PART THREE: SURFACE WATER MONITORING & ASSESSMENTS

A) Current Surface Water Quality Monitoring Program

The following section is a description of the Water Quality Division's (WQD) current ambient monitoring program that is comprised of numerous discrete projects. The WQD's monitoring efforts are classified herein as physical/chemical, biomonitoring, volunteer and other. Within each of these classes, monitoring projects are further described as core, or long-term projects; diagnostic studies, which identify the causes of particular water quality problems; and special studies, which provide information and data on specific water quality issues. Other projects coordinated by close partners of the WQD are also included in this listing.

1) Physical and chemical monitoring

Core Programs

The Spring Phosphorus Program collects spring overturn nutrient and physical and chemical data on Vermont lakes and ponds that are 20 acres in size or larger. Parameters include total phosphorus, total nitrogen, alkalinity, calcium, magnesium, hardness, Secchi disk transparency, and multi-probe profiles (temperature, dissolved oxygen, conductivity and pH). Since 1977, 236 lakes have been monitored in conjunction with this program. Forty-eight lakes have 10 or more years of data and 18 of these have 15 years or more. The Spring Phosphorus Database contains over 1,700 records.

The Lake Assessment Program is designed to rapidly assess the extent to which lakes meet designated uses and to gather information to focus lake management and protection efforts. The sampling intensity for assessment lakes varies with the degree to which impairment is evident or must be documented. In general, lakes are circumnavigated and detailed assessment observations are made regarding in-lake and shoreline conditions with respect to designated uses and threats to water quality. Detailed notes are made regarding the extent and species composition of the macrophyte community. Sampling is performed for total phosphorus, alkalinity, Secchi disk transparency, and multi-probe profiling. Additional sampling may be performed as necessary to determine compliance with Vermont Water Quality Standards. Since 1989, close to 280 comprehensive assessments and 60 cursory assessments have been performed.

The River Water Quality and Aquatic Habitat Assessment Program is designed to: assess the extent to which rivers and streams support designated uses; determine the causes and sources of impacts if there are some; to identify special resource features and high quality waters; and to compile all this data and information into a single report. The Ambient Biomonitoring Program (described below) provides most of the information used to determine a waterbody's aquatic life use support and compliance with Vermont Water Quality Standards. Temperature, nutrients, pH, conductivity and alkalinity are parameters commonly measured concurrently with the biological sampling. The stream geomorphic assessment program (also described below) contributes data and information used to determine aquatic habitat condition. Quality-assured lay monitoring data are a growing portion of the information on rivers and streams especially in determining contact recreation use support based on *E. coli* sampling. Rivers and streams in the basins of focus are also visited to look for obvious sources of pollution from the land or indicators of

problems or threats in the water such as sedimentation, heavy algae growth, or water with unnatural color or odor.

The Water Level Monitoring Program monitors lake surface elevations to establish mean water levels for a variety of purposes, most notably to determine the jurisdictional boundary of the State's lakes and ponds under the shoreland encroachment permit program and Vermont's Public Trust Doctrine.

The Lake Champlain Long-Term Monitoring Program surveys the quality of Lake Champlain waters on a biweekly basis from May to November at 13 locations throughout the lake. Eighteen major tributaries are sampled on an event basis as well. The program's large physico-chemical parameter list includes: species of phosphorus, nitrogen and organic carbon; chlorophyll-a; base cations; alkalinity; total suspended solids; dissolved oxygen; conductivity; and pH. As of April 2003, this program had assembled a database comprising 6,366 lake and 4,282 tributary sampling events.

The Long-Term Monitoring (LTM) Acid Lakes Program collects chemical and biological data on lakes located in low alkalinity regions to determine the effects of acid deposition on Vermont's lakes. Initially, nearly 200 lakes statewide were surveyed during the winters of 1980 through 1982 to identify the acid sensitive areas of the state. Eleven lakes selected from these areas are now included in the LTM and are sampled at least eight times every year for 16 chemical parameters related to acidification. These data are used to classify lakes according to their acidification status, evaluate spatial and temporal variability in measured parameters, track changes in acidification status over time as related to reductions in atmospheric emissions of acid precursors (e.g., oxides of sulfur and nitrogen), and evaluate impacts of acidification on aquatic communities. As of April 2003, the LTM data archive comprised 1,857 in-lake and 405 lake-outlet sampling records. This project contributed data to a seminal article describing long-term acidification trends across northeast North America, which was published in the journal Nature in 2000.

The Stream Geomorphic Assessment Program collects geomorphologic data on streams throughout the state to assess stream geomorphic condition and develop regime relations for Vermont's streams. Geomorphic assessments enable the prediction of expected rates of river adjustment and an evaluation of the effects of various land and river management practices on geomorphic condition and physical habitat quality. Regime relations guide stream protection, management, and restoration projects and assist in the establishment of Vermont-specific physical criteria for water quality classification and use attainment determinations. Parameters measured include channel dimension (cross section), pattern (meander geometry), longitudinal profile, channel substrate conditions, structure and composition of riparian vegetation, and floodplain and valley morphology. Geomorphic assessment protocols have been developed and promoted by the Agency of Natural Resources. Geomorphic assessments are done according to different levels of complexity. The figure on the following page illustrates the location and level of completed or ongoing stream geomorphic assessment efforts.

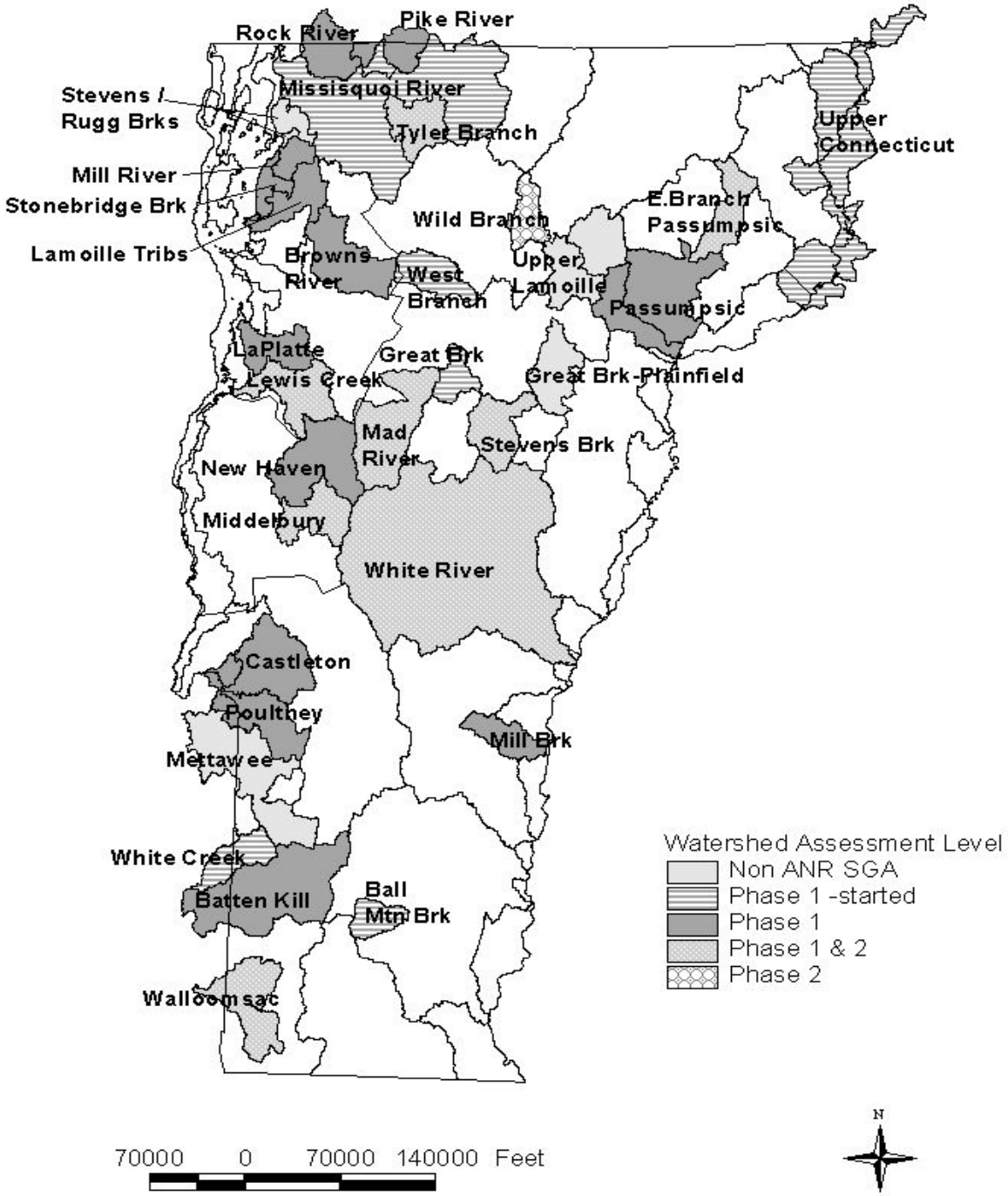


Figure 3.A.1. Location & Level of Stream Geomorphic Assessments (April 2004).

Lake Diagnostic Studies
Diagnostic studies are typically aimed at identifying the cause of eutrophication in Vermont lakes. Over the past 20 years, Vermont has performed numerous such monitoring studies, and the results of these studies have led to remediation steps. Lakes on which diagnostic studies have been performed include Harveys Lake (Town of Barnet), Lake Morey (Fairlee), Lake Iroquois (Hinesburg), Fairfield Pond (Fairfield), Lake Parker (Glover), Lake Carmi (Franklin), and Lake Champlain. Presently, the DEC is investigating the possible initiation of a new diagnostic study for Ticklenaked Pond, a nutrient-impaired lake in the Town of Ryegate.

