve this, the Legislature has directed the Agency to promulgate regulations governing Accepted Agricultural Practices and Best Management Practices.*

Now more than ever, farmers are under considerable pressure to sustain economically viable and

environmental sound farming operations. Farmers must face labor issues, foreign competition, competing land use pressures, regulations concerning animal husbandry, genetics, food safety, and, most germane to Basin 11 planning, stricter water quality regulations under the State's Accepted Agricultural Practices (AAP). In complying with these new AAPs, farmers must address five key WQ protection concepts:

1) Riparian buffer development and stream bank management criteria
2) Livestock impacts on stream banks
3) Setbacks from wells and property boundaries
4) Soil testing for manure spreading and record keeping
5) On-site disposal or composting of animal mortalities

More details about the new AAPs can be found at:
http://www.vermontagriculture.com/AgriculturalWaterQuality/AAP/AAP.htm

According to the Vermont Agency of Agriculture, Food, and Markets, some BMPs needed to improve water quality in Basin 11 include: fencing along streams to exclude animals; waste storage facilities and systems; composting pads; reseeding; spring development; pasture management education for horse farms; soil testing and results interpretation education; roofed loafing areas; riparian buffers and grass filter strips along waterways; stream crossings, walkways and access lanes for animals; streambank stabilization; grade stabilization structures along the river channel; stream channel stabilization; streambank and shoreline protection; improved barnyards and heavy use area protection; roof runoff management; milk-house waste management; silage leachate management; nutrient management planning; pasture management; strip cropping; and surface water diversions.

Recommendations to Address Agricultural Related Water Quality Issues

14. Recommendation: Seek increased funding opportunities for water quality BMPs and equitable distribution of the funds statewide.
Strategies:
1) Work with USDA/NRCS to increase funding for programs such as EQIP, AMA, CRP, CREP, WHIP, etc.
2) Work with VAAFM to increase funding for programs such as VT Buffer Program, NMP and FAP.
3) Work with USFWS to increase funding for PFW program to install more riparian buffers and fencing.
4) Work with USDA/NRCS, VAAFM, and others to improve statewide equitability of EQIP ranking system.
Lead Agencies: VAAFM, NRCDs, WRWA, VDEC, VT Farm Bureau, local watershed groups
Funding options: NA
Timeline: On-going

15. Recommendation: Implement water quality BMPs on willing farms, especially along the lower Williams River.
Strategies:

1) Increase funding for and technical assistance available on BMP's.
2) Enroll farms in the appropriate cost-share programs.
3) Implement planned and funded improvement projects.
Lead Agencies: NRCS, VAAFM
Funding options: EQIP, AMA, CRP, CREP, WHIP, PFW, etc.
Timeline: On-going

16. Recommendation: Increase funding to promote farm viability through programs that assist farmers in diversification or transitioning to alternative systems or support conventional dairy farming.
Strategies:
1) Form partnerships with Vermont NOFA to provide technical assistance to farmers on transitioning to organic production.
2) Work through organizations such as the Vermont Farm Bureau, Rural Vermont, and others, on providing technical assistance to farmers on diversification.
3) Encourage local and regional power companies to increase the capacity of farm generated power.
4) Promote the USDA Rural Development program offering technical assistance in developing farm business plans and funding projects.
Lead Agencies: USDA NRCS & Rural Development, VAAFM, NRCDs, UVM Extension, VT NOFA, Vermont Farm Bureau, Rural Vermont
Funding options: EQIP, CVPS, VT Alternative Manure Management grants
Timeline: On-going

17. Recommendation: Continue outreach to farmers about new AAPs and cost-share programs.
Strategies:
1) Support and promote the NRCD technical assistance programs including the ARS, SVNMP, and LTP to increase knowledge and understanding of the AAPs and potential funding opportunities to address water quality issues on farms.
2) Increase outreach efforts to target horse and small animal producers with information on technical assistance programs, AAPs and funding opportunities.
3) Work with area land trusts and conservation organizations on farmland protection programs.
Lead Agencies: NRCDs, VAAFM, NRCS, Vermont Farm Bureau, Rural Vermont
Funding options: CWA Sec. 319 grants, ARS, LTP, SVNMP budgeting
Timeline: On-going

18. Recommendation: Support tax programs that keep land in agriculture and programs that better serve the farming industry.
Strategies:
1) Work with State and Federal legislators to address tax programs affecting farmland.
2) Support the Use Value Appraisal program.
3) Work with State and Federal legislators to address milk pricing issues through regional policies.
4) Work through groups such as Vermont Farm Bureau and Rural Vermont to establish infrastructure for transport, storage and processing of diversified farm products.

Lead Agencies: VAAFM, NRCDs, VT NOFA, Vermont Farm Bureau, Rural Vermont, FSA, RD, RC&D
Funding options: NA
Timeline: On-going

19. Recommendation: Create a database to compile agricultural statistics by watershed rather than political boundaries.
Strategies:
1) Work with NEAS and USDA to begin compiling statistics in more flexible and/or searchable format.
Lead Agencies: FSA, NRCS, VAAFM, NRCDs, NASS
Funding options: NA
Timeline: On-going

20. Recommendation: Continue work with farmers, through programs like CREP and the VT Agricultural Buffer Program to increase voluntary efforts to establish buffers along surface waterways.
Strategies:
1) Promote the cost share programs available for animal exclusion fencing and buffer establishment including EQIP, AMA, CREP, CRP, PFW, VT Agricultural Buffer Program, etc.
2) Work in partnership with VDEC to establish these buffers with consideration toward maintaining the economic integrity of the agricultural land base in the basin.
3) Organize volunteers to plant buffers on participating agricultural land.
Lead Agencies: FSA, NRCS, VAAFM, NRCDs, VDEC
Funding options: EQIP, AMA, CREP, CRP, PFW, VT Agricultural Buffer Program, TNC
Timeline: On-going

4.2.2 Forestry

Major land use changes over the past three centuries have dramatically changed Vermont streams. From a completely forested landscape to a mostly open one and back again, the centuries have wreaked havoc on the condition, habitat and biology of our waterways. Today 85% of the basin is re-forested. The forest industry in Windsor and Windham counties produced 56,846 thousand board feet of sawlogs and veneer logs in 2003, the first and third highest county volumes in the state respectively. They also produced 24,050 cords of pulpwood in that year. This production is a major economic factor in the region and forest-related jobs are important to the local economy.

One common practice affecting stream health is the clearing of wood debris from streams. Once thought to protect streams from erosion by allowing free flowing water and preventing fallen trees from damaging the streambank, there are now numerous studies that document how large woody debris (LWD) influences channel morphology and plays an important role in aquatic habitat creation and maintenance. The USFS is currently conducting three stream habitat restoration projects using Large Woody Debris (LWD) in the West River watershed on Greendale, Griffith and Jones brooks. These projects are some of the first to use this method in New England. The USFS projects are designed to mimic natural LWD recruitment as observed in smaller streams but

at higher quantities based on LWD modeling work with the University of Massachusetts. Initial findings indicate use of LWD has positive effects on channel morphology, habitat quality, and improved habitat capability for wild brook trout. These studies indicate the importance of restoring the "natural wood regime" via management and conservation practices.

Recommendations to Address Forestry Land Use Issues

21. Recommendation: Encourage sound forest practices, including the participation of loggers and other forest workers in the Logger Education to Advance Professionalism (LEAP) program and the Game of Logging, which increases safety levels and improves forestry practices.
Strategies:
1) Work with VFPR and USFS staff and logger education organizations to disseminate information about these programs.
2) Seek funding for their continuance.
Lead Agencies: Northeast Forest Stewardship Project, VFPR, USFS logger assn's, forestry assn's, Woodland Owners Assn
Funding options: USFS grants, VFPR
Timeline: On-going

22. Recommendation: Create more large woody debris (LWD) demonstration projects in the Basin.
Strategies:
1) Work with USFS, USFWS, VFPR and VDFW staff to locate potential sites for a LWD demonstration project.
2) Seek funding for and implement these projects.
3) Educate forest industry personnel and landowners on the benefits of LWD and host workshops and site visits.
Lead Agencies: VFPR, VDFW, USFS
Funding options: USFS grants, PFW, CWA Sec. 319 grants, Vermont Watershed grants New England Grassroots, CRJC
Timeline: On-going

23. Recommendation: Educate forest industry personnel on the positive water quality impacts of AMPs.
Strategies:
1) Host workshops on the connection between AMPs and water quality improvements including fisheries habitat, wildlife benefits and steam stability.
2) Develop and produce outreach materials encouraging AMP implementation for forest industry personnel and for small forest landowners.
Lead Agencies: VFPR, USFS, logger assn's, forestry assn's
Funding options: USFS grants, VFPR
Timeline: On-going

24. Recommendation: Educate forest industry personnel on riverbank invasive plants and control techniques related to forestry practices.

Strategies:
1) Develop and distribute outreach materials on the impacts to wildlife and stream habitat of Japanese knotweed, Oriental bittersweet, honeysuckle and others that are invading streambanks.
Lead Agencies: VFPR, USFS, logger assn's, forestry assn's
Funding options: USFS grants, Vermont Watershed grants, CRJC
Timeline: On-going

25. Recommendation: Increase the amount of forestland being managed sustainably with water quality protection as a goal.
Strategies:
1) Develop and produce outreach materials for landowners on forest management planning, sustainable forest practices, AMPs and water resource protection.
2) Re-establish and consistently fund the Backyard Forestry Program.
3) Provide loggers with access to portable skidder bridges and half culverts to decrease the impact of stream crossings during logging operations.
Lead Agencies: VFPR, USFS, logger assn's, forestry assn's, Woodland Owners Assoc.
Funding options: USFS grants, VFPR budgeting, Watershed Assistance funds
Timeline: 2008 - 2011

26. Recommendation: Require heavy cut permits to be reviewed for resource protection issues such as water quality protection and fragmentation.
Strategies:
1) Work with Vermont legislature to require water quality reviews of heavy cut permits.
2) Educate forest professionals on the potential consequences of heavy cutting and the need for water quality protection.
Lead Agencies: VWQD, VFPR, Vermont legislature
Funding options: N/A
Timeline: 2009 - 2012

4.2.3 Developed Lands

While just over 1 % of the Basin is developed land, this small portion has large impacts on the quality of the water and the condition of stream, river and lake habitat.

Ski Industry

Bromley Mountain

Representatives from Bromley Mountain offered members of the Watershed Council an overview of their operations over the past 60 years. Bromley installed a municipal public water and sewage system in the 1960s. A permitted woodland "spray irrigation" method for wastewater effluent disposal is in use. The resort plans to upgrade its wastewater treatment facility to tertiary treatment and expand sprayfield capacity by acquiring land from the Green Mountain National Forest.

The bill, which proposes a land exchange and/or sale between USFS and Bromley Mountain Ski Resort, is pending in Congress. The total land involved is approximately 600 acres in five parcels

and would be available for use for sprayfield and trail expansion in the future. Prior to any action the USFS will prepare an Environmental Impact Statement on the impact the exchange will have on the natural and socio-economic resources of the land. This will include the waters as well. The USFS does not have jurisdiction over the waters as all are "waters of the state." The state will be involved in the EIS preparation and the EIS will go through a public comment process.

Current State permitting requires both ground and surface water testing and biological monitoring. There are several Underground Storage Tanks (USTs) on the resort property. All UST have been upgraded - now storage tanks at Bromley are double-lined, with leak protection systems.

Bromley's stormwater management plan addresses siltation issues in surface waters and streams by improving road maintenance to include rock lined ditches and planting vegetated buffers along stream banks. They are currently dealing with issues surrounding culvert sizes in order to reduce stream blockages.

Mill Brook which begins near the intersection of Routes 11 and 30 and flows into Gale Meadows Pond, and one of its tributaries are listed in the 2006 List of Priority Waters as being altered by flow regulation due to "artificial and insufficient flow." Mill Brook is used as the water source for snowmaking operations at Bromley. Although all facilities and activities related to the resort's snowmaking and water usage adhere to existing permit requirements, the brook and tributary are considered altered. New regulations require ski all areas to bring their surface water withdrawals into compliance with minimum flow regulations as part of any new or expanded snowmaking.

Stratton Mountain Resort

Stratton Mountain Resort has implemented many initiatives over the years that preserve or conserve land to create ecological and environmental benefits that advance smart growth alternatives. These projects have been in the areas of wildlife habitat protection, water conservation and wastewater treatment. Conservation easements in seven distinct areas, on 1,499 acres, include whitetail deer wintering grounds and feeding areas, bear travel corridors and feeding areas and Bicknell's thrush habitat. The resort's Master Plan for development is based on "cluster" rather than sprawl development which supports economic viability while reserving a third of the resort property for use by wildlife species. There are many positive environmental activities underway at Stratton, including, for example an underground radiant heating system for the Village pedestrian street, which has eliminated the use of sand and salt for winter de-icing.

The Stratton Mountain resort area sits in the headwaters of the Ball Mountain Brook watershed. A tributary of the North Branch of Ball Mountain Brook and a segment of Styles Brook in this watershed are listed in Part D of the 2006 List of Priority Waters for sediment impairments. Part D lists impaired waters that have completes and approved TMDL plans. These problems are being addressed through the USEPA approved sediment TMDL and the Stratton Mountain Water Quality Remediation Plan. In accordance with recommendations by the Vermont Agency of Natural Resources, the District 2 Environmental Commission approved a Water Quality Remediation Plan for impaired waters within the Stratton Resort and incorporated it into the year 2000 Stratton Resort Master Plan permit. The Stratton Corporation conducts a monitoring program with the objective of evaluating the progress toward restoration of impaired waters, (and

maintenance of high quality waters) to ultimately attain conditions mandated by the Vermont Water Quality Standards. In its Master Plan permit decision the District Environmental Commission, and the State Environmental Board, named the Stratton Area Citizens Committee and the Vermont Natural Resources Council as participants in the annual evaluation of the Water Quality Remediation Plan's progress.

Long-term sampling for nutrients, metals, total suspended solids (TSS), and turbidity is being conducted at 30 locations on eight watersheds including those of the Lower North Branch, Brazers Brook, Kidder Brook, Sunbowl Brook, Styles Brook and three tributaries flowing into Stratton Lake. Twenty-five locations are being monitored for sediment, several coinciding with macroinvertebrate sampling sites. Sampling conducted at two sites that are part of an Indirect Discharge Permit program along the North Branch are also incorporated into Stratton's program. Aquatic biological monitoring under the Stratton Mountain remediation program (see section 3.9) has been on-going since 1999. Several historical VDEC sites were used as monitoring locations. Hydrological information such as stream flow and rain gauge information has also been collected (Pioneer 1999).

Within the context of the Stratton Resort's remediation plan, several tasks have been accomplished. These include:

- Two man-made ponds are now "off-line" – no longer impoundments within stream channels
- Stream channel restorations are underway as specified in the plan
- Road relocation away from the stream has occurred in some areas
- Vegetated stream buffers have been planted
- Several culverts are being resized and reconstructed
- Parking lot improvements
- Treatment of an iron seep
- Ski trail improvements
- Stormwater basins and
- Sand pile barriers

The remediation plan has resulted in improved water quality in all streams on the resort. Biological monitoring has shown overall improvement in water quality as the Plan has been implemented. It is anticipated that Styles Brook will reach full attainment by 2007 and Tributary 1 by 2009. In addition, other streams at the resort have benefited from implementation of remedial measures and modification of operation and maintenance practices. These actions have helped to ensure that these waters will continue to meet state water quality standards.

However, there is concern that Stratton's water quality goals have not been fully achieved. The USEPA approved TMDL that is being addressed through the Water Quality Remediation Plan (WQRP), establishes water quality targets and requires ongoing biological monitoring. The WQRP set forth sedimentation targets to be met in each of the subwatersheds: not all of these targets have been met. Continued construction activities have created highly turbid water and may have exacerbated streambank erosion in several of the once-pristine mountain streams. Stream geomorphic assessments conducted downstream from the resort properties in the North Branch of the Ball Mountain Brook give evidence to suggest these impacts. Although Stratton has

incorporated many proactive stormwater and erosion control techniques into its development plans – cluster housing, retention ponds, swales and large culverts – construction practices employed at Stratton may need further examination.