A wide variety of parameters are sampled in conjunction with lake diagnostic studies, and the actual tests performed are specific to the project. Standard eutrophication parameters (total phosphorus, Secchi disk transparency, and dissolved oxygen) are always measured. Other parameters taken from sediments and the water column can be measured as needed.

Special Studies
Special studies are those performed to gain more information about a particular environmental issue of importance to DEC. There are four special studies noted below.

The EPA-sponsored **REMAP Assessment of Mercury** in Sediments, Waters and Biota of Vermont and New Hampshire Lakes Project is a three-year effort to identify lake types occurring in the two states that have elevated levels of mercury in fish and upper trophic level biota. The parameter list for this integrated collaborative monitoring project is large, and includes standard limnological measurements and mercury in total and methyl phases in sediment, water, and biota. There is also a paleolimnological component that has determined the extent to which atmospherically deposited mercury has entered lakes in the study set. Two peer-reviewed journal articles have been produced from this study that was completed in 2003.

The Best Management Practices Effectiveness Demonstration Project is a long term stream monitoring effort (1999–2007) designed to assess the efficacy of best management practices in controlling pollutants in nonpoint source runoff in tributaries of Lake Champlain.[1] This cooperative DEC-USGS project differs from the project described immediately above in that it uses an upstream-downstream approach to pinpoint reductions in pollutant runoff attributable to specific installed Best Management Practices. The project is being carried out simultaneously on one agricultural and one urban stream in the Lake Champlain basin (Little Otter Creek and Englesby Brook, respectively). Sampling is focused on nutrients and sediment and sampling is conducted monthly and during storm events. Minor BMP structures were installed during 2002 in both watersheds. Larger implementation projects are scheduled for 2004.

In conjunction with the **Paleolimnology of Vermont Lakes Project**, DEC is collaborating with the University of Vermont to develop a set of indicators of present and historical trophic status

[1] During 1994-2001, a similar study was conducted known as **the Lake Champlain Agricultural Best Management Practices Monitoring Project.** This comparative observational study was carried out to evaluate the efficacy of both low- and high-intensity reach specific BMP implementation strategies related to livestock grazing. Parameters measured included total phosphorus, total and Kjeldahl nitrogen, total suspended solids and *E. coli* along with biological assessments. Even though the project has been completed and results published, biological assessments conducted by DEC are continuing.

based on the paleolimnology of carbon and nitrogen stable isotopes ($\delta^{13}C$ and $\delta^{15}N$). Using cores from the sediments of several lakes, DEC is working to identify the extent to which the present trophic condition in these lakes deviates from the historic background. Such information is instrumental in understanding the extent to which productivity (and thus phosphorus) has been elevated since the lake watersheds were first cleared in the early 1800's.

2) Biological monitoring

Core Programs

The **Ambient Biomonitoring Program** was established in 1982 to 1) monitor long-term trends in water quality as revealed by changes in ambient aquatic biological communities over time; 2) evaluate potential impacts on aquatic biological communities from permitted direct and indirect discharges, ACT 250 (10 V.S.A. 151) projects, nonpoint sources, and spills; and 3) establish a reference database to facilitate the generation of Vermont-specific biological criteria for water quality classification and use attainment determinations. Since 1985, DEC has used standardized methods for sampling fish and macroinvertebrate communities, evaluating physical habitat, processing samples, and analyzing and evaluating data. The program has led to the development of two Vermont-specific fish community Indexes of Biotic Integrity (IBI) and several macroinvertebrate metrics. Guidelines have been developed to determine water quality standards attainment using both macroinvertebrate community biological integrity metrics and the IBI. Approximately 75 sites per year are assessed using fish and/or macroinvertebrate assemblages. Alkalinity, pH, conductivity, temperature and such measurements as substrate composition, embeddedness, canopy cover, percent and type of periphyton cover, and approximate velocity are routinely monitored. From 1985 to April 2003, well over 1,700 stream assessments were completed using macroinvertebrate and/or fish from 1229 stream reaches.

The Aquatic Macrophyte Monitoring Program collects baseline information on aquatic plant communities in Vermont lakes by conducting descriptive surveys using a pre-established plant cover scale. This program has been active since the late 1970's, and information is available from 177 discrete surveys.

The WQD conducts numerous **Aquatic Nuisance Species Searches and Surveys** each year to search for new populations and monitor existing populations of nuisance aquatic species, primarily Eurasian watermilfoil (*Myriophyllum spicatum*), water chestnut (*Trapa natans)*, zebra mussels (*Dreissena polymorpha*), and the wetland invasive purple loosestrife (*Lythrum salicaria*).

One interesting component of these aquatic nuisance species efforts is the Lake Champlain Zebra Mussel Monitoring Program. For this effort, 13 in-lake and 12 shoreline stations in Lake Champlain are monitored for larval and settler zebra mussel presence and density every two weeks from April through November. In addition, adult zebra mussel surveys are performed at selected shoreline locations during late summer. Notably, this is the only such zebra mussel monitoring project of it's kind in the United States. As of April 2003, there were 2,220 veliger records and 1,013 settler records within this program's nine years of data records.

Special Studies

The Biodiversity Monitoring Program evaluates the status of selected biological species and communities in Vermont. Specific activities include 1) distribution surveys of aquatic plant, fish and macroinvertebrate species listed by the Vermont Endangered Species Committee as rare, threatened, endangered, or of special concern; 2) distribution surveys of communities having species considered likely candidates for future listing (e.g., snails); and 3) monitoring of biological communities or community types, the diversity of which is threatened (e.g., Lake Champlain mussel and cobble/shale macroinvertebrate communities threatened by zebra mussels). Data are used to describe species distribution, identify species/communities at risk, and develop management plans for the protection of identified species/communities.

The Lake Bioassessment Project was initiated in 1995 to begin developing biological criteria for Vermont lakes. This monitoring effort was launched as a cooperative project with the State of New Hampshire. The goal of the project is to develop numeric measurements of the phytoplankton, macrophyte, and macroinvertebrate communities in reference lakes for use in assessing aquatic life use attainment in lakes. Consistent protocols have been developed to measure these biological assemblages, and to date, 12 New Hampshire and 41 Vermont lakes have been included in the project. Statistically-validated multimetric indices have been developed for the phytoplankton and macroinvertebrate communities. To date, data describing macrophyte commbnities have proven insufficiently precise to develop macrophyte criteria.

The **Vermont Wetlands Bioassessment Project** is a coordinated effort between the DEC and the Vermont Department of Fish and Wildlife's Nongame and Natural Heritage Program to document and understand the biological and physical characteristics associated with seasonal pools (vernal pools) and northern white cedar swamps in Vermont. Since 1999, the project has collected biological, physical and chemical data from 28 seasonal pools throughout the state. Information collected on the invertebrates, amphibians, algae, and plants associated with seasonal pools has been used to assess and monitor the ecological health of seasonal pools in Vermont. This project was completed in 2002 and efforts at using these data to develop vernal pool biocriteria have seen limited success. DEC plans to modify this project for 2004 by adopting protocols and sampling strategies consistent with the Lake Bioassessment Project, to include more rigorous procedures for monitoring marginal wetland macrophytes.

The Lake Champlain Long-Term Monitoring Program described above also includes biological sampling, which is primarily aimed at assessing phytoplankton, zooplankton, and macroinvertebrate communities. Data from this element of the project resides in the New York State Natural History Museum with copies available only in spreadsheet form in Vermont. These data have been underanalyzed and underutilized as of this writing, but should provide a baseline for evaluating changes in ecosystem structure given implementation of the Lake Champlain TMDL for phosphorus.

The Northern Leopard Frog Surveys in the Lake Champlain Basin Project was initiated in response to reports of malformed frogs in the Lake Champlain basin in Vermont in the summer of 1996. Malformed frogs were reported from 12 sites in five counties within the Lake Champlain basin. Systematic field surveys were initiated in 1997, targeting the northern leopard frog (*Rana pipiens*). These surveys recorded the frequency and morphological characteristics of

gross abnormalities among newly metamorphosed northern leopard frog populations at 20 sites within the Lake Champlain basin. With subsequent support through the USEPA REMAP program, DEC has examined over 6,000 northern leopard frogs since 1996, and external malformations have been detected in 7.5% of the frogs examined. Data characterizing the gross abnormalities and describing the frequency and occurrence of abnormalities within northern leopard frog populations continues to be gathered at 10 established sites within the Lake Champlain basin. All findings are reported to the North American Reporting Center for Amphibian Malformations (http://www.npwrc.usgs.gov/narcam/). DEC also continues to collaborate with the National Institute of Environmental Health and Sciences, the National Wildlife Health Center, and other researchers, providing environmental samples and specimens to help further malformed frog investigations.

Other Biological Monitoring Projects either ongoing or conducted on a periodic basis include:

- monitoring nontarget impacts to aquatic biota in lakes chemically treated with the aquatic herbicide Sonar® (fluridone) to control Eurasian watermilfoil infestations;
- monitoring the effects on both target and nontarget organisms of copper sulfate treatments to small recreational lakes and water supply reservoirs; and
- monitoring impacts to nontarget fish and macroinvertebrates in rivers treated with lampricide (TFM) to control sea lamprey (*Petromyzon marinus*) in Lake Champlain..

The Fish Contaminant Monitoring Program is managed by the WQD and performed in cooperation with the Vermont Department of Fish and Wildlife and the Vermont Department of Health. Edible tissue from game fish acquired throughout the state is analyzed for mercury and other contaminants. These data are then used to set and subsequently refine fish consumption advisories issued by the Vermont Department of Health.

3) Volunteer monitoring

Citizen groups have become increasingly involved in monitoring, education, protection, and restoration projects in Vermont. DEC provides assistance and training to volunteers whenever possible. Watershed and lake associations are presently active on numerous rivers and lakes in the state. In fact, there are over 100 such associations statewide. DEC has developed a directory listing various watershed associations and their activities in "Current Programs of Vermont Watershed Associations – October 2003" with a lake association addendum listing active lake groups. This directory listing can be inspected on the web at:
www.anr.state.vt.us/dec/waterq/lakes/docs/lp_watershedprograms.pdf

Core programs

The Vermont Lay Monitoring Program equips and trains local lake users to measure the nutrient enrichment of lakes by collecting water quality data following a rigorously documented and quality assured methodology. This citizen monitoring program is based on trophic parameters and monitors approximately 40 inland lakes and 25 Lake Champlain stations per year. All Lake Champlain stations and many inland lakes in the program are sampled for chlorophyll-a, total phosphorus, and Secchi disk transparency. Other lakes are sampled only for Secchi disk transparency. All sampling occurs on a weekly basis during the summer. Since the development of the Lay Monitoring Program in 1979, data has been generated on 84 lakes and 36 Lake Champlain stations. Seventy-two inland lakes and 30 Lake Champlain stations have

five or more years of full season data. In addition to their standard monitoring, Vermont's citizen lake monitors also assist in the ANS Watchers Program (see below), and in collecting data for the Lake Bioassessment Project.

The Citizen Lake and Watershed Survey Program provides survey sheets and technical training to volunteers, lake and watershed associations, and other interested groups to enable them to perform screening level assessments to identify potential nonpoint sources of pollution to lakes by conducting in-lake, lakeshore, and lake watershed surveys.

The Aquatic Nuisance Species (ANS) Watchers Program trains citizen volunteers to monitor for the presence of invasive nonnative aquatic species. The program is currently focusing on monitoring for Eurasian watermilfoil, water chestnut, and zebra mussels. There are presently about 110 ANS Watchers throughout Vermont.

The Volunteer Acid Precipitation Monitoring Program was initiated in 1980 to monitor changes in precipitation chemistry. Dedicated volunteers at six sites around Vermont (Holland, Morrisville, Mt. Mansfield, St. Albans, St. Johnsbury, and Underhill) collect precipitation samples on an event basis. The volume and pH of each storm event is recorded. Additional parameters such as conductivity and wind direction are recorded at individual stations. The data are used to assess spatial and temporal variability in the pH of bulk precipitation and assess changes in the pH of bulk precipitation over time and as related to reductions in atmospheric emissions of acid precursors (e.g., oxides of sulfur and nitrogen).

Other volunteer initiatives

The Water Quality Division collaborates with the LaRosa Laboratory (showcased below) on a novel program to assist citizen monitoring groups statewide. Beginning in 2003, the Water Quality Division and LaRosa Laboratory began issuing analytical services grants to volunteer organizations, based on a competitive proposal process. The project was very successful in 2003. Eleven projects were supported. These projects ranged in scope from small, single-lake studies to large, multi-year and multi-parameter watershed assessment initiatives. In 2003, the program produced in excess of 1,800 viable, quality-assured data records across Vermont.

4) Monitoring partnerships

Federal

The US Army Corps of Engineers (ACOE) manages several flood control reservoirs in Vermont. These are monitored routinely for flow and stage, and periodically for a variety of physico-chemical constituents. ACOE reservoirs with designated swimming beaches are also monitored for *E. coli* regularly during the swimming season. ACOE reports on it's monitoring activities annually, and shares these reports with WQD. ACOE sampling results are used in conjunction with Integrated Assessment reporting.

The US Environmental Protection Agency (EPA) coordinates regional water quality monitoring projects of a variety of types. In recent years, projects which WQD has been involved include the REMAP New England Wadeable Streams Project and the National Study of Chemical Residues in Fish. EPA was also the principal sponsor of the REMAP Assessment of

Mercury in Waters, Sediments and Biota of Vermont and New Hampshire Lakes project. WQD plans to participate in the upcoming REMAP New England Lakes Project. Results of these studies are used for a variety of purposes in addition to Integrated Assessment reporting.

The US Fish and Wildlife Service (FWS) sponsors projects across New England dealing with toxic contamination of aquatic biota. WQD has collaborated with FWS on several projects, and data are freely shared. In addition, FWS co-sponsored toe REMAP mercury project discussed above.

The US Geological Survey (USGS) operates a network of gauging stations on Vermont waters, which are supported by a cooperative agreement with DEC. This gauging network provides water flow data that are critical for numerous applications, both within and outside of DEC. USGS also coordinates several water quality studies throughout Vermont in a variety of disciplines, and the results and data are commonly shared with DEC for numerous uses including permitting and integrated Assessment reporting.

State

The Vermont Department of Forests, Parks and Recreation operates a comprehensive beach monitoring program for all of it's public use beaches on State Park lands. Twenty-nine beaches are monitored on a weekly basis following established protocols. Swim advisories are posted based on results of the testing, when *E. coli* sample values exceed the Vermont standard for Class B waters of 77 *E. coli* /100ml. These data are openly shared with DEC. They are used for assessments as well as for identifying beaches subject to chronic, controllable bacterial contamination.

The Vermont Department of Health (DOH) operates a program whereby appointed Town Health Officers are trained to collect water quality samples at designated beaches. This program is suitable for small municipalities with informally-used swim beaches. Data reported back to Town Health Officers from the DOH laboratory take the form "safe for swimming," or "violates Vermont's standard unsafe for swimming." These data are not reported not tracked as numeric results. Town Health Officers commonly use these data to post warnings at swim beaches. Owing to resource constraints, samples collected in conjunction with that program cannot follow the strict quality assurance procedures required by DEC and the Department of Forests, Parks and Recreation in their *E. coli* monitoring projects. As such, this program provides useful and preliminary screening information to determine where swim beach water quality may need further assessment.

The Vermont Monitoring Cooperative (VMC) is a collaborative organization in which scientists collect and pool information and data for the purpose of improving our understanding, protection, and management of Vermont's forested ecosystems. Participating cooperators from government, academic and private sectors, conduct research projects on a variety of topics including forest health, air quality and meteorology, wildlife, aquatic systems and others. The VMC helps make the data and results from these projects available to other scientists, educators, resource managers and the general public. The VMC was initiated in 1990 as a state, university, and federal partnership, with a one-hundred year envisioned lifespan. The centerpiece of the VMC is the data library and card catalogue system that allow data to be shared, archived, and

accessed by scientists and other interested parties via the VMC website. The data archive contains data and ancillary textual material from over 100 projects, and is geographically referenced.

Academic

DEC maintains ties with several academic institutions interested in water quality monitoring. A partial list of these institutions includes Dartmouth College, Middlebury College, the University of Vermont, and member schools of the Vermont State College System. Collectively, these institutions carry out numerous projects and resultant data are commonly used by DEC for assessment purposes. The University of Vermont also carries out several larger-scale research and monitoring projects cooperatively with or of significant interest to DEC. A non-inclusive list of University of Vermont projects includes paired assessments of geomorphic and macroinvertebrate biometrics on streams, research into natural background levels and strategies to mitigate *E. coli* in Vermont waters, assessment of cyanotoxins in Lake Champlain and elsewhere, impacts of non-native species on aquatic food webs.

Local

The Addison County River Watch Collaborative (ACRWC) is a volunteer-based consortium of local volunteer organizations that monitor waters in several watersheds in Addison County. The ACRWC has monitored approximately 45 sites across four watersheds for *E. coli* and eutrophication-related parameters. ACRWC provides data and summary reports to DEC on an annual basis for assessment purposes. These data are also being used to assist in development of the Otter Creek and Lower Direct Champlain Basin Plans. The ACRWC received a LaRosa Laboratory services grant in 2003 (see section 5 below). This organization launched a new monitoring project, during 2004 and in partnership with DEC, to assist in the development of nutrient criteria.

The White River Partnership (WRP) is a private, non-profit organization that has established a monitoring program for the watershed using several volunteer "stream-teams." Activities include geomorphic assessment, priority site mapping, and water quality sampling for a variety of constituents including temperature, turbidity, conductivity, and *E. coli*. WRP's volunteer monitors generate quality-assured data that are used to identify priority reaches for protection or remediation.

The West River Watershed Alliance (WRWA) is another watershed group dedicated to similar goals as the ACRWC and WRP but whose focus is on the waters in the West River watershed. The Alliance has re-established a monitoring program in the West River watershed that for many years was run by the Bonnyvale Environmental Education Center (BEEC). BEEC data were provided annually to DEC for assessment purposes for many years. The WRWA also received a LaRosa laboratory services grant in 2003 and 2004.

The City of Burlington and Town of Colchester collectively monitor several heavily-used swimming beaches, by measuring *E. coli* on a regular basis. These data are made publicly in near real-time via the “Burlington Eco-Info” website (www.burlingtonecoinfo.net).

The Watershed Alliance of the University of Vermont and **River Network** have been active in promoting surface water quality monitoring for elementary and high schools throughout Vermont. Such monitoring is valuable from an educational and student/community involvement standpoint.

The Friends of the Mad River (FMR) is a non-profit organization sharing similar goals to the above noted groups. The FMR has undertaken a number of planning and implementation projects along with a long-standing water quality monitoring program which includes *E. coli* and a number of other parameters. DEC has been periodically provided data for use in assessment reporting.

The LaPlatte Watershed Volunteer Water Quality Monitoring Program was initiated to track changes in water quality over time, identify potential problems and progress in improving water quality and protection the watershed, and to contribute to public understanding of water quality issues. This organization received a LaRosa laboratory services grant in 2004.