It should also be noted that many small or individual residential development projects do not have master plans or incentive to subscribe to stormwater and erosion control goals. Many properties surrounding Stratton Resort are being rapidly developed by private landowners without understanding or regard for water quality conditions. This type of development may prove the most problematic in addressing water quality impacts as no overarching entity has oversight of the development.

The Pikes Falls area in Jamaica is facing potential problems with development encroaching on the brook and the added concern of increased numbers of private septic systems in the watershed.

Municipal View

Town of Brattleboro municipal planners offered their view of dealing with development and water quality. In light of recent flooding events, Brattleboro, as many other cities and towns, is developing new policies towards low lying areas and river management tending to - "Let the river do its own thing and stay out of the way." The flooding of the Whetstone Brook in 2004, regular Canal Street wash-outs, and Main Street stormwater overloads during even moderate storms has brought awareness of the problems to the forefront of municipal planning. Brattleboro in particular has embraced the idea that the town needs to keep development away from stream banks. This view, unfortunately clashes with a common desire to have an "urban waterfront" – a scenic, community gathering location.

Discussions have revealed common issues across all development scenarios. The group came to understand that flooding is the most costly natural disaster in Vermont and that most flood damage is due to channel changes, not inundation. It also recognized important planning tools in the complexities of fluvial geomorphology, fluvial erosion hazard (FEH) mapping, and stream geomorphic assessment (SGA) analysis - all which support corridor-based development and land use planning. These more technical approaches to basin planning were previously discussed in section 4.1.2.

It is clear that there must be shoreline regulation and performance based standards to allow urban waterfront to be developed. The town is taking steps towards working stormwater planning into the town plan and control strategies into zoning regulations to mange further development within floodplains.

The concept of low impact development and a proactive, small watershed approach to stormwater management offered several potential solutions which have been included in the list of recommendations

Recommendations to Address Developed Land Use Issues

27. Recommendation: Investigate, provide education on and promote low impact development solutions.
Strategies:
1) Implement demonstration projects using various practices to illustrate and teach about their use including raingardens, swales, sediment basins and ponds.
3) Provide training for development professionals on stormwater management techniques.
Lead Agencies: NRCDs, VDEC, VTrans
Funding options: workshop fees, VT Clean and Clear program, CWA 319 grants
Timeline: On-going

28. Recommendation: Approach land development within the context of the smaller sub-watershed.
Strategies:
1) Consider the watershed capacity limits of existing water resources when planning development projects.
2) Consider hydrology, soil type and erodibility in planning and zoning regulations.
Lead Agencies: VT Environmental Commissions, RPCs, municipal planning commissions
Funding options: NA
Timeline: On-going

29. Recommendations: Apply SGA data to better plan for flood hazards.
Strategies:
1) Work with the FEMA and VANR River Management Program to undertake FEH mapping to guide development plans.
2) Align state funding and technical support to communities who have adopted FEH guidelines
3) Work with towns to update planning and zoning regulations to include consideration of FEH and SGA results.
Lead Agencies: RPCs, municipal planning commissions, NRCDs, VDEC
Funding options: River Corridor grants, FEMA-PDM grants, Vermont Watershed grants
Timeline: On-going

30. Recommendations: Increase awareness of home septic system maintenance on water quality.
Strategies:
1) Conduct seminars on septic system maintenance.
2) Distribute informational materials to homeowners.
3) Encourage regular testing of private well water sources.
Lead Agencies: WRWA, NRCD, RPCs, municipal health offices, VDEC
Funding options: Vermont Watershed grants, CRJC, private foundations
Timeline: On-going

31. Recommendation: Include wildlife habitat protection as a component of the Use Value Program for tax purposes.

Strategies:
1) Work with legislature to amend the Use Value program legislation.
Lead Agencies: VFPR, County Foresters
Funding options: NA
Timeline: 2009 - 2011

4.3 Public Access

4.3.1 Swimming Hole Use

One of the major concerns expressed at Basin 11 public forums was how to sustain the area's heavily used swimming holes as beautiful and fun recreational opportunities and ensure access to them. Usage of these areas has skyrocketed over the last few years. According to assessments conducted by the Windham Regional Commission in 2002, there are as many as 20 public access sites along the main stem of the West River. Upwards of 250 people can visit each of the more popular sites during an optimal day. Along Route 30 that follows the West River, several swimming areas are notable for their use by both locals and visitors. On any given weekend in the summer, for instance, there are dozens of cars parked at Dummerston Covered Bridge or Williamsville Station – several sites along the Rock River being particularly popular. Parking and traffic safety have become a major concern at these areas. More moderate usage of swimming holes along the Williams and Saxtons Rivers, have not created similar public access issues.

Within the context of Basin 11 planning, the Swimming Hole Focus Group meetings, email dialogues, and users surveys conducted during 2003 and 2004 identified the following issues pertaining to high-use sites:

- Trash at sites
- Trampled vegetation
- Eroding trail access
- Stream bed impacts
- High volume traffic
- Unregulated or unsafe parking areas
- Trespassing on posted lands
- Lack of user etiquette
- Lack of local knowledge
- Swimming in unsafe locations
- Pathogens in waters
- Human waste disposal
- Unlicensed vendors

Water quality becomes a personal concern when users are confronted by issues at their favorite local swimming holes. Increased bank erosion and its accompanying sedimentation problems are caused by stormwater runoff and often exacerbated by foot traffic on existing paths and new ones carved through the stream bank shrubbery. The posted reports of *E. coli* bacteria levels have helped raise public awareness of bacterial influx at these sites. And finally, trash accumulation at swimming holes is not only aesthetically unpleasant, but can also be unhealthy.

4.3.2 Public Access Issues and Concerns

The following issues of private ownership and public access were considered in the Swimming Hole Focus Group discussions:

- Swimming hole access can be restricted with changes of ownership
- With increased usage, landowners are less inclined to allow access

- No incentives exist to encourage continued access to privately owned sites
- Misunderstanding by landowners about Vermont's public access laws cause concerns about landowner liability

In 2003 and 2004, specific West River swimming holes were identified as having particular concerns. These areas have been plagued by notable erosion problems along access trails creating unsafe conditions for the public. The Basin 11 Swimming Hole Focus Group has examined and considered the Dummerston Covered Bridge, Deyo's swimming hole, Williamsville town center swimming hole and several areas along the Rock River as prime sites for remediation. Overall safety issues surrounding geological formations and swift river currents – as at Twin Falls on the Saxtons River which has had fourteen fatalities, Hamilton Falls on Cobb Brook and Brockways Mills on the Williams River are noted for their dangerous rocks which have proven extremely hazardous over the years for unsuspecting users.

Indian Love Call

Swimming holes and their access trails, however, are not all on public lands. Vermont law allows the public to walk, hunt and fish on private land unless it is legally posted. But public use of private land is a privilege not a right and landowners ultimately control what occurs on their property. Throughout the state, landowner agreement to public access is eroding. As the public demand for access expands at alarming rates, the associated social, environmental, and legal pressure on willing landowners is ever increasing. Signs proclaiming "Posted: No Trespassing" are becoming more common across the local landscape.

4.3.3. Rock River

Parking on Route 30 at Rock River confluence

Of the swimming holes examined within the basin planning process, those sites along the Rock River, sometimes known as "Indian Love Call" by users seem to be of the greatest concern. A near pristine environment - it is one of the most beautiful swimming and recreational areas open to the public in this watershed. As it is a popular site with the apparent

capacity to hold many hundred people during a summer day, the swimming holes along the Rock River even at high use times provide users a truly memorable experience.

The long weekends of the summer - Memorial Day, July 4th and Labor Day attract the most users. It is mainly during these times where unsafe and illegal parking along Route 30 causes the most concern to area residents. For instance, on July 4, 2005, there were 174 cars either parked along Route 30 or parked in the informal parking area on state right of way. With no marked pedestrian crossing at the intersection of Dover Road and Route 30, a dangerous situation exists. Regarding the physical features of the stream, considerable erosion has occurred along the river trail just in the last two years (Deen and Johnson 2005). According to some users, the near mile-long access way has now become tortuous and a "dangerous trail" (WRWA 2004 Users Survey).

In response to the degree of concern about this tributary, WRWA sponsored a basin planning focus group to specifically address the Rock River. Representatives from the Connecticut River Watershed Council (CRWC), WRC, WCNRCD, WRWA Board of Directors, and the swimming hole user group called The Rock River Preservation now form the Rock River Focus Group. Representatives from the towns of Dummerston and Newfane have been invited to attend. These members have taken up the challenge of developing strategies to address what are felt to be urgent and critical issues stemming from high use at this particular site.

During the course of initial discussions, the group visited the several swimming holes along the Rock River while walking the access trail. The existing condition of the swimming holes and access trail were reviewed and discussed during this site visit. Input from group members indicated that given the length of river available for public use, current numbers of bathers were not necessarily adversely affecting site aesthetics or quality of experience. Although limited data is available to support the assertion, given current human usage, impacts to water quality, stream habitat and overall environment seemed negligible. It was agreed that the degree of severity of bank erosion along the stream cannot be solely attributed to foot traffic, but also to natural shifts in river dynamics. It was reported that much change had occurred just within the last couple of years. Minimal trash was observed, indicating that users (either some individuals or collective numbers) were being extremely conscientious in maintaining the area.

Children crossing Route 30 to reach Rock River trailhead

In the follow up discussions, the group decided that there were two prominent issues that needed to be addressed 1) unsafe parking conditions along Route 30 (to include pedestrian safety) and 2) trail erosion. The group's recommendations and strategies related to issues of swimming hole use and public access along this tributary of the West River follow under Rock River Recommendations.

Recommendations to Address Swimming Hole and Public Access Issues

Both the Swimming Hole Focus Group and the more area-specific, Rock River Focus Group, were created to examine issues and develop recommendations and strategies related to swimming hole use and public access.

32. Recommendation: Pursue West River Trail easements over remaining private property parcels along old West River Railroad.
Strategies:
1) Work with landowners to obtain permanent access easements for trail corridor.
Lead Agencies: Friends of the West River Trail
Funding options: private foundations, land trusts
Timeline: On-going

33. Recommendation: Pursue the purchase of the land or of easements for permanent river access to sites under private property ownership.
Strategies:
1) Research riverfront property owners at access sites.
2) Contact owners and provide information on easements for river access.
3) Work with willing property owners to secure access easements.
Lead Agencies: VDEC, WRWA, VLT
Funding options: private foundations, land trusts, Vermont Watershed grants
Timeline: 2008 - 2011

34. Recommendation: Develop user education programs on respectful and safe river use and access.
Strategies:
1) Post Pack-in/Pack out signs and reminders along access trails where feasible.
2) Hire summer interns through the towns or the WRWA to monitor areas during summer months.
3) Distribute VANRs publication "Public Access on Private Land" to adjacent landowners to inform them of Vermont's liability laws regarding public access.
Lead Agencies: Rock River Preservation , WRWA, Friends of the West River Trail
Funding options: private foundations
Timeline: On-going

35. Recommendation: Work to reduce traffic and parking problems and increase pedestrian safety at swimming hole access sites.
Strategies:
1) Develop site plans for alternative parking.
2) Develop and install safe pedestrian crossings at all road crossings.
3) Test alternative paving surfaces, such as permeable pavers to maintain pervious surfaces at site.
Lead Agencies: VTrans, WRC, NRCDs, Towns of Dummerston & Newfane, other municipalities
Funding options: Transportation Enhancement grant, municipal budgets

Timeline: 2008 - 2012
36. Recommendation: Work with the Town of Londonderry to investigate and remediate bacteriological inputs into the West River.
Strategies:
1) Conduct a sanitary survey of area to determine cause.
2) Do targeted bacteria sampling to narrow area of impact.
3) Work with homeowners, business owners and others to address documented problems.
Lead Agencies: WRWA, VDEC, NRCDs, Town of Londonderry
Funding options: USDA-Rural Development planning and implementation grants
Timeline: 2008 - forward

37. Recommendation: Work with the Student Conservation Association and Vermont Youth Conservation Corps on remediation projects.
Strategies:
1) Create list of erosion, pollution and other projects that could be addressed with a youth labor force.
2) Contract with SCA and VYCC for project work.
Lead Agencies: NRCDs, VDEC, WRWA, SCA, VYCC
Funding options: VDEC/VYCC grants, SCA, private foundations
Timeline: On-going

Rock River Recommendations:
38. Recommendation: Coordinate partners in developing comprehensive long-term site management plan specific to the Rock River.
Strategies:
1) Draft proposed strategies to present to Dummerston and Newfane town officials.
2) Work with local and State agencies to develop solutions.
3) Work with Student Conservation Association and Vermont Youth Conservation Corps for technical and labor assistance.
Lead Agencies: NRCDs, WRC, VDEC, VTrans, Towns of Dummerston and Newfane, Rock River Preservation , WRWA
Funding options: Transportation Enhancement grants, Vermont Watershed grants, municipal budgets
Timeline: 2008 - 2012

39. Recommendation: With input from town officials, local and state agencies and organizations develop a plan for addressing parking and erosion issues in the Rock River.
Strategies:
1) Explore feasibility of conducting a Recreational Study relative to parking at swimming hole sites. - Consider limits to public access to foster protection of natural resources.
2) Explore feasibility of pedestrian crossing under Route 30 bridge and trail expansion through neighboring properties.
3) Facilitate communication between towns and VTrans to solicit agency involvement to develop strategies.
4) Arrange regular meetings with town officials, local and state agencies, and technical

professionals.
5) Examine ways to reduce traffic congestion and parking problems:
    a.) Consider No Parking zones on north bound side of Route 30;
    b.) Build parking areas with designated parking places and confined access;
    c.) Encourage state police enforcement of No Parking zones;
    d.) Consider the alternative of WRWA volunteer ticketing in No Parking zones;
    e.) Consider shuttle service from Maple Valley ski area on high-use weekends.
6) Examine studies on salmon habitat improvement relative to human disturbance.
7) Conduct site visits with SCA and VYCC experts to plan and implement trail maintenance projects.
8) Examine "Rock River Festival" ideas to promote alternative activities.
9) Develop West/Rock confluence beach into a more attractive swimming site to attract bathers away from the Rock River.
10) Work with towns to institute vendor permitting or prohibit vendors at access areas.
Lead Agencies: NRCDs, VTrans, town Conservation Commissions, Rock River Preservation, CRWC
Funding options: Transportation Enhancement grant, VTrans
Timeline: 2008 - 2011

40. Recommendations: Develop Rock River Education Program to foster river stewardship.
Strategies:
1) Identify and expand Rock River swimming hole user email/website networks.
2) Contact websites that currently advertise Vermont Swimming Holes:
    a.) Educate the website producers of impacts of site advertising,
    b.) Suggest "limited access" verbiage be added to available information.
3) Create informational kiosks at Williamsville Station.
4) Post Pack-in/Pack out signs and reminders along access trails.
5) Write newspaper articles to build public awareness.
6) Lead workshops and talks on river stewardship.
Lead Agencies: WRWA, Rock River Preservation, NRCD,
Funding options: private foundations
Timeline: On-going

41. Recommendations: Install composting toilets along the access trail to deter untreated waste being washed into the river.
Strategies:
1) Identify appropriate locations for facilities.
2) Install and maintain facilities.
Lead Agencies: Rock River Preservation, NRCD, WRWA, VDEC
Funding options: private foundations, Transportation Enhancement grant, VTrans
Timeline: 2008 – 2011

4.4 Roads and Road Maintenance

Roads and road maintenance relative to water quality were examined within the context of the Watershed Council's roundtable discussions. Participants included VDEC Water Quality Division, VTrans, the Vermont Local Roads Program, WRC, SWCPRC, town road supervisors and planning commissions, ski areas, WRWA, private consultants, and interested residents.

4.4.1 Roads - Erosion and Sediment Problems

In addition to the amount of land covered by transportation and utilities, which creates impervious surfaces and alters natural runoff patterns, the location of roads is often the cause of impacts to rivers and streams. Since colonial days, the river corridor and floodplain have often been the easiest route to construct roads. Roadways and railways built along side stream channels often purposefully straightened the stream channels. Straightening in this manner causes stream bank instability, erosion and increased water volume, which can destabilize areas downstream (VANR 2003). The road and rail embankments block the stream's ability to access its normal floodplain during high water.

In Vermont, more than 65 percent of local town roads have unpaved, graveled surfaces. Every road or driveway, paved or unpaved, can become a conduit for rainwater or snowmelt, eroding the road and shoulder material and carrying it to nearby streams and lakes – introducing sediment and phosphorus to lakes and streams. Soil erosion occurs when soil particles are carried away from the road bank, ditch, or road base by water, wind, ice, or gravity. Exposed soil, rapid water velocity, and fine sands and silts, all increase the potential for soil erosion. Other pollutants such as oil and grease can also be washed from roads. These sediments and pollutants are then carried away into nearby streams and ponds. Graveled roads, if not properly managed, can contribute heavily to water pollution (VANR1995).

4.4.2 General Road and Road Maintenance Issues

In the last 100 years Vermont's population has increased from approximately 325,000 to over 650,000 people. The current development boom continues, but given the state's mountainous topography and it's "river roads", it is not likely that many new highways will be constructed to accommodate the continuing influx of new residents and their vehicles. "We have to work with what we have" (personal communication, Hoffman, 2005).

Greater traffic volume and higher speeds on gravel roads can greatly impact surface integrity, reducing the life of road repairs and grading. Initially expensive to lay, paved roads are generally cheaper to maintain, however eventual repairs are more costly. Gravel roads are cheaper to construct and, if built properly, cheaper to maintain but some, because of need for frequent repair, can be more expensive in the long run. Every town has its stretches of roadway that require almost constant attention from the highway department. While both paved and gravel roads are considered to be impervious and water must drain into roadside ditches, paved roads often cause more of an increase in velocity and flow.

4.4.3 Culvert Issues

Town maintenance departments are confronted with the task of locating and assessing all culverts within their municipal boundaries. Currently, about 80 percent of Vermont towns have conducted some kind of culvert inventory. When culvert inventories are conducted, towns frequently discover inadequate structures. Many culverts are undersized or ill-positioned and inadequate for the water volumes they need to carry. Road improvement projects to handle increasing traffic volumes are sometimes impossible due to older "short" culverts that can not accommodate road widening or drainage improvements. It was reported that an estimated 60 or 70 percent of existing culverts are too short to increase road widths. Landowners are often averse to granting permission to increase culvert size (length or diameter) in driveways or on adjacent roadways. With trends toward more intense storm events and higher flow volumes on a more frequent basis, towns are facing flooding and washouts with more costly road and culvert repairs every year and our rivers and streams are facing greater discharges of sediments.

Culverts may also be a barrier to fish passage when the end of the culvert is not at the same level as the stream. Most fish cannot jump the vertical distance up to the mouth of a hanging culvert to pass upstream to spawning areas or cool upstream waters during the summer.

Beaver activity may block culverts requiring repeatedly cleaning away material and may possibly road lead to damage and erosion. A more long-term solution to this problem may be to install and maintain water control structures (such as the use of piping to serve as a siphon to lower the water level in the beaver pond) or exclusionary devices. Removing the beaver population in good habitat will likely only result in new beavers moving in.

4.4.4 Safety and De-icing Issues

Over 100,000 tons of sodium chloride (salt) are applied to state roads yearly for de-icing purposes. Road salts applied to roadways can enter air, soil, groundwater, and surface water from direct runoff and snowmelt, release from surface and streambed soils, and from wind-borne spray. These salts remain in solution in surface waters and are not subject to any significant natural removal mechanisms (EC, 2001). Their accumulation and persistence in watersheds pose risks to aquatic ecosystems and to water quality. Approximately 55 percent of road-salt chlorides are transported in surface runoff with the remaining 45 percent infiltrating through soils and into groundwater aquifers (Church and Friesz, 1993).

Recommendations that Address Road and Road Maintenance Issues

42. Recommendation: Increase awareness of maintenance measures that will reduce back road erosion.

Strategies:

1) Promote participation in the Better Back Roads and Local Roads programs.

a.) Conduct Better Back Roads and VTrans workshops with town officials and highway managers.

b.) Develop and promote the Road Foreman Network to grow the support network between towns and state agencies and federal agencies.

2) Provide funding to conduct workshops for select boards and other town officials on erosion control techniques and policies to support these techniques.
3) Assist towns with completing road capital budgets to better plan for maintenance needs
4) Encourage the maintenance of beaver ponds and other wetlands which act as sediment traps and nutrient sinks.
Lead Agencies: VTrans, RPCs, NRCDs, municipalities
Funding options: Better Back Roads grants, Local Roads program
Timeline: On-going

43. Recommendation: Facilitate cooperative purchasing and sharing of "high-ticket" equipment and vehicles between neighboring towns (such as liquid de-icing equipment, hydroseeder).
Strategies:
1) Work with towns to coordinate equipment needs and purchases.
Lead Agencies: VTrans, RPCs, NRCDs, municipalities
Funding options: Better Back Roads grants, municipal budgeting
Timeline: On-going

44. Recommendation: Work with towns to determine the location, existing condition, and capacity of bridges and culverts in Basin 11.
Strategies:
1) Work with towns to conduct bridge and culvert assessments using Vermont DEC Stream Geomorphic Assessment protocols.
    a.) Develop GIS data layer to map sites, highlighting sites of concern,
    b.) Prioritize and target bridge and culverts in need of replacement or repair.
2) Provide funding to provide workshops on capital budget planning for road managers.
Lead Agencies: VTrans, RPCs, NRCDs, TNC, municipalities
Funding options: Better Back Roads grants, River Corridor grants, Vermont Watershed grants, CWA Sec. 319 grants, transportation grants
Timeline: On-going

45. Recommendation: Educate municipal, regional and state road agencies regarding polluted runoff from snow removal and snow dump sites.
Strategies:
1) Create and distribute educational materials on contaminants contained in snowmelt.
2) Create guidelines for snow disposal and snow disposal storage sites.
3) Inventory snow dump sites in the Basin.
Lead Agencies: VTrans, RPCs, NRCDs
Funding options: Better Back Roads grants, River Corridor grants, transportation grants, private foundations
Timeline: 2008 - 2010

46. Recommendation: Research and test alternative de-icing products to reduce the use of sodium chloride on roads.
Strategies:
1) Research alternatives to salt.

2) Conduct trials of alternatives to determine the best products for Vermont road conditions.

Lead Agencies: VTrans, RPCs, municipalities
Funding options: Better Back Roads grants, River Corridor grants, transportation grants
Timeline: On-going

4.5 Dams and Impoundments

The Basin 11 Watershed Council continued its examination of watershed issues in the West, Williams, and Saxtons Rivers with the creation of a discussion group that reviewed the situation regarding dams and impoundments. The so-called Dam Focus Group, which met in 2004 and 2005 was composed of interested stakeholders, including technical experts from the USACE, the VANR, the USFWS, TNC, CRWC, as well as representatives of local organizations, recreation groups and concerned residents. In its discussions, the Dam Focus Group also considered other smaller but notable areas that experience flow-related problems, especially those areas where aquatic life is impacted.

4.5.1 Sedimentation

Sedimentation resulting from dam operations was recognized by the focus group as a prime water quality issue. Sediment tends to accumulate behind all dams. The increasing amounts of sediment can cause channel alterations upstream as well as downstream impacts if they are released. In the case of the two USACE flood control dams at Townshend and Ball Mountain, the Ball Mountain Dam is a bottom-release operation, while the Townshend Dam is weir controlled. A weir structure provides time for particles to filter from the water column before the water goes over the weir and through the gates. The bottom-release allows varying amounts of sediment to move through the gates with the regulated flows. Although no accurate measurements are known, it is possible that at the Townshend and Ball Mountain Dams, approximately two thirds of the reservoir capacity may be lost to sediment storage. However there is still another 150 feet of storage space available. According to USACE staff, no dredging is planned at this time.

4.5.2 Altered Flow

Streamflow and water level fluctuation can have significant effects on aquatic habitat and biota, aesthetics, streambank stability and other uses and values of the state's waters. Activities that alter the **natural flow** and water levels include water withdrawals for municipal, domestic, agricultural or industrial uses, hydroelectric and flood control dams, and the operation of dams used for other purposes.

Decidedly, one of the most controversial environmental issues in the West River is the impact of stream flow altered by flood control operations at the two USACE flood control dams. The Vermont ANR and many local environmental groups are concerned that the irregular, artificially-induced flow patterns that are the result of operations (flood control and reservoir water level adjustments) at the Townshend and Ball Mountain dams adversely impact the aquatic biota and physical habitat of the river. Precise flow regulation at Ball Mountain is difficult due to the large size of the gates which were designed for flood control regulation, not providing natural flows. The COE has agreed to provide instantaneous run of the river flows as much as possible and a

variety of options are being explored to more closely meet run of river flows

The USACE, U.S. Fish and Wildlife Service, and Vermont ANR have agreed on a Coordination Plan that addresses some of the major water quality issues identified as resulting from USACE dam operations. The agreement is included as Appendix A.15.

In another long-term cooperative effort for the West River, The Nature Conservancy (TNC), in collaboration with the WRWA, identified three strategies critical to conserving and restoring specific conservation targets. They are 1) restoration of ecological flows in the West River, 2) removal of barriers to fish passage throughout the watershed, and 3) improvement of the riparian condition (banks and floodplains) of the mainstem and tributary streams. Within this context TNC has worked extensively with the USACE to initiate a Sustainable Rivers Program for the West River. This is a six step process that incorporates the needs of natural ecosystems with human needs, and identifies potential areas of conflict and ways to resolve those conflicts. Over the last two years, TNC has assembled and analyzed existing data on the West River's flow regime under present management conditions, identified key aquatic organisms most sensitive to disrupted flows, and conducted interviews with experts.

4.5.3 West River Whitewater Releases from USACE Flood Control Dams

The Basin 11 Watershed Council examined the issue of water releases from USACE Ball Mountain flood control dam on the West River. Water-based recreation of whitewater kayaking, canoeing, and rafting has been popular in the West River for decades where the naturally occurring rapids and swift currents offer exciting river sport. The flood control operation of the USACE dams beginning in 1961 offered a more predictable timetable for high flows to whitewater groups throughout New England. Several organizations with interests in promoting their sport –American Whitewater, Appalachian Mountain Club, New England Flow and the Vermont Paddlers Club – worked release agreements with the USACE for their memberships over the years. Releases are scheduled and advertised for one weekend in the spring and one weekend in the fall when the USACE releases a sufficient volume to create whitewater conditions from the Ball Mountain and the Townshend Dams. These bi-annual release events have brought hundreds of river enthusiasts to the West River each year with significant economic benefit for recreation-based enterprises in several river-side towns, as well as private and public campgrounds in the area.

However, as mentioned above, these releases can have significant effects on aquatic habitat and biota, aesthetics and other uses and values of the state's waters. Over the last fifteen years, scientists and river ecologists in many areas of the country have conducted habitat and flow studies to determine impacts to rivers from high volume whitewater releases. Evidence shows there are adverse impacts to aquatic habitat and biota from rapid increases and decreases in river flow. (See Appendix A.15.)

Although no site specific flow studies have been conducted to define impacts of whitewater releases in the West River, the VANR and USFWS consider existing evidence and related studies as sufficient and have worked with the USACE to reduce the number and flow volume of the annual whitewater releases at Ball Mountain Dam. The three agencies are implementing a three-

year adaptive management process to use as a framework for identifying and resolving issues of concern. The goal of the process is to evaluate current operational and maintenance practices and identify ways to maintain and restore the integrity of the downstream and upstream aquatic and terrestrial ecosystems while maintaining the projects' primary purpose of flood control and recognizing other recreation and natural resource management objectives. (See Appendix A.15.)

4.5.4 Dam Removal

Many of the 38 dams in Basin 11 are small and are operated "run-of-river," that is, they do not manipulate flows or water levels. These and other old dams create barriers to the movement of fish throughout the basin, threatening Atlantic salmon restoration as well as the viability of other anadromous fish populations and preventing the movement of resident fish and other aquatic organisms. Some of these dams no longer serve their original purpose of hydropower, recreation, or water supply and are falling into disrepair. Obsolete dams may create public safety hazards by exacerbating flooding upstream or causing significant flood damage downstream in the event of failure. They are also economic and legal liabilities for their owners.

Removal of unneeded dams can reap significant benefits and is often less expensive than repair or reconstruction. Restoration of aquatic river habitat, lower water temperature and enhanced fisheries are some of the benefits of dam removal.

Dams considered for potential removal in Focus Group discussions:
<u>West River</u>
1) Williams Dam, Londonderry – deteriorating, no current use, blocks fish passage, accumulates sediment, potential safety hazard. Possible historic-designation issues.
2) Weston Ponds, Weston – blocks fish passage, aesthetically appealing. Need public education about benefits of natural run.
<u>Saxtons River</u>
3) Breached dam remnants under Route 5 bridge, Bellows Falls– engineering plans in place to remove existing defunct structural remains.

No funding has been allocated for removal of these dams. There are state and federal grant funds available on a competitive basis for dam removal projects that may be applied for.

4.5.5 Hydro Power Generation

<u>Williams River</u>
Brockway Mills in Rockingham is the only dam in the Basin used to generate hydroelectric power. Privately owned and operated, the dam has FERC Licensing until 2032. In 2003, the plant generated 1.6 million kwh of electricity. The owner/operator is working to comply with state requirements and has installed temporary downstream fish passage to allow salmon smolts to migrate downstream as well as addressing other issues.

Recommendations to Address Dams and Impoundment Issues

47. Recommendation: Host annual informational meeting of all dam partners to update and address operational and environmental progress.
Lead Agencies: VDEC, USACE, Utilities, TNC, VT Dam Task Force
Funding options: NA
Timeline: As needed

48. Recommendation: Support congressional funding initiatives for replacement of the Ball Mountain dam gates and structural modifications to enable "run of river" flows.
Lead Agencies: VDEC, USACE, TNC, WRWA
Funding options: NA
Timeline: Until installed

49. Recommendation: Determine the impacts of the West River flood control dams on aquatic biota and physical habitat upstream and downstream from the USACE dams.
Strategies:
1) Conduct physical geomorphic stream assessments and biological studies.
2) Monitor compliance and enforcement of the West River flood control dams with the coordination plan in place with VANR and USFWS.
Lead Agencies: TNC, USACE, VDEC
Funding options: TNC, River Corridor grants, USACE
Timeline: 2008 - 2011

50. Recommendation: Complete assessments of all dams in the basin to identify potential candidates for removal.
Strategies:
1) Identify and map all dams in the basin and use this data to update the VANR dams inventory database.
2) Evaluate individual dams with potential for removal projects and develop removal plans in cooperation with the dam owner and local community.
3) Identify dams that provide significant public benefits that can be modified to address environmental impacts rather than removed.
4) Carry out assessments of dams in the basin where there is expressed interest in potential hydropower development to identify candidates for further investigation of micro-hydropower generation.
5) Determine whether Invasive Aquatic Plants exist in an impoundment prior to dam removal, and plan how to minimize their transport downstream.
Lead Agencies: RPCs, NRCDs, WRWA, VDEC, VDFW
Funding options: NOAA, private foundations
Timeline: 2008 - 2011

51. Recommendation: Remove obsolete and non-essential impoundment structures.

Strategies:
1) Identify one high priority barrier with high likelihood of successful removal and restoration, to use as a model for additional dam removal projects throughout the watershed.
2) Create partnerships with TNC, CRJC, CRWC, WRWA, private contractors and volunteers to work on dam removal projects.
Lead Agencies: RPCs, NRCDs, WRWA, VDEC, VDFW
Funding options: NOAA, private foundations
Timeline: 2008 - forward

52. Recommendation: Provide public outreach and river stewardship education pertaining to the adverse impacts of rapid releases from flood control dams on stream habitat, biota and water quality.
Lead Agencies: CRWC, WRWA, TNC, VDEC, VDFW
Funding options: CRWC, CRJC, private foundations
Timeline: 2008 - 2010

53. Recommendation: Coordinate Federal and State agency meetings to address flow impairment of Flood Brook due to Hapgood Pond impoundment.
Lead Agencies: VDEC, USFS
Funding options: N/A
Timeline: 2009 - forward

54. Recommendation: Conduct water quality sampling at bi-annual white water releases.
Lead Agencies: WRWA, VDEC
Funding options: LaRosa grant, CRJC, private foundations, paddling organizations
Timeline: 2008 - forward

55. Recommendations: Work with towns along the West River mainstem to develop and promote a week-long area-wide River Festival to replace lost revenue from reduction of USACE whitewater release events.
Lead Agencies: WRWA, municipalities
Funding options: private foundations, VFPR
Timeline: On-going

4.6 Water withdrawals

Within the context of the Watershed Council's roundtable discussions, issues pertaining to water withdrawals in Basin 11 were examined. Protecting groundwater is imperative because groundwater is currently used for drinking water by approximately 70% of all Vermonters. About 46% of the state's population is self-supplied (private wells), while about 24% is served by public water systems that use groundwater. The rest (30%) rely on surface water as their source of drinking water (VDEC 2005).