The Missisquoi River Basin Association (MRBA) is an active non-profit group of volunteers dedicated to the restoration of the river, its tributaries, and Missisquoi Bay. Bringing together diverse interest groups within the community, MRBA's activities are many and varied, including tree planting for streambank stabilization, trash cleanup, supporting farmers in a nutrient management program, river outings, and education forums. In 2005, MRBA began an extensive volunteer nutrient monitoring program at 19 sites on the Missisquoi River and its major tributaries.

5) Monitoring spotlight on…..

The LaRosa Environmental Laboratory - Analytical Services Partnership Program

The Vermont Department of Environmental Conservation is pleased to use this report to showcase a relatively new and highly successful water quality assessment program - the LaRosa Environmental Partnerships Program. This program, which provides slots for laboratory tests to partner organizations throughout Vermont, furthers the purpose of characterizing surface water quality conditions. The program was enabled owing to an important change in the funding mechanism for the Department's LaRosa Environmental Laboratory.

Historically, the LaRosa facility was funded on a per-test basis, with individual State programs paying a fixed rate per analysis. This limited the Department's ability to monitor sites as, most often, there were but limited State funds available to support water quality testing for waters that were not subject to Federal grant projects. In 2002, the LaRosa facility initiated a three-year trial of an alternate funding strategy, whereby each division of DEC (e.g., Water Quality, Waste Management, etc.) was levied an allocation to support the laboratory, in proportion to prior-years use. In return, each division could request tests on an as-needed basis. The Water Quality Division decided to provide its unused allocation to volunteer lake and watershed organizations to augment water quality monitoring in waters of local importance.

Under the LaRosa Analytical Services Partnership Program, locally-based citizen organizations apply for partnership awards, following an RFP-based competitive process. Volunteer-based associations across Vermont are eligible, including river, lake, and watershed groups, and water quality and conservation committees associated with local municipalities. Post-secondary academic institutions and not for profit non-governmental organizations are eligible provided that one of the following criteria are met: 1) the project is designed jointly with a local association to assess current water quality conditions or diagnose a known water quality problem of interest to the local association; or, 2) the project assesses the extent of or diagnoses the cause of a water quality problem of statewide importance.

Many project types are eligible for the program, so long as waters under evaluation are of joint interest to the local association sponsoring the project and to DEC. Annually, proposals for new or existing multi-year projects are accepted. Continuation of existing multi-year projects is subject to availability laboratory capacity, continuing need for the data, and project performance and reporting during prior years.

The program is novel in that no funds are disbursed. Rather, partners are allocated a specified number of pre-scheduled laboratory analyses, to be performed by the LaRosa Laboratory free-of-charge. The program provides sample bottles and/or preservatives that are required for the intended tests. Transportation of samples to the LaRosa Laboratory in Waterbury, as well as costs associated with sample collection, equipment[2] and other project functions are not covered by the program. As such, the LaRosa Analytical Partnerships Program truly serves to develop partnerships between the State and local organizations.

Each project selected for a LaRosa Partnership award is required to prepare a quality assurance project plan. To accomplish this while minimizing the difficulties of QAPP preparation for partner organizations, a pre-established and pre-approved "generic" QAPP is provided that covers the majority of activities likely to be carried out under the program. This QAPP was initially written by EPA to support small monitoring projects funded by the Lake Champlain Basin Program. For the LaRosa Partnership Program, it was modified to be compliant with the current LaRosa Environmental Laboratory quality assurance plan document. DEC staff and a few highly-trained citizen monitors provide guidance to participants on monitoring program design, parameter selection, monitoring techniques, and data quality assessment. Citizens are also provided copies of the DEC's 2005 *Volunteer Guide to Surface Water Quality Monitoring*, and the DEC's citizens Guide to *E. coli* bacteria monitoring.

Since 2003, 20 separate projects have been supported, yielding just over 14,000 discrete datapoints from 262 geo-referenced sites, occupying seven of Vermont's planning basins (see Figure 3.A.2 below). The most extensively monitored regions capture most of the watersheds draining to Lake Champlain and Lake Memphremagog, and the West, Williams, and Saxtons River basins. Several smaller projects are active in waters that drain to the Connecticut River.

[2] The Department is aware that EPA New England is considering developing a water quality monitoring equipment loan program for citizen-programs. Such an initiative would dovetail well with the LaRosa Partnership Program.

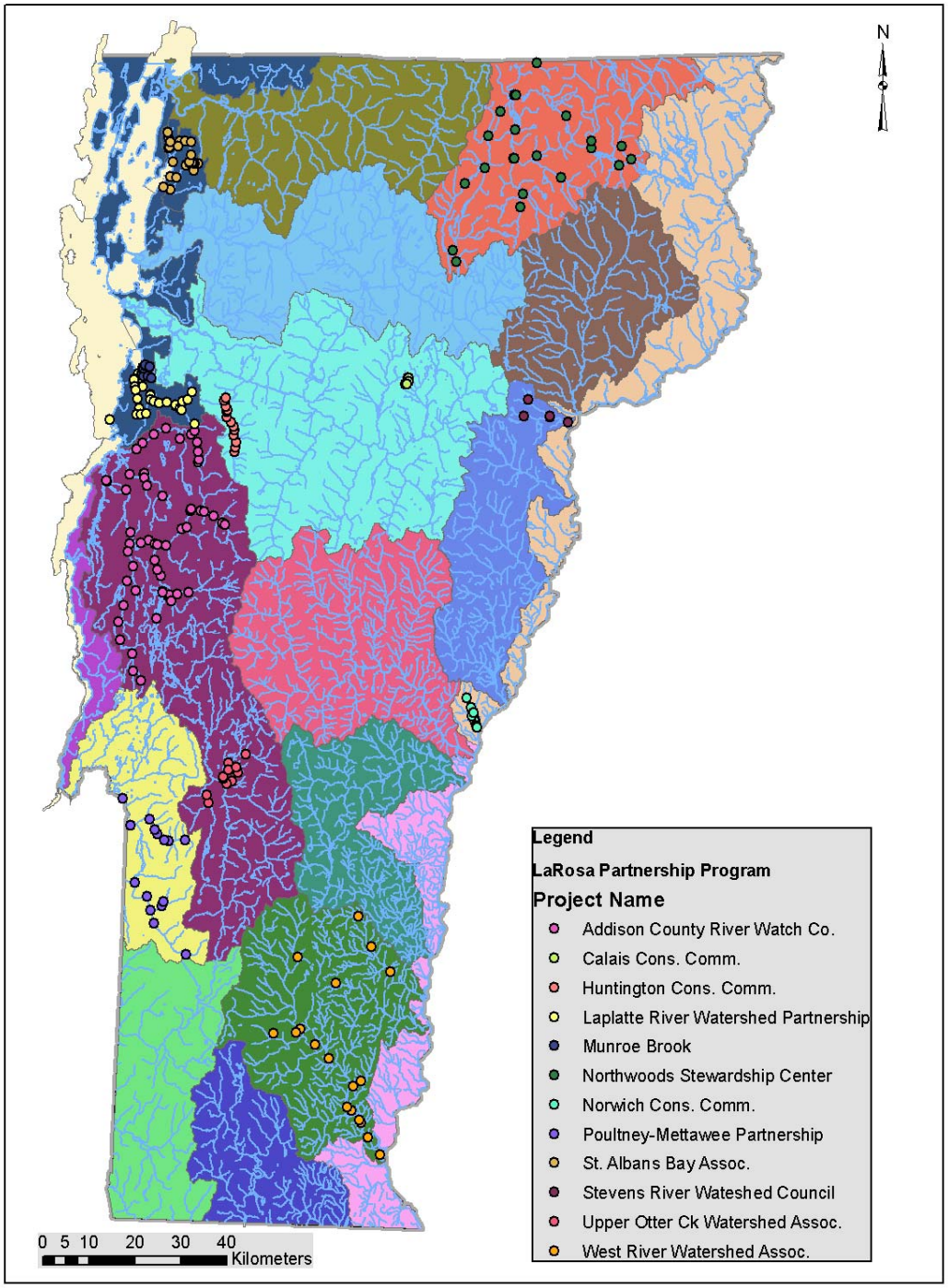


Figure 3.A.2. LaRosa Partnership Program monitoring locations.

While written reporting requirements for LaRosa Partnerships are fairly flexible, the monitoring groups are held to high standards in regards to data quality assessment and data submissions. The laboratory data are freely provided to the groups on an on-going basis through a web-based

reporting system, but are not accepted for assessment and listing until they are re-submitted to DEC using a data submission template, and only after data quality assessment is completed.

The most commonly measured parameters are *E. coli* bacteria, followed by phosphorus, total suspended sediments, total nitrogen, turbidity, and NOx. While monitoring groups are free to request any number of tests from the full suite of analytes offered by the LaRosa Laboratory, annual partnership allocations are balanced to maintain laboratory capacity for Water Quality Division programs, and cannot affect other Department laboratory users.

The partner groups have used the data results in numerous ways, including identifying stressed or potentially impaired locations, monitoring swimming beach suitability, guiding geomorphic assessment reaches, site remediation, and community education. Some examples of data results are provided in the following manner.

Figure 3.A.3 shows *E. coli* measurements from swimming locations measured by the Huntington Conservation Commission. Figure 3.A.4 shows average total phosphorus concentrations, for 2004, from the Addison County Riverwatch Collaborative, the Poultney-Mettowee Partnership, the LaPlatte Watershed Partnership, and the Upper Otter Creek Watershed Council. Total phosphorus increases in the LaPlatte River from upstream to downstream locations are shown in Figure 3.A.5.