Participants in the discussion provided the following information pertaining to water withdrawals. Data describing water withdrawals and estimated water use are generally reported at the county-

level. Table 4-2 shows water withdrawals reported during 2000 in Windham County.

Table 4.1 Water Withdrawals – in Millions of Gallons per Day - Freshwater in Windham County

2000	Surface-water	% of Total	Ground-water	% of Total	Acres Irrigated
All Uses	358.45	100%	3.88	100%	----
Irrigation	0.32	0.09%	0.03	0.77%	570
Livestock Watering	NA	----	NA	----	----
Public Supply	1.99	0.56%	1.23	31.70%	----
Domestic Supply	0	0.00%	2.11	54.38%	----
Industrial	1.96	0.55%	0.51	13.14%	----
Mining	NA	----	NA	----	----
Thermoelectric*	354.18	98.81%	0	0.00%	----

USGS 2000 Water Use for Windham County In Mgal/d

http://water.usgs.gov/watuse/data/2000/vtco2000.xls NA = Not Available

* It is important to note that the Thermoelectric withdrawal amount pertains to the Connecticut River and NOT the West River.

4.6.1 Agricultural Uses

Water from the West, Williams and Saxtons Rivers is an important resource for agriculture in the Basin. Access to water for crop irrigation and animal watering is crucial to area farmers. In 2002, USDA reported that 71 Windham County farms were doing some type of irrigation on 336 acres of crops. This is an 800% increase over the 9 farms & 55 acres that were irrigated 20 years ago. Between 1985 and 2000, the number of acres under irrigation in Windham County has doubled from 170 to 340 million gallons per day.

USGS tracks water use by watershed and county, though the most recent data is only available by county. Water withdrawals for irrigation and animal watering purposes combined make up less than 1% of the total withdrawals in Windham County.

Table 4.2 Windham County - Water Withdrawals (Mgal/Day)

	Year	Ground Water	Surface Water	Acres Irrigated
All Uses	1985	5.28	20.94	
	1990	3.14	18.22	
	1995	3.64	4.02	
	2000	3.18	2.7	
Irrigation	1985	0	0.08	170
	1990	0.01	0.13	530
	1995	0.04	0.32	610
	2000	0.02	0.22	340
Livestock	1985	0.81	0.27	
	1990	1.03	0.34	
	1995	0.88	0.29	
	2000	nr	nr	

nr - no record

4.6.2 Ski Industry

There are three major ski resort areas in Basin 11, Stratton Mountain Resort, Bromley Ski Area and Magic Mountain development all drain, in whole or on part, into the West River. Each makes significant surface and groundwater withdrawals. All three withdraw water for drinking water and snow-making purposes and also have wastewater systems that include permitted spray fields. Maple Valley Ski area, currently not operating, also has a snowmaking withdrawal permit that could be re-activated at some time in the future. Planned and future ski area expansions may require additional water for snowmaking and construction of new snowmaking ponds. New regulations require ski areas to bring their surface water withdrawals into compliance with minimum flow regulations as part of any new or expanded snowmaking. Ski areas in the region have also become heavily involved in the construction of resort housing and year-round recreational facilities, causing significant demands for potable water supplies and sewage disposal.

Along with at least nine drilled wells used for drinking water and snowmaking, Magic Mountain also withdraws water from Thompsonburg Brook, which is held in a storage pond for snowmaking.

Stratton Mountain Resort uses water from Stratton Lake to irrigate its 27-hole golf course located in Winhall and to provide water for snowmaking on the mountain. Water is withdrawn from the Winhall River in accordance with VANR snowmaking rules, stored in a 150 million gallon pond in Winhall and pumped to Stratton Lake as needed. Stratton Lake is also replenished from rain and melting snow via the three tributaries to the lake. Stratton has projected 432 million gallons of water withdrawals annually for snowmaking to cover 91 percent of its ski trails. The resort estimates that it has enough domestic water supply capacity to meet its permitted Master Plan "build-out" goals, drawing water mainly from 18 drilled wells and three constructed reservoirs. There are also several fire protection ponds spread throughout the property. Concern has been expressed over the cumulative impact on surface water levels from the water supply well

withdrawals from five of Stratton's wells, all of which are within a Class A1 watershed. Testing results showed flow in Kidder Brook was reduced to very close to the minimum permissible in Class A1 waters.

Bromley has four bedrock wells for the resort area's residential use, providing 12 million gallons/year – close to 40,000 gallons/day. Bromley's snowmaking operation draws 90 million gallons per year from groundwater aquifers. Snowmelt is channeled by swales into a staging pond and then pumped back for resort use. Current plans to develop an "East Village" residential/commercial area include an additional storage pond. The entire 300-acre drainage basin is surrounded by U.S Forest Service lands. Although all facilities and activities related to the resort's snowmaking and water usage adhere to existing permit requirements, Mill Brook and a tributary to it, located below Bromley's storage pond are considered altered due to "artificial and insufficient flow."

4.6.3 Water Supply and Source Protection

The Water Supply Division of the VDEC has a federally approved Source Water Assessment Program. This program includes many of Vermont's pre-existing requirements for protection of public groundwater and surface water sources, and incorporates several new elements necessary to meet the federal requirements of the Source Water Assessment Program. The Source Water Assessment Program was developed with the help of a Technical and Citizen's Advisory Committee which included representatives from state agencies, independent consultants, environmental groups, and water system representatives.

Public Water Systems

Vermont's Source Water Assessment and Protection Program includes different requirements for the three different types of public water systems. In Vermont, a Source Protection Plan (SPP), includes the delineation of the protection area, an inventory of the potential contaminants of concern in that area, and an assessment of the susceptibility of the drinking water source to contamination. These are required under the federal program. Vermont also requires a management plan for the potential risks and a contingency plan.

The three types of public water systems include:

- A Public Community (C) Water System which could be a municipality, mobile home park, or retirement community which serves at least 25 residents year round or has at least 15 service connections.
- A Non-transient, Non-community (NTNC) Public Water System which could be a school, factory, or office building with their own source of water that serves at least 25 of the same people more than six months per year.
- A Transient, Non-community (TNC) Public Water System which could be a restaurant, motel, or campground which serves 25 or more people a day more than 60 days a year.

In Basin 11 there are 17 Community, 18 NTNC and 51 TNC systems.

Source Protection Plans are required for Community and NTNC water systems throughout the state, and are recommended for TNC water systems. The Water Supply Division is available to

provide technical assistance in preparing the SPPs. Because SPPs deal with potential human health issues, the State strictly and rigorously enforces them to protect public water supplies. However, drinking water sources may be threatened by pollutants beyond what the water system's SPPs are able to cover. Independent management of adjacent land use is a critical factor in protection of both surface and groundwater sources. Contamination must be prevented before it enters the source water to prevent health problems and reduce costs of contaminant remediation. Many public water suppliers do not have total control over land use in areas either surrounding, or up hill of their source water areas.

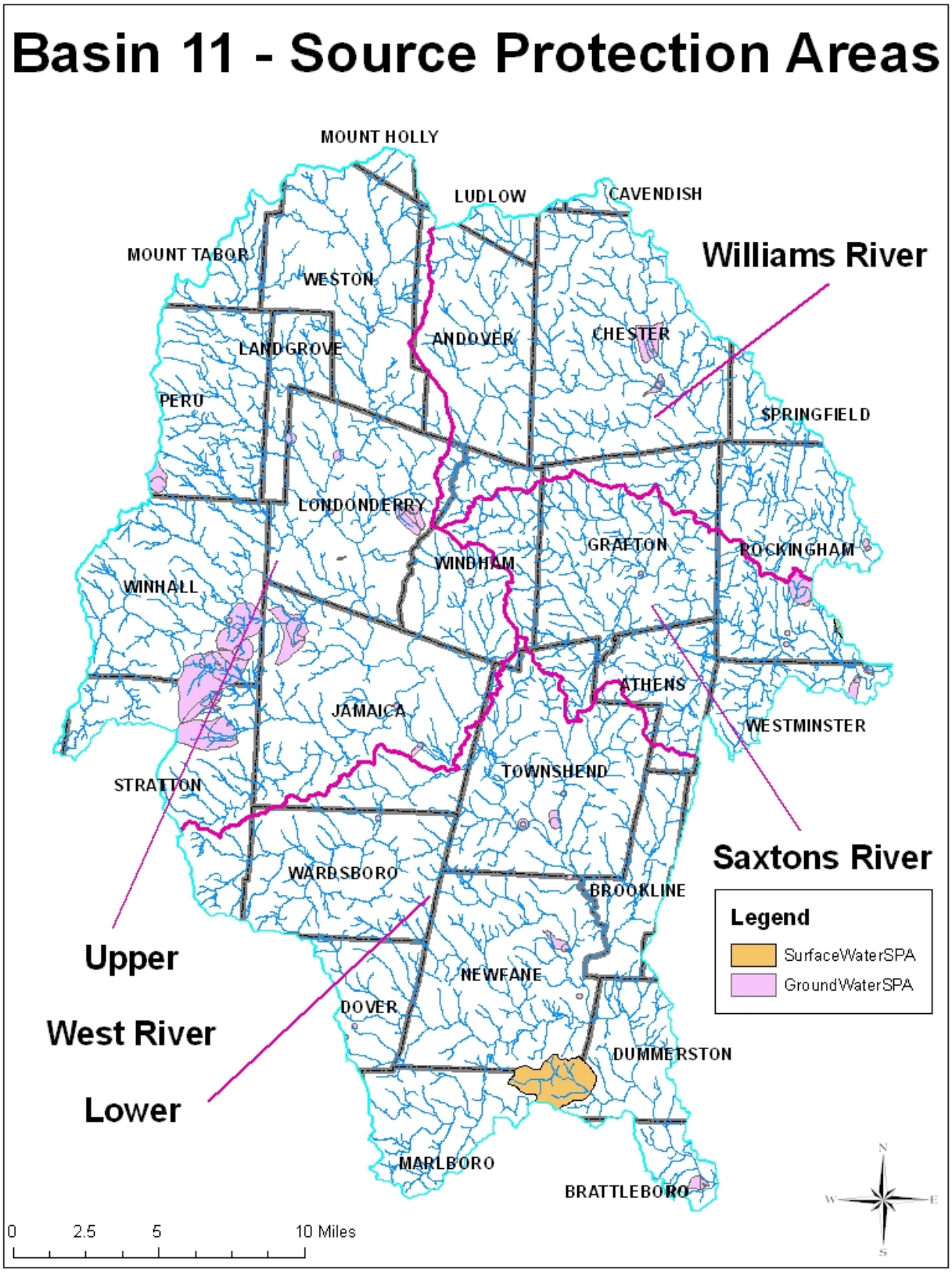


Figure 4 – Drinking Water Source Protection Areas

4.6.4 Municipal Water Systems

The largest municipal water system in Basin 11 is the Town of Brattleboro where Sunset Lake in Marlboro is the prime source of drinking water. The lake outlets into Stickney Brook. From Stickney Brook an inter-basin transfer diverts flow into the Pleasant Valley Reservoir in the Whetstone Brook watershed (Basin 13) which supplies 1.7 million gallons of water per day to the town. Due to this diversion which leaves Stickney Brook seasonally devoid of flow, it is listed as in the 2006 List of Priority Surface Waters as being altered by water flow levels. Four groundwater wells located in the Retreat Meadows are maintained as back-up water supply reserve. Many other towns have village water systems.

Recommendation that Address Water Withdrawal and Groundwater Protection Issues

56. Recommendation: Assess all basin public water sources to determine surrounding land use and the feasibility of establishing protection zones around source areas through purchase, easement or land conservation.
Strategies:
1) Work with the towns of Brattleboro and Marlboro to increase protection of the Sunset Lake watershed.
2) Work with municipalities to develop zoning regulations in source water areas that protect groundwater resources.
Lead Agencies: RPCs, municipalities
Funding options: USDA – Rural Development, VDEC/Water Supply Division
Timeline: 2008 - 2011

57. Recommendation: Given development pressures in sensitive watershed areas, fire districts and other potential water uses that could be developed, investigate studies to determine water resource capacity and capacity limits.
Strategies:
1) Map aquifers throughout the Basin.
2) Through scientific study in conjunction with the Vermont Geological Survey determine aquifer capacity and withdrawal limits.
3) Base permitting and zoning determinations on aquifer capacity.
Lead Agencies: VGS, VDEC, RPCs, municipalities
Funding options: USDA – Rural Development, VDEC/Water Supply Division, VGS
Timeline: 2008 - 2010

58. Recommendation: Assist VDEC's Source Water Protection Program in their on-going work with town governments and their road maintenance departments to establish "low-salt" zones along roads within source protection areas.
Lead Agencies: VDEC, RPCs, municipalities
Funding options: VDEC Water Supply Division, VTrans
Timeline: 2008 - 2010

4.7 Watershed Education

A watershed education focus group was formed early in the Basin 11 planning process. Drawing from a wide range of community and state education organizations, the group defined and identified issues as well as developed far-ranging and creative ideas that offered practical and noteworthy solutions to many problems.

4.7.1 Public Outreach Issues

Recognizing that a lack of information and general misunderstanding of watersheds and water quality issues often make it difficult to convey meaningful messages about local environmental problems, it is clear that public education and outreach are critical to successfully implementing and sustaining all types of water quality programs. Major watershed education issues identified included:

- Communicating water quality issues to the general public;
- Reaching the "unconverted" to promote better understanding and involvement;
- Enhancing coordination between community groups with similar water quality goals; and
- Locating funding for local projects and programs.

4.7.2 Watershed Education in Local Schools

During the spring of 2004 and in the midst of the Education Focus Group discussions, the Vermont Department of Education released its latest version of the curriculum standards, Vermont's Framework of Standards and Learning Opportunities. With this approach to developing public school curriculum, the standards allow teachers to integrate community-based activities into lesson-plans and classroom studies, opening the door to incredible learning opportunities at all K-12 levels. Using state-defined "grade-level" expectations as their guides, teachers can incorporate watershed and river stewardship projects and activities into their everyday class room lessons. However, one of the main obstacles identified by the Education Focus Group is the lack of information about specific community organizations and the programs they offer schools. There is the need for a central repository of information for Basin 11 public and private school teachers to highlight community organizations and agencies and their available resources to expand watershed education activities in schools.

Vermont's Framework of Standards and Learning Opportunities can be found at:
http://education.vermont.gov/new/pdfdoc/pubs/framework.pdf

Recommendations that Address Watershed Education Issues

59. Recommendation: Raise public awareness of the watershed concept and the connections that residents of each river basin have to the watershed.

Strategies:

1) Post WRWA WQ sampling results and maintain kiosk educational displays.
2) Prepare WRWA annual water quality monitoring report and distribute it widely.
3) Write press releases and informational articles for local news media.
4) Create, promote and publicize WRWA watershed website and events calendar.