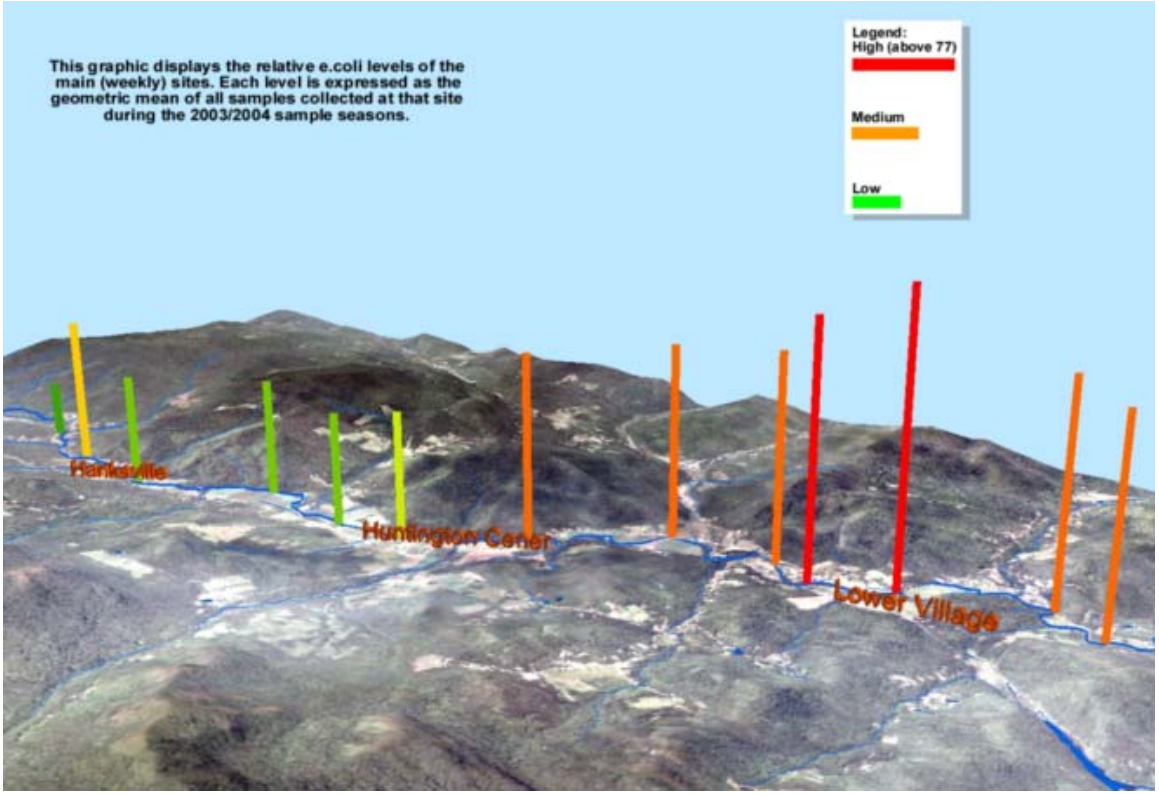
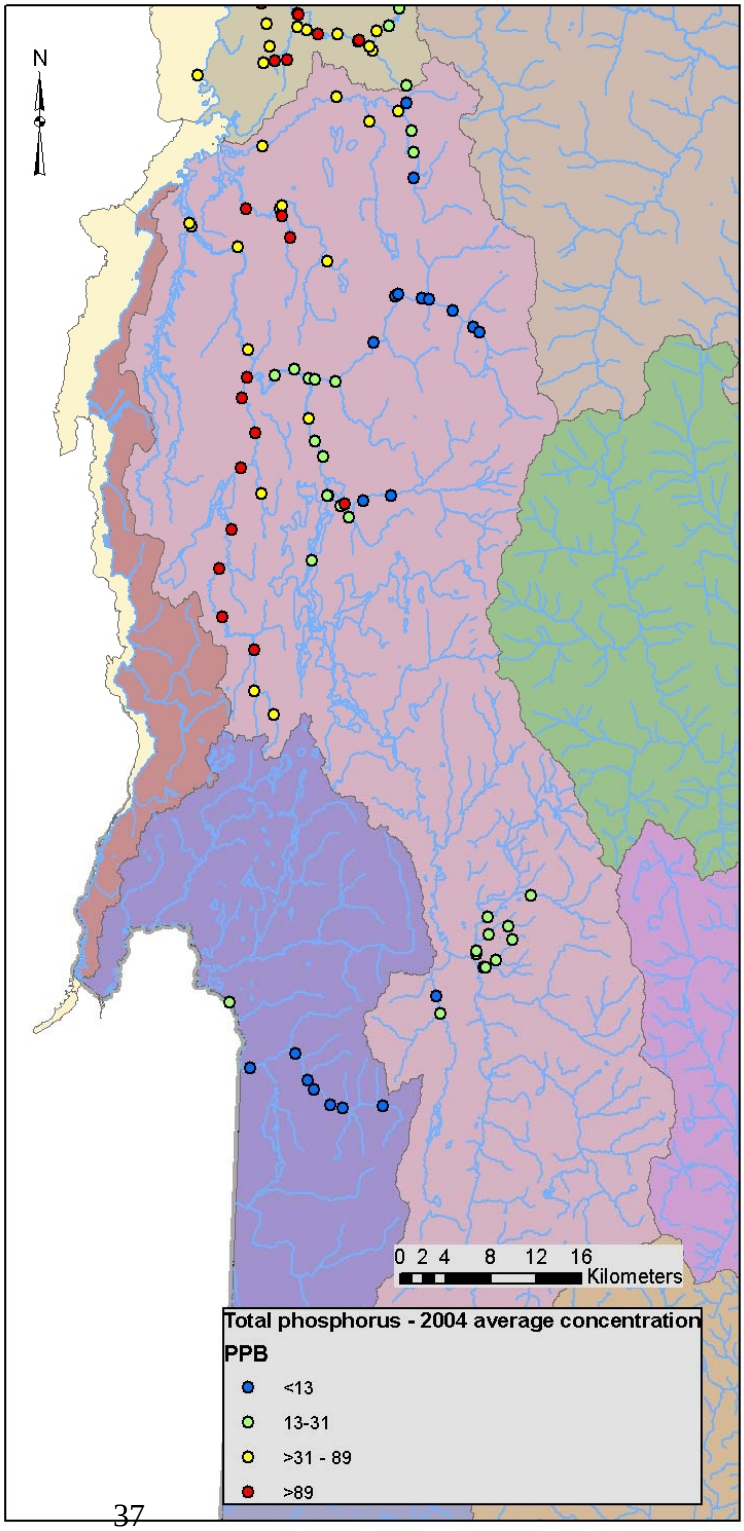


Figure 3.A.3. Geometric mean E. coli concentrations for swimming holes along the Huntington River, 2003-2004.

Partnership participants have provided a wealth of valuable assessment data to DEC and these have been used to support several assessment and listing decisions and to corroborate existing assessments in numerous waters. However, the primary beneficiary of this program is not DEC but rather the watershed organizations that support the monitoring groups. Entering into monitoring partnerships with DEC has resulted in an enhanced level of citizen participation in the basin planning process, resulting in the establishment of more diverse watershed councils and in the implementation of necessary remediation projects.

As groups have become more familiar with monitoring techniques, the watersheds in which they live, and the associated needs for cohesive and coordinated support, they have increasingly sought external grant funding to employ full-time monitoring coordinators. Such coordinators presently exist for four of the largest projects supported by the program. This type of growth within a monitoring organization can transform a small citizen watershed group into an effective watershed-based advocacy organization. The most "mature" groups supported by the LaRosa Partnership Program are independently carrying out coordinated water quality monitoring, geomorphic assessment, and streambank and lakeshore remediation projects, all under the umbrella of Vermont's basin planning process.

This apparent success has not come without growing pains though. In 2005, about 37% of services provided to the Water Quality Division from the LaRosa Laboratory were for Partnership projects. While this level of support is admirable, it has placed a strain on Water Quality Division staff who administer the program, and on the LaRosa staff.



During 2006, the Water Quality Division will be carrying out an internal planning process to determine the level of support that can be allocated to the LaRosa Partnership Program. While it is unlikely the program will cease, it is reasonable to expect that boundaries will be established on individual partnership project sizes and durations. This is expected to maximize effectiveness and geographic coverage, while helping to build basin planning capacity throughout the State.