5) Link events to public access TV, create info-commercials about water quality monitoring, river issues, and local initiatives.
6) Develop public service announcements – "River Minutes."
7) Assist with and support river-related festivals and events such as Herrick Cove Wildlife Festival, etc.
8) Create Community Watershed Bulletin - e-board, e-blackboard.
9) Use new Waypoint Visitors Centers to focus watershed based activities.
10) Assist and support Annual River Clean-Up's throughout the Basin.
Lead Agencies: WRWA, community organizations
Funding options: private foundations
Timeline: On-going

60. Recommendation: Increase public involvement in watershed projects and planning.
Strategies:
1.) Undertake specific targeted watershed restoration or project activities.
2.) Promote/ enhance/ encourage and provide incentives for municipal planning and zoning efforts with regard to water quality issues.
3) Coordinate ways for local organizations to pursue opportunities for volunteer service.
4) Work with Friends of the West River Trail to enhance the educational aspect of the West River Trail.
5) Support salmon restoration and monitoring in the basin.
6) Hold workshops on Low Impact Development practices.
7) Work with the Better Backroads and Vermont Local Roads programs to develop further educational programs for back road maintenance.
8) Work with landowners to identify appropriate agricultural and habitat assistance programs.
9) Develop River Stewards and Adopt-A-Swimming Hole programs.
Lead Agencies: WRWA, community organizations
Funding options: private foundations
Timeline: On-going

61. Recommendation: Create a clearinghouse for watershed education resources available within the Basin 11 area.
Strategies:
1) Create a watershed newsletter or interactive website for area teachers and other educational professionals.
2) Develop a web-based Watershed Educator Resource Directory.
    a.) Work with VT StateWide Environmental Education Programs (SWEEP) to enhance the SWEEP Directory.
Lead Agencies: WRWA, community organizations
Funding options: private foundations
Timeline: 2008 - 2010

62. Recommendation: Coordinate educational efforts between teachers and local organizations with existing watershed education programs.

Strategies:
1) Coordinate with local and statewide environmental education programs.
2) Expand student education opportunities for area high schools – set up special water quality monitoring programs using student projects.
3) Promote the Envirothon program sponsored by the NRCDs that advances both instruction and friendly competition between schools on environmental issues including water quality.
4) Develop watershed-oriented "Kids Fairs" that highlight educational programs, activities, and internships with local organizations and businesses.
5) Sponsor Project WET and Project WILD-Aquatics workshops for teachers.
Lead Agencies: WRWA, community organizations, NRCDs, SWEEP
Funding options: private foundations
Timeline: On-going

63. Recommendation: Increase public awareness of the character and challenges to the watersheds and water quality by increasing general "watershed appreciation."
Strategies:
1) Offer a series of presentations, workshops and field trips on topics such as local agriculture, historical and geological features, and recreational uses (canoeing/kayaking, rowing, fishing, birding, diving, hiking, etc.).
2) Promote uses of and activities in and on the rivers to increase people's connection to the waterways.
Lead Agencies: WRWA, community organizations, NRCDs, SWEEP
Funding options: private foundations
Timeline: On-going

5. Waterbodies Impaired on the 2006 Section 303(d) List of Waters

Under USEPA guidance and federal regulations, impaired waters must be identified by the State and reported under Section 303(d) of the Clean Water Act. These waters are so designated based on data that show them to be out of compliance with Vermont Water Quality Standards due to one or more pollutants. All waterbodies identified as impaired in the State's 303(d) list are scheduled for the development of a TMDL (Total Maximum Daily Load) pollution source control plan. These control plans identify the pollution sources, determine a numeric target to be reached for each pollutant to bring the waterbody into compliance with the Water Quality Standards, allocate the load of each pollutant to meet that numeric target, and develop a monitoring plan to determine when compliance has been achieved and the waterbody is no longer impaired.

If the waterbody is identified as impaired but has specific regulatory measures in place that are likely to bring it into compliance with Vermont Water Quality Standards, it is not required to be reported as needing a TMDL under Section 303(d). All other impaired waterbodies where no legal remedies exist must be listed and scheduled for Total Maximum Daily Load development.

5.1 Impaired Lakes and Rivers of Basin 11

In the 2006 Vermont List of Priority Surface Waters, Part D, there are five impaired lakes listed in Basin 11 that have completed and EPA approved TMDL's. These five are Forrester Pond (Jamaica), Little Pond (Winhall), Stratton Pond (Stratton), Moses Pond (Weston), and Sunset Lake (Marlboro). The identified impairment for the five lakes is acidification due to atmospheric deposition.

Acidification due to atmospheric deposition is discussed in Part II, Chapter 3.

The critical loads determined as the result of the TMDL serves to facilitate a better understanding of the status and magnitude of acidic atmospheric deposition on surface waters in Vermont, leading at some point to the control of significant acid sources. However, because the state has one of the lowest levels of in-state emissions of sulfur and nitrogen oxides, much of the problem lies beyond Vermont's borders ostensibly caused by the coal-fired energy plants of the Midwest. Vermont has little direct control over these sources of atmospheric pollution, and therefore must rely on USEPA Clean Air Act enforcement efforts to reduce these emissions. Due to the obvious source of pollution being acid deposition stemming from coal burning power plants in other states, the VDEC has suggested that the implementation of this TMDL is the primary responsibility of the USEPA to regulate the source.

The State has complied with USEPA regulations for impaired waterbodies in Basin 11 and is currently at work on TMDLs for those impaired surface waters remaining. Ball Mountain Brook above the North Branch confluence and Styles Brook (VT11-15) have a completed and EPA approved TMDL. The West River below Ball Mountain Dam (VT11-10) has sediment and

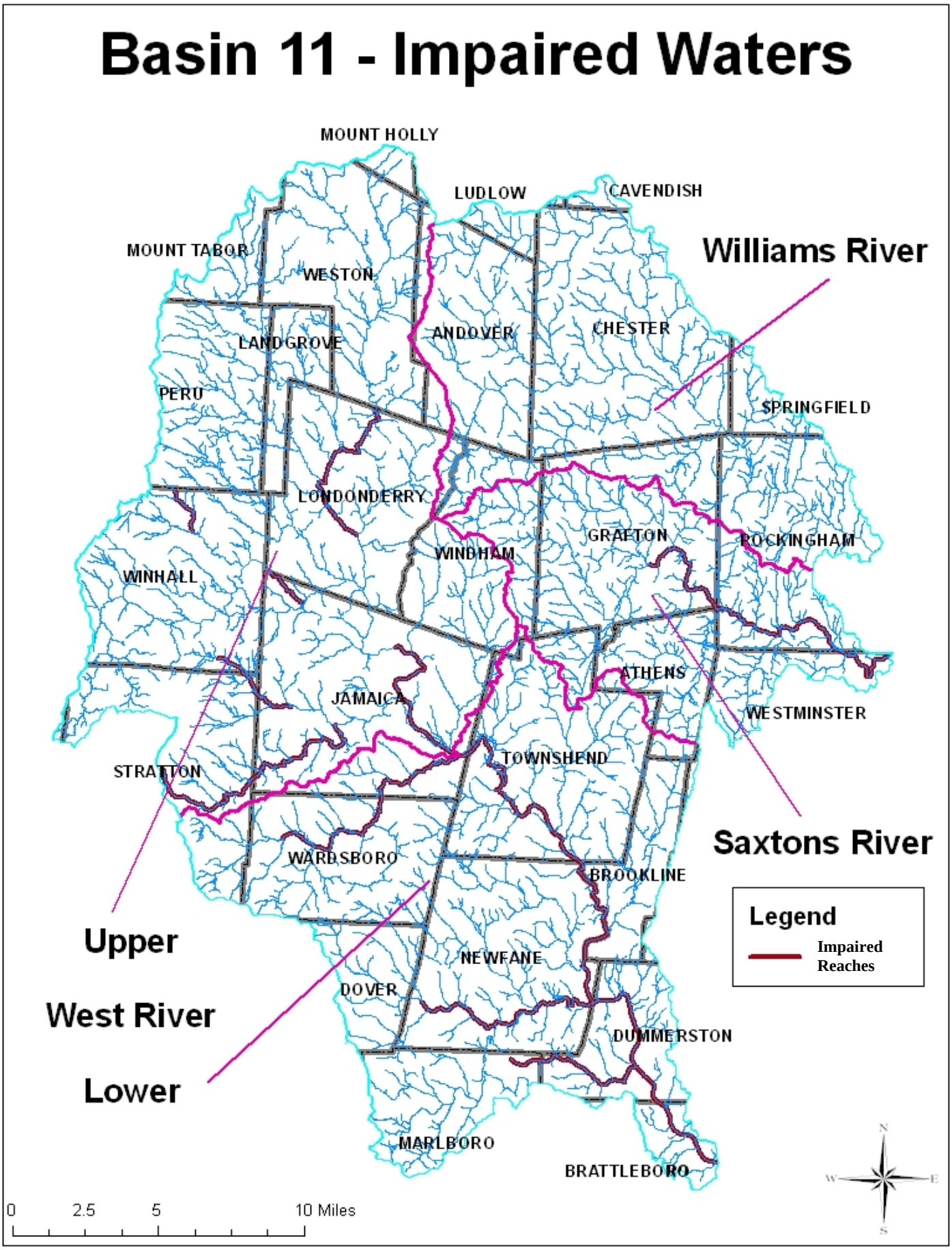


Figure 5 – Impaired Waterbodies as of 2006

temperature impairments and Bear Creek and, portions of Kidder Brook and Ball Mountain Brook are listed as impaired for acid deposition on the 2006 Vermont 303(d) List of Impaired Waters for Basin 11.

One reach in Basin 11 is listed in 2006 under Part B of the Section 303(d) List of Impaired Waters. Part B waters are assessed as impaired but do not require the development of a TMDL. The North Branch of Ball Mountain Brook from Stratton Lake to Kidder Brook is impaired by manganese which coated the streambed. An innovative pipe bypass system under Stratton Lake has resulted in the elimination of the discharge and ensures reliable downstream passage of low to moderate flows below Stratton Lake to the North Branch of Ball Mountain Brook. Staining of the substrate is no longer occurring – however, staining from previous discharge has not yet dissipated.

Although no waterbodies in Basin 11 have been listed as impaired due to mercury contamination, it should be noted that the VDOH currently has a fish consumption advisory in affect for **all** waters due to the presence of elevated mercury (Hg) levels in fish tissue. All waters in the state are considered stressed for this contaminant problem. A mercury-based TMDL for fish contamination is not planned before 2008 (VDEC, 2006).

5.2 Waters in Need of Further Assessment

Waters needing further assessment are listed under Vermont 2006 List of Priority Surface Waters Outside the Scope of the Clean Water Act Section 303(d), Part C. These waters are considered "stressed" but sufficient data has not been collected to confirm a violation of the State standards. Part C waters are high priority for assessment and monitoring. Of the six stream locations listed within Basin 11, five are currently being examined by the WRWA's monitoring program. The Basin 11 planning effort has worked in full cooperation with the VDEC planners and their technical staff to unearth relevant data that would identify potential areas of concern as well as existing informational gaps. Local initiatives sponsored by the WRWA implemented a basinwide chemical and biological stream sampling program to augment the work of the VDEC to monitor bacterial, nutrient, and sediment loadings.

Table 5 2006 List of Priority Surface Waters, Part C.

Waterbody ID	Segment Name and Description	Possible Pollutant	WQ Problems Needing assessment	Monitoring and assessment	Action/Strategy
VT11-01	Lower Williams River (Mouth Upstream to Middle Branch Confluence)	Sediments, Nutrients, Temperature	Encroachments, & runoff from ag & development, poor riparian condition	State monitoring sites Volunteer monitoring TSS, *E.coli*, Temp May through September 2003-2006, Volunteer Macroinvertebrate Sampling 2003, 2004	Work with land owners to encourage riparian buffer development. New AAP implementation should help reduce nutrients and sediments in this largely agricultural area.
VT11-05	Lower Saxtons River	Sediment, Temperature	Poor riparian condition, channel modification	State monitoring sites Volunteer monitoring TSS, *E.coli*, Temp May through September 2003-2006, Volunteer Macroinvertebrate Sampling 2003, 2004	Work with land owners to encourage riparian buffer development. New AAP implementation should help reduce nutrients and sediments.
VT11-07	West River Mouth to Grassy Brook (12 miles)	Temperature, Flow modification	Wide shallow channel, loss of riparian buffer, USACE dam operations	State monitoring sites Volunteer monitoring TSS, *E.coli*, Temp May through September 2003-2006, Volunteer Macroinvertebrate Sampling 2003, 2004	Encourage residents to grow riparian buffers. Continue work with USACE to change flow regimes to reflect more natural conditions.
VT11-10	West River, Townshend Dam to Grassy Brook	Temperature, Flow modification	Townshend dam operations, impounded waters	State monitoring sites Volunteer monitoring TSS, *E.coli*, Temp May through September 2003-2006, Volunteer Macroinvertebrate Sampling 2003, 2004	Encourage residents to grow riparian buffers. Continue work with USACE to change flow regimes to reflect more natural conditions.
VT11-14	Wardsboro Brook, from West Wardsboro to Mouth (7 miles)	Sediment, Temperature	Streambank erosion, land development, road runoff, channel widening, loss of riparian vegetation	State monitoring sites Volunteer monitoring TSS, *E.coli*, Temp May through September 2003-2006, Volunteer Macroinvertebrate Sampling 2003, 2004	Prioritize & carry out stream geomorphic assessments for this area.
VT11-16	Winhall River (IP Bridge to Mouth)	Sediment, Temperature	Channel habitat change, road runoff, loss of riparian, vegetation, erosion and sedimentation	State monitoring sites	Prioritize & carry out stream geomorphic assessments for this area

5.3 Waters Altered by Regulated Flows

There are six locations considered to be "Waters Altered by Flow Regulation" in Part F of the State's 2006 Priority Surface Waters List . As mentioned in Chapter 4, the Basin 11 planning effort has examined three of these affected waters involving the USACE dams with the creation of the Dam Focus Group of interested stakeholders. This group includes the USACE, the VANR, the USFWS, TNC as well as representatives of local organizations, recreation groups and concerned residents. Recently, significant progress has been made toward agreement between the VANR and the USACE to bring the operation of its two large flood control dams into compliance (see section 4.5.2). Dam operations in the West River are still a major concern and Basin 11 planners will work with all parties involved to create a reasonable and feasible scope of activities to help facilitate a solution to this larger issue.

Table 5.1 2006 List of Priority Surface Waters, Part F.

Waterbody ID	Segment Name/ Description	WQ Problem	Current Control Activitiy/Strategy
VT11-05	Signal Hill Brook	Possible lack of minimum flow below water supply withdrawal point	WSID #5303 Vermont Academy (emergency water supply backup)
VT11-08	Stickney Brook (2.5 miles)	Artificial flow conditions seasonally devoid of flow below diversion dam	WSID # 5290 - Brattleboro Water Dep't; Water supply reservoir above dam; sediment & temperature also noted as other possible pollutants
VT11-10	West River (below Ball Mountain Dam to Townshend Dam Impoundment (9 miles)	Artificial flow regime at dam	No minimum flow by USACE based on any biological/WQ criteria; USACE studying structural modifications to bring operations at Corps dams into compliance with VT WQS
VT11-10L01	Ball Mountain Reservoir	Water level fluctuation alters aquatic habitat	VANR & USACE have MOA to bring dam operations into compliance with VT WQS
VT11-16	Mill Brook (1.6 miles) and Tributary to Mill Brook (2.2) miles	Artificial and insufficient flow below Bromley snowmaking water withdrawal	Partial Support 1.6 miles and Non-Support 0.7 miles, Partial Support 1.5 miles
VT11-18L01	Hapgood Pond (Peru)	Annual drawdowns impair aquatic habitat	No actions listed

6. Establishing Management Goals

Improved watershed management and cooperation among municipal, state and federal agencies, and area residents will be required to achieve and maintain WQS and meet competing uses of the region's rivers, lakes and ponds. The Basin Planning process outlined in the 2006 Vermont Water Quality Standards (WQS) sets forth a process for developing management plans for the waters of the State.

One important element of basin planning includes establishing management goals for waters that designate both the beneficial uses and values of surface waters and the level of protection to meet the needs and expectations of each community and the state as a whole. The basin planning process should encourage community involvement in identifying (1) existing uses of surface waters, (2) outstanding resource waters, and (3) new classifications and water quality management types for waters in their community (WQS). The implementation of these objectives through this basin plan is expected to meet the goals and corresponding objectives identified through the Basin 11 planning process, the West River Watershed Alliance and its partners and collaborators, municipalities, watershed residents, and landowners.

The management goals of each classification and type describe the values and uses of the surface water that are to be protected or achieved. Management goals can be established through the following process:

- Classification of waters and designation of water management types,
- Designation of waters as warm and cold water fisheries,
- Designation of existing uses of a water, and
- Designation of waters as Outstanding Resource Waters for specific values (10 VSA § 14242a).

6.1 Typing and Classification

Since the early 1970s, Vermont has had a classification system for surface waters that establishes management goals. These goals describe the uses and values of surface waters that are to be protected or restored through appropriate management. Once classified, the waters must be managed to obtain and maintain the designated classification. The original system included Classes A and B. Class A waters are divided into two subclasses: A(1) and A(2). As part of the Vermont Water Quality Standards revisions in 2000, Class B waters were divided into Water Management Type B(1), Type B(2) and Type B(3). These types are based on both existing water quality and reasonably attainable and desired water quality goals.

6.1.1 Proposed Stream Classifications and Types for Basin 11

As part of the planning process, proposed management goals for Basin 11 were presented to each municipal selectboard and/or planning commission in the West, Williams, and Saxtons River watersheds. Many towns were asked to review the proposal and provide input to ensure that the Agency of Natural Resources' suggested management goals are compatible with their town goals for surface waters. VANR will, following guidance from the Water Resources Panel (WRP), submit a proposed classification and typing scheme to the WRP of the Natural Resources Board

which, if adopted, will amend the Vermont Water Quality Standards. It is the responsibility of the VANR, individuals and all levels of government to work to achieve, maintain or exceed the level of water quality specified by the designated types and classifications. All towns in Basin 11 will have the opportunity to review the proposal prior to its submission to the WRP.

In its current form, a proposal for re-classification and typing is based on current water quality, habitat and biota as well as land cover, land use and the expectations for land use set out in each town plan. The management goals associated with typing and classification pertain to water quality. The means of achieving these goals will relate to land management, stormwater management, the implementation of Accepted Agricultural Practices, riparian corridor protection, erosion control practices for construction sites, better road management practices, and Acceptable Management Practices for silviculture among others. The quality of surface waters in Vermont is mostly dependent upon the content and amount of surface runoff from surrounding land in addition to the proper operation of wastewater treatment plants.

During the typing and classification proposal process underway, each town was, or will be, presented with:

- The classification system for surface water protection in the state of Vermont; (10 VSA § 1253).
- A list of adjacent land uses that would be compatible with the goals for the different categories of surface water protection; and
- The Department of Environmental Conservation's opinion of how the expected land uses outlined in each town plan or zoning regulations would support the suggested goals for surface waters (rivers, ponds and wetlands).

Opportunities to discuss the typing and classification proposal will include public hearings on the plan and town selectboard meetings. In addition, the Water Resources Panel will hold public hearings on the typing and classification proposal during rulemaking.

Current Status of the Basin 11 Typing Proposal

As of late 2007 activities working toward typing and classification of Basin 11 have been deferred due to the passage of H. 154. This legislation allows the plan portion of the Basin 11 planning process to move forward and become enacted by the Secretary of the Agency of Natural Resources while the lengthy process of developing the water classification proposal for Basin 11 is being completed.

Many staff hours by a number of organizations and citizens have gone into preparing the typing and classification proposal to date, however it will not be submitted until final guidance has been agreed upon.

6.1.2 Classification System

CLASS A Waters

Presently all waters above 2,500 feet and those waters so designated by the State, are classified A(1) by Vermont statute. The management objective for A(1) waters is to maintain their **natural condition**. Waters used as public water supplies, regardless of elevation, are classified A(2). Basin 11 has 3 brooks below 2500 feet that were designated by the Water Resources Board as Class A. These are: Kidder Brook, Cobb Brook and the Winhall River within the Green Mountain National Forest.

The following waters are classified as A(2):

- Sunset Lake & Stickney Brook, Town of Brattleboro water supply.
- Styles Brooks, Stratton Corp. water supply.
- Chester Reservoir & the outlet stream, Village of Chester water supply.
- Bolles Brook, Village of Saxtons River & Vermont Academy water supply.

CLASS B Waters

All the remaining surface waters in Basin 11 are currently Class B.

The division of B waters into three management types was reorganized by the WRP to furnish a greater level of protection to existing higher quality waters and to recognize attainable uses that could be supported by improvements to existing water quality. The typing system for Class B waters is, for the most part, a continuum of acceptable conditions of water quality criteria such as aquatic biota, aquatic habitat and recreational opportunities. A simplification of the B1, B2 and B3 designations would be to say that the spectrum from B3 to B2 to B1 is described as representing "good," "better" and "best" aquatic conditions.

All Class B waters are managed to achieve and maintain a level of quality that fully supports the following **designated uses** in addition to those listed under the individual types below:

Public water supply - Suitable for use as a source for a public water supply with filtration and disinfection;

Irrigation of crops and other agricultural uses - suitable, without treatment, for irrigation of crops used for human consumption without cooking and suitable for other agricultural uses.

Beyond these basic requirements each Type has specific goals that must be obtained. According to the WQS, the goals that must be attained for each type are:

Type B1 – Waters in almost natural condition

Aquatic Biota and Habitat – limited to ***minor*** changes in biota and ***minimal*** changes in habitat from the reference condition while still fully supporting all biota;

Aesthetics - water character, flows, water level, bed and channel characteristics exhibit ***excellent*** aesthetic values;

Swimming and Contact Recreation - suitable for swimming and other forms of water based

recreation where sustained direct contact with the water occurs and, where attainable, suitable for these uses at very low risk of illness;
Boating, Fishing, and Other Recreational Uses - to the full extent naturally feasible ***without degradation*** due to artificial flow and water level management or artificial physical impediments.

Type B2 – Waters managed to achieve and maintain no more than moderate changes in the biota and minor changes in habitat

Aquatic Biota and Habitat – limited to ***moderate*** changes in biota and ***minor*** changes in habitat from the reference condition while still fully supporting all biota;
Aesthetics – water character, flows, water level, bed and channel characteristics exhibit ***very good*** aesthetic values;
Swimming and Contact - suitable for swimming and other forms of water based recreation where sustained direct contact with the water occurs and, where attainable, suitable for these uses at very low risk of illness;
Boating, Fishing, and Other Recreational Uses - to the extent naturally feasible ***with no more than minor degradation*** due to artificial flow and water level management or artificial impediments, and with appropriate mitigation for artificial physical impediments.

Type B3 - Waters managed to achieve and maintain no more than moderate changes in the biota and moderate changes in habitat

Aquatic Biota and Habitat – limited to ***moderate*** changes in biota and ***moderate*** changes in habitat from the reference condition while still fully supporting all biota;
Aesthetics – seasonal and temporal variability to water character, flows, water level, bed and channel characteristics may be allowed provided ***good*** aesthetic values are achieved;
Swimming and Contact - suitable for swimming and other forms of water based recreation where sustained direct contact with the water occurs and, where attainable, suitable for these uses at very low risk of illness;
Boating, Fishing, and Other Recreational Uses waters - to the extent feasible, and with appropriate mitigation for artificial physical impediments.

6.1.3 Land uses that would best achieve goals for Types B1, B2 and B3

It is assumed that agricultural and silvicultural activities that follow Accepted Agricultural Practices and Acceptable Management Practices respectively comply with the Water Quality Standards (which includes the goals for B1, B2, and B3 management types). For other land uses, the Agency believes that each management type could support the following land uses and still meet their respective water quality goals:

B1

- Predominately forested with maintained riparian buffers;
- Low density residential with maintained buffers and maintained septic systems;
- Roads that run at a distance from the stream, do not regularly wash out and are maintained with minimal salt and sand.

B2

- All other land uses and covers not described for B1 or B3 that are currently present.

B3
• High density residential, commercial, and industrial areas;
• Roads running parallel to the stream and maintained with high levels of sand and salt;
• Industrial use of surfaces waters for snowmaking, power generation, and manufacturing;
• Up and down-stream of impoundment areas.

6.1.4 Proposal Supports Expected Land Uses Outlined in each Town Plan

The basin plan classification proposal designates most Class B waters as either management type B2 or B1. The proposed B1 waters are located predominantly within mountainous terrain and on, or adjacent to, publicly owned lands. The range of protection afforded waters by the proposal encourages the more intensive activity in the valleys and sets goals for higher water quality in the headwater areas, which tends to meet towns' and residents' expectations for land use. Based on the review of town plans and zoning regulations in Basin 11, the Department of Environmental Conservation does not believe that the proposal presented as part of this plan would conflict with each community's expectations for land use in the area. The following describes how the goals of a town plan are evaluated under each water quality management type.

B1
The proposal designates waters as B1 where lands are predominately forested, expected land use is predominated by low density residential or a less intensive land use, and roads are stable, meaning that they are well maintained and do not regularly wash out. A small area of a B1 designated stream and its watershed can include residential and agricultural zones, but the management goal would be for this land to remain predominantly forested

B2
Most of the surface waters would be designated as B2, as they show some impact from human activity but still support healthy aquatic life and habitat.

B3
Where B3 designation is proposed waters are subject to managed water level fluctuations, such as at flood control dams, water withdrawals and other impoundments. Under these circumstances, the Department of Environmental Conservation would expect moderate changes in aquatic habitat and biota. There are several proposed reaches designated as B3s in the Basin 11 – mainly in the West River.

6.2 Warm Water and Cold Water Designations

Beyond the classification and water management type assigned for each waterbody, lakes, ponds, rivers and streams are designated as either warm or cold water fisheries habitat in the Vermont Water Quality Standards (2006). Dissolved oxygen requirements for warm water fisheries are lower than for cold water fisheries.

<u>Warm Water Fish Habitat</u>
1. All wetlands, except those designated as cold water fish habitat below, and the following waters are designated as warm water fish habitat:
2. (a) Burbee Pond, Windham
   (b) Cole Pond, Jamaica

(c) Lily Pond, Londonderry
(d) Lowell Lake, Londonderry

Cold Water Fish Habitat

1. All waters not designated as warm water fish habitat above are designated as cold water fish habitat.
2. The following wetlands are designated as cold water fish habitat:
   (a) Those wetlands adjacent to the headwaters of the Winhall River and its tributaries on the east and west side from the outlet of Stratton Pond to the Stratton-Winhall boundary, a distance of approximately 2.0 miles.

6.3 Existing and Designated Uses

It is the policy of the State of Vermont to protect and enhance the quality, character and usefulness of its surface waters, prevent the degradation of high quality waters, and prevent, abate or control all activities harmful to water quality. Further, Vermont's Anti-Degradation Policy requires that the Existing Uses and the level of water quality necessary to protect those Existing Uses shall be protected and maintained (Section 1-03, Vermont Water Quality Standards). Determinations on the presence of an Existing Use can be made during basin planning or on a case-by-case basis such as during consideration of a permit application.[9] In this initial iteration of Existing Uses documentation the Agency of Natural Resources has chosen to address four areas from the factors for consideration listed below. These are contact recreation (swimming), boating, fishing and public drinking water supplies. Other factors will be addressed in future plans and may be addressed sooner on a case-by-case basis during consideration of an application.

The VANR uses a list of specific criteria to identify Existing Uses during river basin planning and the development of river basin water quality management plans. The listed Existing Uses and criteria can be found in Appendix A.13. These criteria have been developed for use during the basin planning process in order to ensure that EU identification in basin planning is done in a transparent, consistent and repeatable manner in each river basin plan across the state. ANR plans on developing additional EU criteria for use during permit review.

During the planning process in Basin 11, the Department of Environmental Conservation has collected sufficient information to identify the Existing Uses listed in Appendix A.13. **The list is not meant to be comprehensive**. The Existing Uses included are limited to those with access points on public lands or those on private lands with documented landowner permission. The public is encouraged to nominate other Existing Uses which will be cataloged for a more thorough investigation on a case-by-case basis during the permit review process for an activity that might adversely affect the use and will be included in future basin plans as appropriate. Recommendations for EU determination should be made in writing to the Agency of Natural Resources.

[9] As per the Vermont Water Quality Standards, "existing use means a use which has actually occurred on or after 11/28/1975, in or on waters, whether or not the use is included in the standard for classification of the waters, and whether or not the use is presently occurring."

The following factors are considered when identifying Existing Uses (see VWQS Section 1-03 B):
• Aquatic biota and wildlife that use or are present in the waters;
• Habitat that supports existing aquatic biota, wildlife or plant life;
• The use of waters for recreation or fishing;
• The use of waters for water supply or commercial activity that depends directly on the preservation of an existing high level of water quality; and
• With regard to the factors considered under the first two bullets above, evidence of the use's ecological significance in the functioning of the ecosystem or evidence of the use's rarity.

Designated Uses are specified in the management objectives for each class of water as set forth in §§ 3-02 (A), 3-03(A), and 3-04(A) of the Vermont Water Quality Standards. The Designated Uses of waters in Basin 11 are:

- Aquatic biota/habitat
- Contact recreation
- Secondary contact recreation
- Aesthetics
- Drinking water supply
- Agricultural water supply

6.4 Outstanding Resource Waters (ORW)

Pike's Falls/Ball Mountain, Town of Jamaica - A portion of the North Branch of Ball Mountain Brook between the point where Kidder Brook enters the brook above Pikes Falls to the point below the falls where an unnamed tributary, which originates from the Winhall Municipal Forest, enters the North Branch. This segment is approximately 4,000 feet in length and within this distance the stream descends 140 feet, much of the drop occurring within Pikes Falls. In 1991 the Water Resources Board designated this ORW on the basis of its exceptional natural, recreational and scenic values. This petition for ORW designation was the first of its kind filed with the Water Resources Board.

6.4.1 Waters to Consider for Future ORW Protection

Participants in the planning process suggested additional waters in the basin the might be considered for ORW designations due to their special characteristics, excellent water quality or unique habitat and community composition. The waters for further discussion include:

Water:	**Consideration**:
West River	
Cobb Brook	- Class A - water quality (Biota - Excellent) - Hamilton Falls - fisheries - scenic area - recreation

West River above Rte. 155	- barrier falls - fisheries - scenic area
East Branch, West River above jct. of Rte's 100 & 155	- falls - scenic area - fisheries - recreation, swimming
Fair Brook – upper	- fisheries - scenic area
Greendale Brook	- mostly USFS land - fisheries - water quality (Biota - Excellent)
Jelly Mill Falls, Stickney Brook	- falls - swimming - geology - water quality (Biota – Very Good) - scenic area - historic mill foundation
Jenny Coolidge Brook	- USFS - fisheries - water quality
Little Pond (Winhall)	- migratory bird stopover - scenic area - recreation - water quality
Oregon Falls – Baker Brook (Newfane)	- falls - scenic area - fisheries - recreation
Rock River upstream of Goose City (Dover)	- 3 waterfalls about 100 yards long - fisheries - water quality (Biota - Excellent)
Stratton Pond	- water quality - T&E vertebrate - wildlife habitat - migratory bird stopover - fisheries - scenic area - rare natural area - recreation, swimming, hiking, fishing
Turkey Mountain Brook ravine	- falls - fisheries

	- scenic area - water quality (Biota - Excellent)
Winhall River (upper) (above end of Kendall Farm Rd)	- natural community - T&E vertebrate - water quality (Biota - Excellent) - fisheries - Class A1
Williams River	
Wyman's Falls	- falls - scenic area
Herrick's Cove	- Important Bird Area, designated 2000 - natural communities (3) - T&E species (6) - migratory bird stopover - bald eagle stopover and nesting - flood storage - scenic area - Rare Whorled Leaf Water Milfoil (*Myriophyllum verticillatum)* present

7. Implementation of the Basin 11 Management Plan

Many State and federal agencies, private organizations, and community groups have been involved in developing the strategies in this basin plan. The next step is the implementation of the strategies by these groups and others.

The collaborative process of developing concerns and strategies ensures that participating groups are implementing the Basin 11 Management Plan. Since the basin planning initiative included extensive discussions with the community and resource agencies, the actions of some of the potential key players, such as the State Watershed Coordinator, the West River Watershed Alliance (WRWA), Windham County NRCD and the WRC, are already aligned in that direction. For other potential partners, the plan will provide ideas, opportunities and the rationale to leverage funding for implementation projects. Implementation then needs only a small catalyst to start the process or a guiding hand to keep it progressing. For some strategies, the Vermont DEC will facilitate the implementation process by setting up meetings and providing technical support. Implementation of other strategies will require the resources and energy of other community groups using the plan as a guide.

The success of the Basin 11 Management Plan is not to be limited to the implementation of strategies. In addition, the basin planning process has developed a vast network of groups working together to meet common goals. The strength of the network will help leverage existing funds and support from other organizations. If the process has been successful, the next basin planning process will begin with the existing partnerships intact.