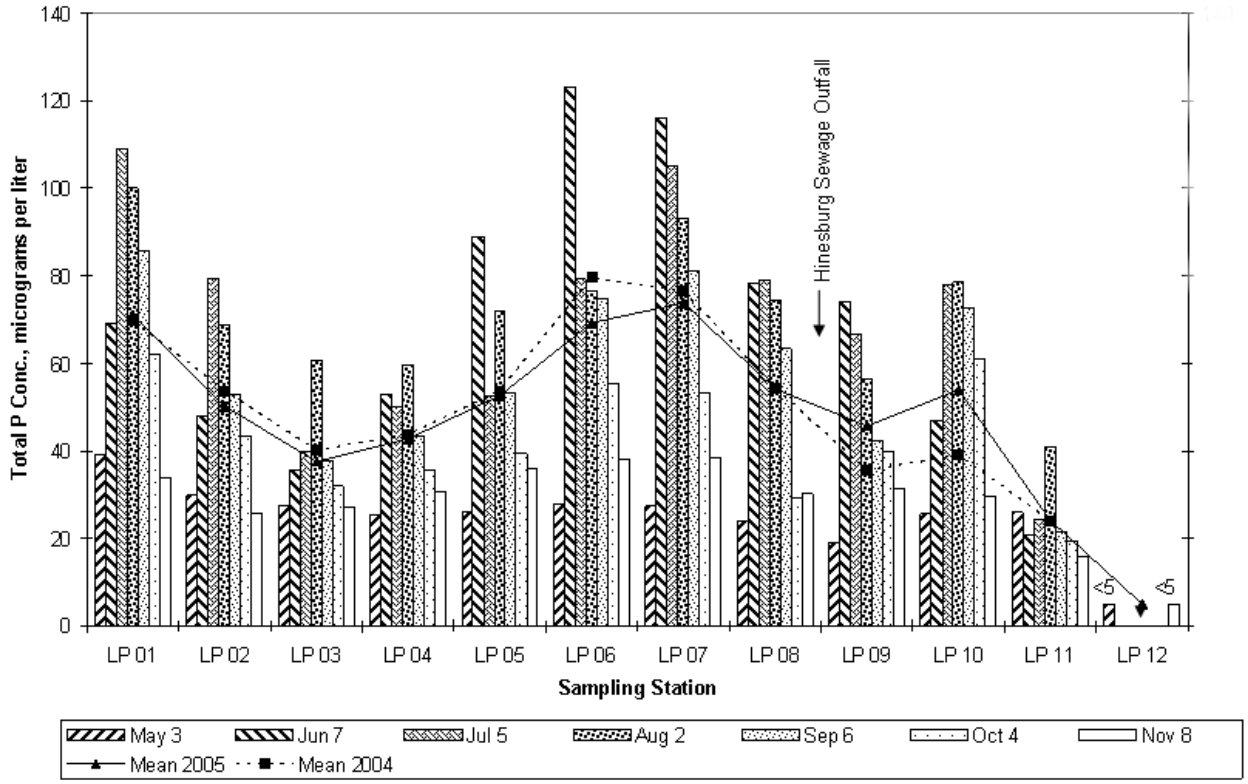


Figure 3.A.5. Total phosphorus measured at eleven stations in the Laplatte River mainstem, for 2005, with means for 2004 and 2005.

B) Assessment Methodology

The following section describes the manner in which the WQD regularly gathers data and other information to make informed decisions about the status, integrity or condition of surface waters.

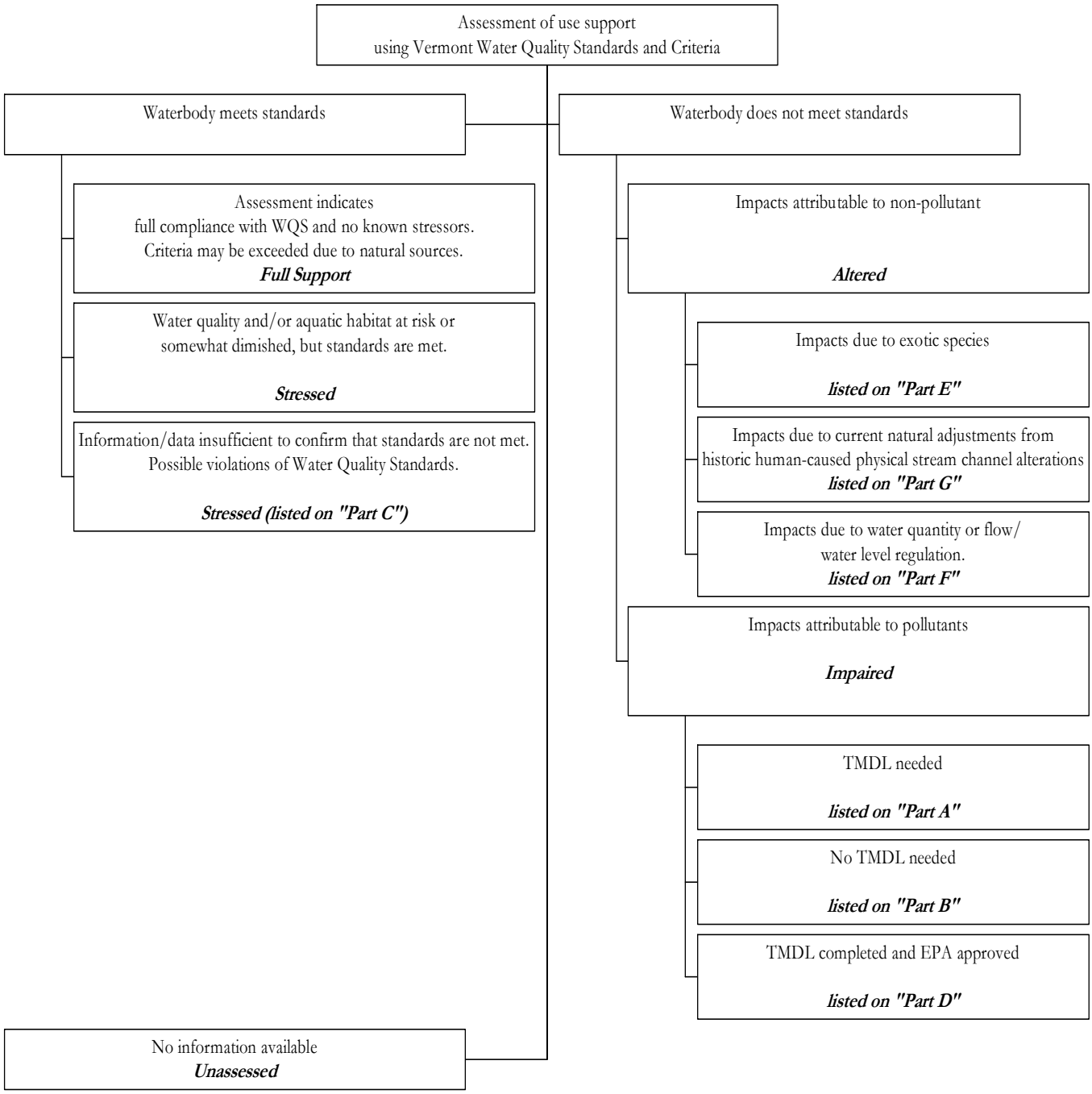
The collection, analysis and evaluation of water quality monitoring data and other information represent the assessment of a water's condition. The assessment of a water is most accurate when judgements about the water's condition are made using chemical, physical and/or biological data of known reliability collected through monitoring. While not as definitive as data collected though monitoring, an assessment of a water's condition can also take into account field observations or other qualitative information.

The Vermont Water Quality Standards, periodically revised and promulgated by the Vermont Water Resources Board[3], provide the basis used by DEC in determining the condition of surface waters including whether the water meets (attains) or does not meet (exceeds or violates) certain criteria. The assessment of a water's condition within the context of the Water Quality Standards requires consideration of the water's classification and management type, a variety of designated or existing uses, and a series of criteria which can be numerical or narrative. The outcome of an assessment conducted by the DEC is to categorize Vermont's surface waters as either "full support," "stressed," "altered," or "impaired." Waters determined to be "impaired" or "altered," and certain "stressed" waters are presented for water quality management purposes on one or more listings. Over time, DEC is gradually reducing the number of waters characterized as "unassessed." The organizational chart appearing on the following page illustrates the major components of DEC's surface water assessment and listing process.

The reader is referred to Appendix C for the entire 2006 Assessment and Listing Methodology.

[3] In 2004, and associated with Act 115 (an act pertaining to permit reform), the Environmental Board and the Water Resources Board were abolished. The Act, which became effective on January 31, 2005, replaced the Environmental Board with the Natural Resource Board which consists of a full-time chair and two citizens panels - the Land Use Panel and the Water Resources Panel. The Water Resources Panel assumed rulemaking functions previously held by the Water Resources Board.

Chart Depicting Organization of Vermont's Water Quality Assessment & Listing Methodology.



C) Rivers & Streams Water Quality Assessment (Statewide)

Two river basin water quality assessment reports were completed and a third was nearing completion in the two years since the 2004 305b Report. A report for Basin 6 (Missisquoi River basin) was completed in 2004 and a report for Basin 17 (Lake Memphremgog basin) was completed in August 2005. A report for Basin 8 (Winooski River watershed) is due for completion in 2006. Each completed assessment report noted above and those completed previously are available from DEC on request. The more recently completed river basin assessment reports can be found on the DEC Water Quality Division web site (www.vtwaterquality.org, click on "planning" then click on "specific basins"). The data and information gathered prior to production of these reports are incorporated into the rivers and streams and lakes and ponds discussions and reporting numbers which follow below.

1) Assessment of use support

The assessment of Vermont's statewide river and stream surface water quality and aquatic habitat conditions has been updated from the 2004 305b statewide assessment with water quality information and data from waters monitored and assessed during the last two years. There is a substantial difference, however, between the use support determinations in this statewide assessment summary and those of 305b reports prior to 2004. As described above and in the appendix containing the Assessment Methodology, miles of river or stream are placed in one of four categories by designated use – full support, stressed, altered or impaired. This categorization differs from the categories of full support, full support/threatened, partial support, and non-support used in all earlier 305b assessment reports. This biennial report contains rivers and streams that have been re-assigned to the new categories to the extent possible. However, the current assessment categories do not directly equate to the former categories and there are a number of waters where the data and information are too old to permit a decision about the proper assessment category for the river or stream miles. The assessment category of these rivers and streams will be determined as Vermont DEC gets to them *in the assessment rotation and as such, the numbers given below in use support categories as well as the miles of rivers and streams affected by different causes and sources need to be considered as transitional*.

Determination of use support is based on data and information from biological monitoring, chemical monitoring, physical assessments, modeling results, and known sources of problems such as channelization work, combined sewer overflows (CSOs), or flow fluctuations, non-singular incidences of fish kills or spills.

According to EPA and its Total Waters database, Vermont has approximately 7,100 miles of perennial rivers and streams. Of the approximate 5,491 river and stream miles assessed for this report, overall approximately 88% of those miles are in compliance with the state's water quality standards and support designated uses, and 12% do not meet water quality standards or do not fully support the designated uses. Of the 88% meeting standards, approximately 14% are considered stressed by some pollutant or activity.