7.1 Evaluation of the Planning Process

No planning process is complete without feedback on the elements of the plan. This can range from documenting the actions taken to improve water quality to placing a conservation easement on a swimming hole in order to assure its protection for future generations. Periodically, during the implementation phase of the plan, the Basin 11 Watershed Council, its partners and collaborators will review the process and examine accomplishments in planning and implementation. This annual "report card" will be used by VANR and partner organizations to evaluate the progress being made toward reaching the water quality goals set out in the plan. Progress will be measured by checking on the different strategies completed or in progress in various parts of the basin.

Topics to be considered include the adequacy of the process set forth by the State, the WRWA and its partners, the progress on implementation of strategies, reactions of the public to the process, and the adequacy of resources needed to conduct planning and implementation. In addition, the Watershed Council and its partners will annually address the accomplishments made toward achieving the Basin Plan goals and the goals of the VANR's *Watershed Planning Initiative*.

7.2 Progress Reporting

The benchmarks set forth in this basin plan will be revisited periodically to ensure that there are financial and technical resources allocated to implement these strategies. If these benchmarks are

assigned a specific timeline, the expectation is to achieve the goals through these benchmarks. Simply stating a decrease in the loss of land due to erosion or fish habitat improvement doesn't provide the documentation necessary to monitor and evaluate the effectiveness of each strategy. While it may be unreasonable to expect that the basin plan will address every water quality concern within a five-year period, it may be perfectly acceptable to meet expectations within a twenty-year time frame. Under this premise, the proposal to list each benchmark within a specific 5-year cycle should be met to ensure the successful implementation of this basin plan. For this plan to be successful in the West, Williams, and Saxtons River basins in the next five years, these benchmarks will be met and/or exceeded.

Reference and Resources

Andrews 1997. James Andrews, *A Survey of the Ball Mountain and Townshend Dam Project Areas for Vernal Pools and Rare or Protected Reptiles and Amphibians (Draft Report*), 1997. Prepared for the U.S. Army Corps of Engineers New England Division. Middlebury College, Middlebury, VT.

BEEC 1999. Bonnyvale Environmental Education Center. *How Clean is the Saxtons River? A Report on the Saxtons River Project: A Citizen Water Quality Monitoring Program*, Prepared by Frances Doyle, Bonnyvale Environmental Education Center, Brattleboro, VT.

BEEC 2001. Bonnyvale Environmental Education Center. *The West River Watch Project Report 2001*. Prepared by Frances Doyle, Bonnyvale Environmental Education Center, Brattleboro, VT.

Behar 2000. Sharon Behar, *Testing the Waters – Chemical and Physical Vital Signs of a River*. River Network.

Callahan, Laurie. *Project Completion Report, 2004, 2005 and 2006 Aquatic Nuisance Control Grant in Aid to Municipalities, Town of Brattleboro – Retreat Meadows/Lower West River*. Prepared for the Vermont Department of Environmental Conservation.

Christopher, Thomas J. 2005. American Whitewater/FLOW letter dated January 26, 2005 to the Vermont Department of Forests, Parks and Recreation in response to requests for public comment on the Draft "Vermont Outdoor Recreation Plan 2005-2009".

Church, P.E. and P.J. Friesz. *Effectiveness of Highway Drainage Systems in Preventing Road-Salt Contamination of Groundwater: Preliminary Findings.* Transportation Research Board. Transportation Research Record 1420. *http://books.nap.edu/books/NI000009/html/3.html*. 1993.

CWP 2001. Center for Watershed Protection. NEED Title

EC 2001. Environment Canada, 2001. *Priority Substances List Assessment Report, Road Salts.*

Engstrom, Brett and Thompson, Elizabeth 1996. *An Ecological Inventory of the Wetlands of the West River Watershed, Vermont*. Prepared for the Vermont Nongame and Natural Heritage Program, Department of Fish and Wildlife, Agency of Natural Resources, Waterbury, VT.

LCBP 2003. Lake Champlain Basin Program. *Opportunities for Action: An Evolving Plan for the Future of the Lake Champlain Basin*, States of New York and Vermont and the US Environmental Protection Agency, Grand Isle, VT.

NVRCDC 2002. George D. Aiken & Northern Vermont Resource Conservation and Development Councils. *Vermont Better Backroads Manual*.

PEA 2000. Pioneer Environmental Associates. *Water Quality Remediation Plan 2000 Annual*

Performance Report. Prepared for the Stratton Corporation. Stratton, VT.

SWCRPC 2003a. Southern Windsor County Regional Planning Commission. *Southern Windsor County 2003 Regional Plan*. Adopted July 22, 2003.

SWCRPC 2003b. Southern Windsor County Regional Planning Commission. *Southern Windsor County at a Glance.* Revised December 2003. Ascutney, VT.

TNC 1998. The Nature Conservancy. *Rivers of Life: Critical Watersheds for Protecting Freshwater Biodiversity*. Edited by Lawrence L. Master, Stephanie R. Flack, and Bruce A. Stein. Arlington, VA.

Thompson, Elizabeth H. and Sorenson, Eric 2000. Wetland, Woodland, Wildland, A Guide to the Natural Communities of Vermont. University Press, Hanover, NH.

Thompson, Elizabeth H. 2002. *Vermont's Natural Heritage, Conserving Biological Diversity in the Green Mountain State*. A report from the Vermont Biodiversity Project. 48 pages.

USACE 1972. U.S Army Corps of Engineers, New England Division. *Flood Plain Information, Connecticut River, West River, and Whetstone Brook.* Prepared for the Town of Brattleboro, VT.

USACE 1977. U.S. Army Corps of Engineers, New England Division. *Ball Mountain Lake, Jamaica, Vermont, Master Plan for Recreation Resources Development,* Waltham, MA.

USACE 2001. U.S. Army Corps of Engineers, New England Division. *Annual Report FY 2001, Water Control Management, December 2001*. Prepared by Water Management Section Reservoir Regulation Team, Waltham, MA.

USEPA 2003. U. S. Environmental Protection Agency. *Federal Clean Water Act and NPDES.* Fact Sheet Adapted from http://www.epa.gov/npdes/pubs/fact3-0.pdf.

VANR 1975. Agency of Environmental Conservation, Department of Water Resources, *West-Williams-Saxtons Basin Water Quality Management Plan, September, 1975*. Prepared pursuant to Section 303(e) of P.L. 92-500 and the State Continuing Water Quality Management Planning Process.

VANR 1988. Vermont Agency of Natural Resources. *Land Management Plan, Hamilton Falls Natural Area, Jamaica State Park, Jamaica.* Prepared by Jay Maciejowski for the Department of Forests, Parks and Recreation.

VANR 1997. Vermont Agency of Natural Resources. *Rare Freshwater Mussels and Significant Natural Communities at Ball Mountain and Townshend Lake.* Prepared for the U.S. Army Corps of Engineers New England Division by Mark Ferguson, Eric Sorenson and Robert Popp, VANR, Department of Fish and Wildlife, Nongame and Natural Heritage Program, Waterbury, VT.

VANR 1998. Vermont Agency of Natural Resources. *Public Recreation on Private Land, A Landowner's Guide.* VANR, Department of Forests, Parks, & Recreation, Waterbury VT.

VANR 2001. Agency of Natural Resources, *Basin 11 – West, Williams, and Saxtons Rivers Assessment Report, November 2001*. Prepared by the Department of Environmental Conservation, Water Quality Division. Waterbury, VT.

VANR 2002. Vermont Agency of Natural Resources. *West River and Tributaries Atlantic Salmon Fry Stocking Evaluation - Job Performance Report.* Project No. F-34-R-4. June 2002.

VANR 2003a. Vermont Agency of Natural Resources. *Vermont Stream Geomorphic Phase 1 Watershed Assessment, Phase 2 Rapid Assessment, Phase 3 Survey Assessment, and Handbook Appendices.* Waterbury , VT.

VANR 2003b. Vermont Agency of Natural Resources. *Report to the House and Senate Institutions Committee: Proposed Policy on Dams.* Prepared by the Vermont Department of Natural Resources Facilities Engineering Division. January 2003.

VANR 2005. Vermont Agency of Natural Resources. *Vermont Fish and Wildlife Department Annual Report: West River and Tributaries Atlantic Salmon Fry Stocking Evaluation*. Prepared by James R. McMenemy, District Fisheries Biologist, for the Department of Fish and Wildlife, Waterbury, VT.

VDEC 1988a. Vermont Department of Environmental Conservation. *The Waterfalls, Cascades and Gorges of Vermont.* Jerry Jenkins and Peter Zika for the Vermont Agency of Natural Resources, Waterbury , VT.

VDEC 1988b. Vermont Department of Environmental Conservation. *A Guide for Evaluating the Outstanding Rivers and Streams of Vermont: Part II Exemplary Streams in the West River Basin*, 1988. Jerry Jenkins for the Vermont Agency of Natural Resources

VDEC 1989a. Vermont Department of Environmental Conservation. *Upper West River Basin Water Quality Management Plan,* 1989, Vermont Agency of Natural Resources, Waterbury, VT.

VDEC 1989b. Vermont Department of Environmental Conservation. *Vermont's Whitewater Rivers: their Geology, Biology and Recreational Use*. Jerry Jenkins and Peter Zika for the Vermont Agency of Natural Resources, Waterbury , VT.

VDEC 1992. Vermont Department of Environmental Conservation. *Vermont Swimming Hole Study.* Vermont Agency of Natural Resources, Waterbury , VT.

VDEC 2001a. Vermont Department of Environmental Conservation. *Basin 11 West, Williams, & Saxtons Rivers Assessment Report*. November 2001. Vermont Agency of Natural Resources, Waterbury, VT.

VDEC 2001b. Vermont Department of Environmental Conservation. *Fluvial Morphology: a Foundation for Watershed Protection, Management, and Restoration.* Vermont Agency of Natural Resources, Waterbury, VT.

VDEC 2001c. Vermont Department of Environmental Conservation. *Wadeable Stream Biocriteria Development for Fish and Macroinvertebrate Assemblages in Vermont Rivers and Streams*. Vermont Agency of Natural Resources, Waterbury, VT.

VDEC 2002a. Vermont Department of Environmental Conservation. *White River Basin Plan, A Water Quality Management Plan.* Vermont Agency of Natural Resources, Waterbury, VT.

VDEC 2002b. Vermont Department of Environmental Conservation. *State of Vermont 2002 Water Quality Assessment – 305(b) Report*. Vermont Agency of Natural Recourses, Waterbury, VT.

VDEC 2002c. Vermont Department of Environmental Conservation. *State of Vermont Year 2002 303(d) List of Waters: Part A - List of Impaired Surface Water in Need of TMDL,* July 2002. Prepared for USEPA by Vermont DEC, Water Quality Division, Waterbury , VT.

VDEC 2002d. Vermont Department of Environmental Conservation. *Citizen's Guide to Bacteria Monitoring in Vermont Waters.* Vermont Agency of Natural Resources, Waterbury, VT.

VDEC 2003a. Vermont Department of Environmental Conservation. *Alternatives for River Corridor Management.* Vermont Agency of Natural Resources, Waterbury, VT.

VDEC 2003b. Vermont Department of Environmental Conservation. *Vermont Watershed Initiative, Guidelines for Watershed Planning.* Vermont Agency of Natural Resources, Waterbury, VT.

VDEC 2004b. Vermont Department of Environmental Conservation. *Biochemistry of Mercury in Vermont and New Hampshire Lakes: An Assessment of Mercury in Water, Sediment, and Biota of Vermont and New Hampshire Lakes. Comprehensive Final Report,* May 2004. Prepared by Neil Kamman of the Vermont Department of Environmental Conservation. Waterbury, VT.

VDEC 2005. Vermont Department of Environmental Conservation. *An Ounce of Prevention: A Groundwater Protection Handbook for Local Officials.* September 2005, Vermont Agency of Natural Resources, Waterbury, VT.

VFWD 1993. Vermont Department of Fish and Wildlife. *The Vermont Management Plan for Brook, Brown and Rainbow Trout.* Vermont Agency of Natural Resources, Waterbury, VT.

VFWD 1996. Vermont Department of Fish and Wildlife, Nongame and Natural Heritage Program. *An Ecological Inventory of the Wetlands of the West River Watershed, Vermont.* Brett Engstrom and Elizabeth Thompson for the Vermont Agency of Natural Resources, Waterbury, VT.

VFWD 2004. Vermont Department of Fish and Wildlife. Fact Sheet: *Whitewater Paddling*

Releases on the West River. Vermont Agency of Natural Resources, Waterbury, VT. www.vtfishandwildlife.com/library/Factsheets/Aquatic_Habitat_Factsheet.pdf

VTWRB 2000. Vermont Water Resources Board. *Vermont Water Quality Standards 2000*. Montpelier, VT.

VTWRB 2004. Vermont Water Resources Board. *Vermont Water Quality Standards 2004.* Montpelier, VT.

VVMR 2004. Cordell, Ken, Green, Gary T. , Betz, Carter J. and Owens, Matthew. *Vermont And The Vermont Market Region*: A Report Submitted To The School Of Natural Resources At The University Of Vermont By The Outdoor Recreation And Wilderness Assessment Group, Southern Research Station, USDA Forest Service, Athens, Georgia. March 2004

WPT #86. Watershed Protection Techniques, Technical Note #86. 2(3): 443-444 Impact of Suspended and Deposited Sediment http://www.stormwatercenter.net/Library/Practice/14.pdf

Wegner and Yaggi 2004. William Wegner & Marc Yaggi, *Environmental Impacts of Road Salt and Alternatives in the New York City Watershed* in Stormwater: The Journal of Surface, Water Quality Professionals. At http://www.forester.net/sw_0107_environmental.html.

WRWA 2004. West River Watershed Alliance. *Water Quality Monitoring Program Report 2004.* Prepared by Em Richards, Windham County Natural Resources Conservation District, April 2005. Brattleboro, VT.

WRWA 2006. West River Watershed Alliance. *Water Quality Monitoring Program Report 2006.* Prepared by Clay Houston, Windham County Natural Resources Conservation District, January 2007. Brattleboro, VT.

Westing 2002. Westing, Arthur. *Championing the Land*. White paper for Windham Regional Commission and article in Brattleboro Reformer, March 20, 2002.

Westing 2003. Westing, Arthur. *Riparian Zones: Their Relevance to Town Plans and Zoning Ordinances in the Windham Region of Vermont*.). Prepared for the Windham Regional Commission, Brattleboro, VT, April 8, 2003.

WRWA 2003. West River Watershed Alliance. *Summary of the West River Organizational Inventory.* Prepared by Emily C. Richards for the Vermont Department of Environmental Conservation and the U.S. Forest Service.

WRC 1998. Windham Regional Commission. *West River Tributaries Nonpoint Source Pollution*

Stream Assessment Report, January 1998.

WRC 1999. Windham Regional Commission. *Vermont Route 30 Corridor Management Study Southern Section – US5 Junction in Brattleboro to VT11 Junction in Winhall.*

WRC 2001a. Windham Regional Commission. *Riparian Forested Ecosystem inventory, West River Watershed (Rock River Sub-basin).* A project conducted and report prepared with Clean Water Act 604B funding. Brattleboro, 2001.

WRC 2001b. Windham Regional Commission. *Windham Regional Plan*. December 2001

Other Resources

A Forest that Works for All, The Vermont Forest Resources Plan 1999-2008. Prepared by the Vermont Agency of Natural Resources, Department of Forests, Parks and Recreation, Springfield, Vermont.

Accepted Agricultural Practice Regulation, Effective Date: January 25, 2005. Agency of Agriculture, Food and Markets

Acceptable Management Practices for Maintaining Water Quality on Logging Jobs in Vermont. 8th Printing 2005. Prepared by the Vermont Agency of Natural Resources, Department of Forests, Parks and Recreation, Springfield, Vermont.

Application for Minor License, Townshend Dam Project, 1982. Prepared by the West River Basin Energy Committee.

Ball Mountain Dam Sedimentation Study, Draft Report, 1996. Prepared by the U.S. Army Corps of Engineers.

Connecticut River Corridor Management Plan, 1997. Prepared for the Connecticut River Joint Commissions by Sharon Francis and Adair D. Mulligan.

Conservation 2001, Acting on a Vision for Fish and Wildlife Conservation. A Comprehensive Wildlife Conservation and Restoration Plan. 2001. Prepared by the Vermont Department of Fish and Wildlife.

Master Plan to Reservoir Development at Townshend Flood Control Reservoir, 1966, Prepared by the U.S. Army Corps of Engineers.

Model Water Resources Planning Polices, 1990. Prepared by the Windham Regional Commission.

Options for State Flood Control Policies and a Flood Control Program, 1999. Prepared for the Vermont General Assembly Pursuant to Act 137 Section 2, Vermont Agency of Natural Resources, Waterbury, VT.

Report on the Feasibility of Installing Hydro Facilities at Townshend Dam, 1981. Prepared by the West River Basin Energy Committee.

Strategic Plan for the Restoration of Atlantic Salmon to the Connecticut River, 1997. Prepared by Connecticut River Atlantic Salmon Commission.

Supplement to Application for License for Ball Mountain Dam Hydro Project, 1984. Prepared by "Ball Mountain Dam Towns" The Agency of Natural Resources, Department of Environmental

Conservation, Water Quality Division, Waterbury, Vermont.

The Streamside Sentinel, 2005. Newsletter publication prepared by the Vermont Agency of Natural Resources, River Management Division.

Townsend State Forest Long Range Management Plan, March 2002. Prepared by the Vermont Agency of Natural Resources, Department of Forests, Parks and Recreation, Springfield, Vermont.

A Classification of the Aquatic Communities of Vermont, 1988. Prepared by the Vermont Agency of Natural Resources, Department of Environmental Conservation, Waterbury, VT

Vermont Rivers Study, 1986. Prepared by the VANR Agency of Environmental Conservation with assistance of the National Park Service.

Vermont Urban and Community Forestry Program, Action Plan 2002-2006. VANR Department of Forests, Parks, and Recreation.

Glossary

10 V.S.A., Chapter 47 - Title 10 of the Vermont Statutes Annotated, Chapter 47, Water Pollution Control, which is Vermont's basic water pollution control legislation.

Accepted Agricultural Practices (AAP) - land management practices adopted by the Secretary of Agriculture, Food and Markets in accordance with applicable State law.

Acceptable Management Practices (AMP) - methods of silvicultural activity generally approved by regulatory authorities and practitioners as acceptable and common to that type of operation. AMPs may not be the best methods, but are acceptable.

Aggradation – a progressive buildup or raising of the channel bed and floodplain due to sediment deposition. The geologic process by which streambeds are raised in elevation and floodplains are formed. Aggradation indicates that stream discharge and/or bed-load characteristics are changing. Opposite of degradation.****

Alkalization – to make or cause a pH value to increase to greater than 7.

Anadromous – a fish species that feeds and grows to maturity in the ocean, then migrates into freshwater rivers and lakes to spawn.

Aquatic biota - all organisms that, as part of their natural life cycle, live in or on waters.

Basin - one of seventeen planning units in Vermont. Some basins include only one major watershed after which it is named such as the White River Basin. Other Basins include two or major watersheds such as Basin 11 including the West, Williams and Saxtons Rivers.

Best Management Practices (BMP) - a practice or combination of practices that may be necessary, in addition to any applicable Accepted Agricultural or Silvicultural Practices, to prevent or reduce pollution from nonpoint source pollution to a level consistent with State regulations and statutes. Regulatory authorities and practitioners generally establish these methods as the best manner of operation. BMPs may not be established for all industries or in agency regulations, but are often listed by professional associations and regulatory agencies as the best manner of operation for a particular industry practice.

Bioassessment - surveys of the macroinvertebrate and fish communities of lakes, wetlands, rivers, and streams in order to evaluate the biological health, or biological integrity, of the resource surveyed. This type of survey is called biomonitoring or biosurveying.

Biological Integrity – 1) "biological integrity may be defined as the maintenance of community structure and function characteristic of a particular locale or deemed satisfactory to society" Cairns (1977); 2) "the capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having a composition and diversity comparable to that of the natural

habitats of the region" Frey (1977).

Causes – the pollutants or conditions that stress, impair or otherwise have an impact on the aquatic biota, the aquatic habitat, swimming, fishing, the fishery, boating, drinking water supply, fish consumption or other uses of the river or stream.

Classification - a method of designating the waters of the State into categories with more or less stringent standards above a minimum standard as described in the Vermont Water Quality Standards.

Conductivity – a measure of the water's ability to conduct an electrical current, directly related to the total dissolved ions in the water. *

Contact recreation (Primary) – this water classification protects people from illness due to activities involving the potential for ingestion of, or immersion in, water. Primary contact recreation usually includes swimming, water-skiing, skin-diving, surfing, and other activities likely to result in immersion. (EPA Water Quality Standards Handbook, 1994)

Designated use - any value or use, whether presently occurring or not, that is specified in the management objectives for each class of water as set forth in §§ 3-02 (A), 3-03(A), and 3-04(A) of the Vermont Water Quality Standards.

Dissolved Oxygen – the concentration of free molecular oxygen dissolved in water.*

Dystrophic - a lake or pond having brownish acidic waters, a high concentration of humic matter, and a small plant population.***

Easement – a restriction placed on a piece of property to protect its ecological and open-space values. It is a voluntary, legally binding agreement that limits certain types of uses or prevents development from taking place now and in the future. In a conservation easement, a landowner voluntarily agrees to donate or sell certain rights associated with his or her property, such as the right to subdivide, and a private organization or public agency agrees to hold the landowner's promise not to exercise those rights.*****

Existing use - a use that has actually occurred on or after November 28, 1975, in or on waters, whether or not the use is included in the standard for classification of the waters, and whether or not the use is presently occurring

Fluvial erosion hazard - refers to the endangerment of human investments and public safety resulting from land use choices and expectations that conflict with the dynamic and oftentimes catastrophic physical adjustments of stream channel and flood plain dimensions, elevations, locations and longitudinal slope, in response to rainfall/runoff events and sometimes ice jams. (contrast with flood inundation hazard)

Fluvial geomorphic equilibrium - the condition in which the physically dynamic nature of fluvial systems is freely expressed over time in response to the range of watershed inputs and climatologic conditions, and as influenced by topographic, geologic, and existing human imposed boundary conditions.

Fluvial geomorphology - a science that seeks to explain the physical interrelationships of flowing water and sediment in varying land forms.

Hypolimnetic - the layer of water in a thermally stratified lake that lies below the thermocline, is noncirculating, and remains perpetually cold.***

Impaired water - a water that has documentation and data to show: a violation of one or more criteria in the Vermont Water Quality Standards, or conditions that cause lack of full support for any given designated use for the water's class or management type.

Impervious – a surface that does not allow water or other liquids to penetrate through

Improved Barnyards - a series of practices to manage and protect the area around the barn, which is frequently and intensively used by people, animals, or vehicles, by controlling runoff to prevent erosion and maintain or improve water quality. Practices may include: heavy use area protection, access roads, animal trails and walkways, roof runoff management, and others.

Index of Biotic Integrity (IBI) – a synthesis of diverse biological information that numerically depicts associations between human influence and biological attributes. It is composed of several biological attributes or "metrics" that are sensitive to changes in biological integrity caused by human activities.*

Littoral – the shoreline zone of a lake where sunlight penetrates to the bottom and is sufficient to support rooted plant growth.**

Lotic - pertaining to or living in flowing water.***

Low Impact Development - a set of innovative stormwater management techniques that infiltrate, filter, store, evaporate, and detain runoff close to its source through small, cost-effective landscape features located at the lot level. These include practices such as raingardens, bioretention facilities, dry wells, filter/buffer strips, grassed swales, and rain barrels.

Macroinvertebrate –animals without backbones and large enough to see with the naked eye.*

Macrophyte – a rooted aquatic plant that grows in or on the water.*

Natural condition - the condition representing chemical, physical, and biological characteristics that occur naturally with only minimal effects from human influences.

Natural flow - the flow past a specified point on a natural stream that is unaffected by stream

diversion, storage, import, export, return flow, or change in use caused by modifications in land use. ****

Nonpoint source pollution - waste that reaches waters in a diffuse manner from any source other than a point source including, but not limited to, overland runoff from construction sites, or as a result of agricultural or silvicultural activities.

pH - a measure of the hydrogen ion concentration in water on an inverse logarithmic scale ranging from 0 to 14. A pH under 7 indicates more hydrogen ions and therefore more acidic solutions. A pH greater than 7 indicates a more alkaline solution. A pH of 7.0 is considered neutral, neither acidic nor alkaline.

Point source - any discernable, confined and discrete conveyance including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, landfill leachate collection system, vessel or other floating craft from which either a pollutant or waste is or may be discharged.

Reference condition - the range of chemical, physical, and biological characteristics of waters minimally affected by human influences. In the context of an evaluation of biological indices, or where necessary to perform other evaluations of water quality, the reference condition establishes attainable chemical, physical, and biological conditions for specific water body types against which the condition of waters of similar water body type is evaluated.

Riparian – located on the banks of a stream or other body of water.

Riparian Buffer Zone - the width of land adjacent to lakes or streams between the top of the bank or top of slope or mean water level and the edge of other land uses. Riparian buffer zones are typically undisturbed areas, consisting of trees, shrubs, groundcover plants, duff layer, and a naturally vegetated uneven ground surface, that protect the waterbody and the adjacent riparian corridor ecosystem from the impact of these land uses.

Runoff - water that flows over the ground and reaches a stream as a result of rainfall or snowmelt. ****

Secondary contact recreation – this water classification is protective when immersion is unlikely. Examples are boating, wading, and rowing. These two broad uses can be logically subdivided into an almost infinite number of subcategories (e.g., wading, fishing, sailing, powerboating, rafting.). Often fishing is considered in the recreational use categories. (EPA Water Quality Standards Handbook, 1994)

Sedimentation - the sinking of soil, sand, silt, algae, and other particles and their deposition frequently on the bottom of rivers, streams, lakes, ponds, or wetlands.

Sources – the land uses, human activities, or occurrence of conditions that are the origin of the causes of impairments, impacts or stresses on river and stream in the basin.

Terrigenous - derived from the land, especially by erosive action. Used primarily of sediments.***

Thermal modification - the change in water temperature.

Total maximum daily load (TMDL) - the calculation of the maximum amount of a pollutant that a waterbody can receive on a daily basis and still meet Vermont Water Quality Standards.

Total phosphorus – the total amount of phosphorus dissolved in solution (reactive) and in particulate form.*

Total suspended solids – the total amount of particulate matter that is suspended in the water column.*

Transparency – a depth measurement taken by lowering a white and black, 8-inch diameter, Secchi disk into the water to the point just before it cannot be seen.

Trophic – a relative level of productivity.*

Turbidity - the capacity of materials suspended in water to scatter light usually measured in Nephelometric Turbidity Units (NTU). Highly turbid waters appear dark and "muddy."

Type / Typing - a category of water management requirements based on both the existing water quality and reasonably attainable and desired water quality management goals. Through the basin plan all Class B waters must be allocated into one or more Water Management Types pursuant to § 3-06 of the Vermont Water Quality Standards.

Waste Management System -a planned system in which all necessary components are installed for managing liquid and solid waste, including runoff from concentrated waste areas and silage leachate, in a manner that does not degrade air, soil, or water resources. The purpose of the system is to manage waste in rural areas in a manner that prevents or minimizes degradation of air, soil, and water resources and protects public health and safety. Such systems are planned to preclude discharge of pollutants to surface or ground water and to recycle waste through soil and plants to the fullest extent practicable.

Water quality parameter – the physical, chemical or biological attribute measured to determine water quality.

Water Quality Standards - the minimum or maximum limits specified for certain water quality parameters at specific locations for the purpose of managing waters to support their designated uses. In Vermont, Water Quality Standards include both Water Classification Orders and the Regulations Governing Water Classification and Control of Quality.

Waters - all rivers, streams, creeks, brooks, reservoirs, ponds, lakes, springs, wetlands and all bodies of surface waters, artificial or natural, which are contained within, flow through or border

upon the State or any portion of it.

Watershed - all the land within which water drains to a common waterbody (river, stream, lake, pond or wetland).

Source:

* - *Vermont Volunteer Surface Water Monitoring Guide*, VDEC, Water Quality Division, 2005

** - Caduto, M.J., 1990. *Pond and Brook: A Guide to Nature in Freshwater Environments*, University of New England Press, Hanover, NH

*** - Dictionary.com

**** - Vermont Stream Geomorphic Assessment, Phase 2 Rapid Assessment, Appendix Q

***** - The Nature Conservancy - http://www.nature.org/aboutus/howwework/conservationmethods/privatelands/conservationeasements/files/consrvtn_easemnt_sngle72.pdf

List of Acronyms

319	Federal Clean Water Act, Section 319
AAP	Accepted Agricultural Practice
Agency	Vermont Agency of Natural Resources
AMA	Agricultural Management Assistance Program
AMP	Acceptable Management Practice
ANS	Aquatic Nuisance Species
ARS	Agricultural Resource Specialist
B1	Class B Water Management Type 1
B2	Class B Water Management Type 2
B3	Class B Water Management Type 3
BASS	Biomonitoring and Aquatic Studies Section, Vermont Water Quality Div.
BCRC	Bennington County Regional Commission
BMP	Best Management Practice
CRCDC	Connecticut River Conservation District Coalition
CRJC	Connecticut River Joint Commissions
CRP	Conservation Reserve Program
CREP	Conservation Reserve Enhancement Program
CRWC	Connecticut River Watershed Council
CVPS	Central Vermont Public Service Co.
CWA	Federal Clean Water Act
Department	Vermont Department of Environmental Conservation
EQIP	Environmental Quality Incentive Program
FERC	Federal Energy Regulatory Commission
FWRT	Friends of the West River Trail
FSA	Farm Service Agency (USDA)
GIS	Geographic Information System
GMNF	Green Mountain National Forest
LCBP	Lake Champlain Basin Program
LTP	Land Treatment Planner
LWD	Large Woody Debris
NASS	National Agricultural Statistics Service
NEAS	New England Agricultural Statistics
NEGEF	New England Grassroots Environmental Fund
NFWF	National Fish and Wildlife Foundation
NOAA	National Oceanic and Atmospheric Administration
NOFA	Northeast Organic Farming Association of Vermont
NPDES	National Pollution Discharge Elimination System
NPS	Non-point source pollution
NRCD	Natural Resource Conservation District
NRCS	Natural Resources Conservation Service
ONRCD	Ottauquechee Natural Resources Conservation District
ORW	Outstanding Resource Water

PDM	Pre-Disaster Mitigation
PFW	Partners for Fish and Wildlife
RC&D	Resource Conservation and Development Council of USDA
RPC	Regional Planning Commission
RRP	Rock River Preservation
SCA	Student Conservation Association
SEP	Supplemental Environmental Program
SGA	Stream Geomorphic Assessment
SIT	School for International Training
SVNMP	Southern Vermont Nutrient Management Program
SWCRPC	South Windsor County Regional Planning Commission
T&E	Threatened and Endangered Species
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TU	Trout Unlimited
USACE	United States Army Corp of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USFS	United States Forest Service
UVA	Use Value Appraisal program, or Current Use Program
VAAFM	Vermont Agency of Agriculture, Food and Markets
VANR	Vermont Agency of Natural Resources
VDEC	Vermont Department of Environmental Conservation
VDFPR	Vermont Department of Forests, Parks and Recreation
VDHP	Vermont Department of Historic Preservation
VDOH	Vermont Department of Health
VFWD	Vermont Fish and Wildlife Department
VGS	Vermont Geological Survey
VIP	Vermont Invasive Patrollers
VLCT	Vermont League of Cities and Towns
VLT	Vermont Land Trust
VNNHP	Vermont Nongame and Natural Heritage Program
VNRC	Vermont Natural Resources Council
VSA	Vermont Statutes Annotated
VTrans	Vermont Agency of Transportation
VYCC	Vermont Youth Conservation Corp
WCNRCD	Windham County Natural Resources Conservation District
WHIP	Wildlife Habitat Incentive Program
WQRP	Water Quality Remediation Plan
WQS	Water Quality Standards
WRC	Windham Regional Commission
WRP	Water Resources Panel
WRWA	West River Watershed Alliance
WWTF	Wastewater Treatment Facility

Appendicies