Table 3.C.1 below is a summary of the number of miles of rivers and streams throughout Vermont which support or do not support the water quality standards or designated uses of the waters. For each river use or value that is assessed, the miles of river or stream fully supported,

stressed, altered, or impaired are determined. For example, river miles that are supported for aquatic biota have macroinvertebrate and fish communities in good to excellent health based on a number of metrics for each community. River miles that are supported for swimming have no or very few known high levels of *E. coli*, a bacterium that is used as an indicator for the presence of pathogens from warm-blooded animals. Overall use support, expressed as proportion of miles meeting/not meeting uses, by waterbody, is shown in Figure 3.C.1 on the following page. Figures in the table appearing in parenthesis are those from the 2004 305b Report.

The number of miles in each support category are provided for six uses or values: aquatic biota and/or habitat, contact recreation (swimming, tubing), secondary contact recreation (boating, fishing), aesthetics, fish consumption, and drinking water supply. The use called "overall" reflects the miles for which one or more of the uses are fully supported, stressed, altered, or impaired. The fish consumption use is not factored into the "overall" category because all miles of river and stream are at least stressed for fish consumption due to a statewide fish consumption advisory. If taken into account in "overall", this status would mask the extent of other stresses.

Table 3.C.1. Statewide Overall & Individual Use Support Summary (miles) for Rivers & Streams.

Designated Use	Full support	Stressed	Altered	Impaired	Total assessed
Overall	4055.2 (4003)	790.7 (848)	294.8 (317)	354.8 (311)	5495.5 (5479)
Aquatic biota/habitat	4148	835.1	294.7	217.7	5495.5
Contact recreation	4743.5	430.2	6.5	142.1	5322.3
Secondary contact recreation	4592.1	605.4	126.3	53.5	5377.3
Aesthetics	4479.3	687.2	173.4	134.6	5474.5
Drinking water supply	253.9	10.3	10.4	11.5	286.1
Fish consumption	0	6036.7	0.1	86.8	6123.6

2) Summary of Causes and Sources

A cause is a pollutant or condition that results in a water quality or aquatic habitat impairment, alteration or stress; a source is the origin of the cause and can be a facility, a land use, or an activity. Tables 3.C.2 and 3.C.3 below summarize the miles of rivers and streams affected by various causes and sources, respectively.

Because a stretch of river or stream may be affected by more than one cause or source, the same mileage may be tallied in several places in Tables 3.C.2 and 3.C.3. For this reason, the two columns on each table are not additive because the total would overestimate the total number of miles affected by all causes and sources in Vermont. The purpose of these summaries is to give natural resource managers and the public an idea of the relative size of the impact from different pollutants or conditions on Vermont's waters and from which land uses or activities they may originate.

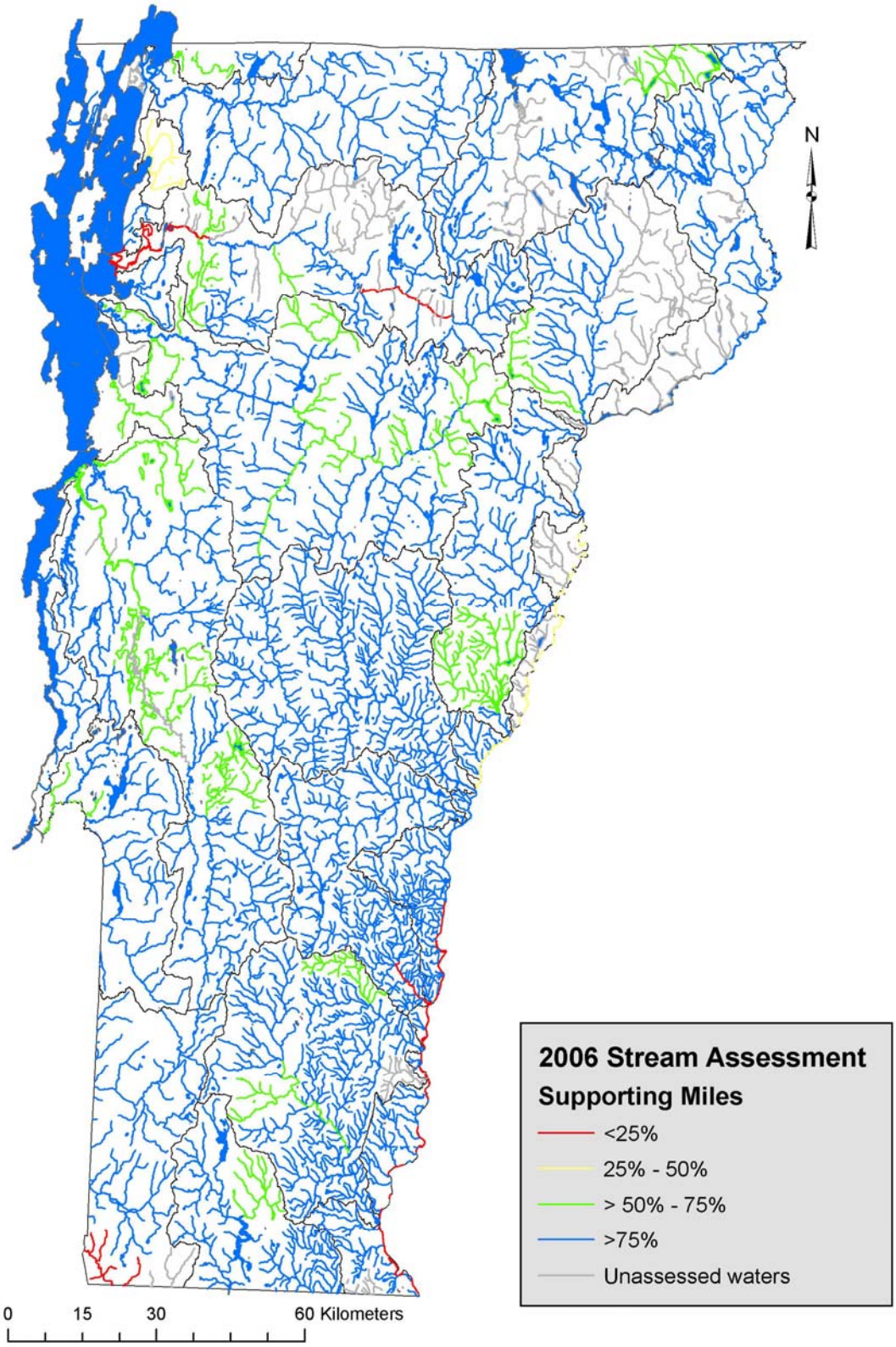


Figure 3.C.1. Overall Use Support for Vermont Rivers and Streams.

Causes

Sedimentation/siltation is the largest cause of stresses and impairments to river or stream water quality or aquatic habitat in Vermont. Sedimentation/siltation has long been the leading pollutant of our flowing waters. Unnatural levels of sediment alter or destroy macroinvertebrate habitat and fish spawning areas, fill in swimming holes, and cause the river or stream channel to become unstable. Sedimentation results in approximately 332 miles of river and stream not meeting standards and stresses another 723 miles based on the information available at this time.

The second largest documented cause of impacts and impairments is flow alteration. This problem affects about 249 miles and stresses another 68 miles.

Physical habitat alterations affect the third largest number of miles of river and stream having an impact on 209 miles and stressing another 442 miles.

The cause affecting the fourth largest number of miles in terms of pollutants or conditions is nutrient loading to waters. Nutrients contribute to 200 miles of river and stream not meeting standards and to over 440 stressed river or stream miles.

The other substantial causes identified include: metals affecting about 132 miles and stressing another 131 miles; turbidity affecting 131 miles and stressing 142 miles; pathogens affecting about 118 miles and stressing over 280 miles; and thermal modifications affecting 97 miles and stressing over 470 miles (the second largest stressor identified)..

Past assessments have generally had similar results in terms of which pollutants or conditions have the most impact on water quality or aquatic habitat. Sedimentation was the most extensive cause of pollution noted in the 2004, 2002, 2000, 1998 and 1996 305b Reports. The eight most significant causes of river and stream impairments, alterations, or stresses are given in Table 3.C.2.

Table 3.C.2. Total River and Stream Miles Affected by Cause Category.

Cause of impairment, alteration, or stress	Magnitude (miles)	
	Not meeting standards	Meeting standards but stressed
Sedimentation	332.4	722.7
Flow alterations	249.1	68.2
Physical habitat alterations	208.7	441.9
Nutrients	200.3	442.2
Metals	132.4	131.2
Turbidity	131.1	141.6
Pathogens	117.5	284.9
Thermal modifications	97.4	474.6

Sources

The five sources of pollution identified as having the greatest impacts or causing the greatest stresses on miles of river and stream are flow alteration from hydroelectric facilities, snowmaking water withdrawals and other sources; streambank erosion; agricultural land uses and activities; atmospheric deposition; and removal of riparian vegetation. In some situations, the three sources of streambank erosion, agricultural land activity, and riparian vegetation removal could be interrelated and affecting one given stretch of river and stream at the same time. A second tier of significant sources of impacts includes urban/developed land runoff, flood impacts resulting from human structures or activities, and channel instability again that due to human activity

Flow fluctuations or reductions alter about 245 miles and stress another 66 miles. The number of miles attributed to flow modification as a source are less than in the 2004 305b assessment due to licenses issued at hydroelectric facilities and snowmaking withdrawal changes.

Streambank erosion has been identified as the cause of about 244 miles of impact and 560 miles of stresses. Streambank erosion is described as a source in and of itself, but this 'source' results from other 'sources' such as riparian vegetation removal and channel instability.

Agricultural land uses and activities have an impact on 198 miles and stress another 501 miles of river or stream. As mentioned above, the interrelationship between agricultural activities, riparian vegetation loss, streambank erosion, and channel instability as sources makes the attribution of miles stressed, altered, or impaired to each of these sources an imprecise task. The relative contribution of each source should be the focus.

Atmospheric deposition is primarily responsible for mercury and acidified conditions in Vermont's surface waters. While these conditions are most exacerbated in lake systems, stream biological communities do exhibit quantifiable impacts, particularly due to acidification. Atmospheric deposition has an impact on 141 miles of river and stream and stress about 17 miles.

Approximately 136 miles of impact and 531 miles of stress have been attributed to the removal of riparian vegetation. Removal of riparian vegetation continues to be a growing problem in the state. Individual residential and commercial landowners, farmers, town road crews and the Agency of Transportation all encroach on the riparian zone with their activities and the result is the loss of the trees and shrubs protecting rivers and riverbanks. Flooding and channel instability also result in loss of riparian vegetation, but the loss of riparian vegetation also increases a stream's vulnerability to channel changes in an unstable system.

Urban/developed land as a source includes runoff from any urban, suburban, village or other developed areas. Developed land changes the amount and timing of runoff reaching rivers and streams and the runoff contains many pollutants including sediment, metals, nutrients and organic compounds. Urban/developed land runoff affects about 85 miles of river and stream and stresses about 178 miles as determined in this assessment.

Flood impacts and channel instability are the seventh and eighth largest sources of impacts to rivers and streams as currently documented. The flood impacts are those that result from poorly sited or designed human structures (road, bridges, culverts), which blow out during a flood resulting in more damage to the river or stream habitat than would be otherwise. Flood impacts have affected about 77 stream miles and stressed another 76 miles. Channel instability can be a result of flood impacts, flood "repair" work, instream gravel mining, stormwater runoff, watershed hydrology changes. A variety of human activites can cause channel instability but channel instability is a source of sedimentation and habitat alteration. Channel instability contributes to at leas 74 stream miles not meeting standards and stressess another 144 miles.

Other sources specifically tracked include: land development, upstream impoundments, onsite wastewater systems, hazardous waste sites, and resource extraction among others.

Table 3.C.3. Total Miles of Rivers & Streams Affected by Source Category.

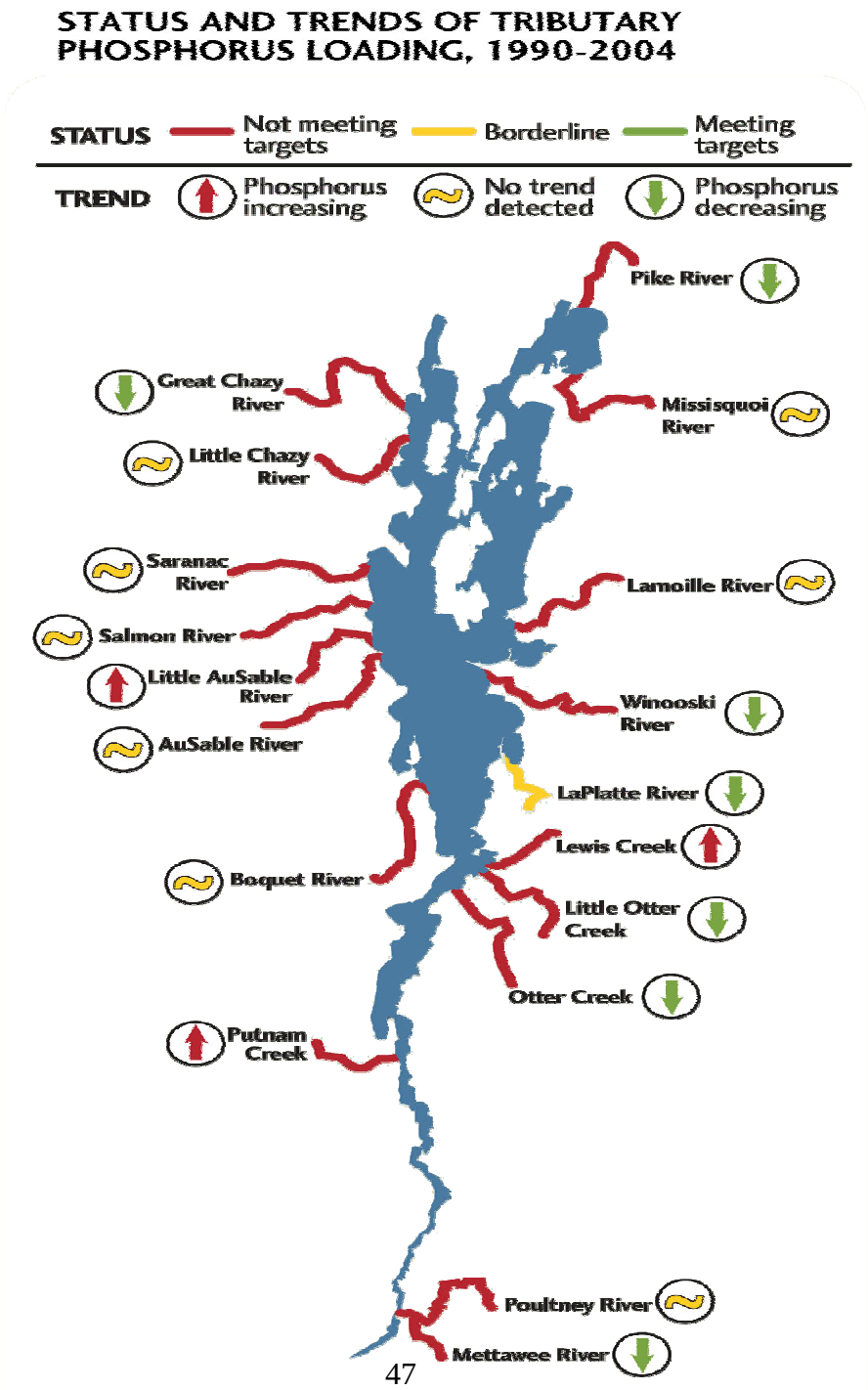
Source of impairment	Magnitude (miles)	
	Not Meeting Standards	Meeting standards but stressed
Flow modification	244.9	65.5
Streambank erosion	243.7	560.0
Agriculture	198.2	501.4
Atmospheric deposition	140.9	17.0
Removal of riparian vegetation	136.2	531.1
Urban/developed land runoff	85.1	177.9
Flood impacts	77.0	75.9
Channel instability	74.2	143.6

3) Status & Trends of Phosphorus Loading to Lake Champlain from Monitored Tributaries[4]

Tributary rivers carry most of the phosphorus to Lake Champlain. Great progress has been made in reducing phosphorus from point sources, such as [municipal] sewage treatment and industrial discharges. Today, less than ten percent is from these sources. Runoff from nonpoint souces, such as roads, developed land, lawns, riverbanks and agricultural land, contributes over ninety percent. Of the nonpoint sources, 56% of the phosphorus comes from agricultural lands, 37% is produced by developed land and 7% is from forests.

[4] Information for this particular section of the 305b Report has been taken from: The 2005 State of the Lake Report. Lake Champlain Basin Program. Grand Isle, Vermont.

The Lake Champlain Basin Program has funded water quality monitoring for phosphorus and other indicators since 1992. [For the report], monitoring data were examined to see if there have been increasing or decreasing phosphorus trends between 1990 and 2004. Data from monitoring at the mouths of the Lake's 18 major tributaries (9 of which are in Vermont) indicate that only the LaPlatte River is close to meeting its target phosphorus load [defined in the Lake Champlain phosphorus-based Total Maximum Daily Load]. Seven tributaries, however, show an improving trend (6 are in Vermont) and three show worsening trends for phosphorus (1 is in Vermont). The remaining 8 tributary rivers have no trend (3 of these are in Vermont). A figure representing the status and trends of measured tributary phosphorus loading is shown below.



Source: Lake Champlain Basin Program 2005 State of the Lake Report.

D) Lakes & Ponds Water Quality Assessment (Statewide)

1) Assessment of use support for inland lakes

A statewide summary of inland lake use support is provided in Table 3.D.1. All lake/pond waters within the borders of the State are considered as "inland lakes" except for the eleven segments of Lake Champlain. Moore and Comerford Reservoirs (along Connecticut River), Lake Memphremagog and Wallace Pond are transboundary waters reported as "inland lakes." Figures appearing in parenthesis in the table are those reported in the 2004 305b Report.

Overall, 37,522 inland lake acres support uses, and 17,825 acres do not support uses. Proportionally, aesthetics use is most highly supported in inland lakes (89% of acres), followed by swimming (88%). Improvements in these numbers relative to those published in the 2004 305b Report relate largely to reductions in Eurasian watermilfoil populations on several lakes after chemical treatments.

Although all waters are impacted by mercury pollution and are subject to consumption advisories, Vermont's assessment methodology indicates the need for waterbody-specific tissue data to indicate non-support of fish consumption. Accordingly, when assessed following the methodology, 85% of inland lake acres support fish consumption use. However, based on research conducted specifically in Vermont, all waters are subject to atmospheric mercury contamination, and many waters have the potential be impaired for fish consumption, were data available to support such assessments. More information regarding fish mercury monitoring is available in Part Four.

Table 3.D.1. Acres of Vermont Inland Lakes Supporting or Not Supporting Uses.

Use	Full Support	Stressed	Total Meeting WQS	Altered	Impaired	Total Not Meeting WQS	Not Assessed
Overall Uses	21012 (15026)	16510 (20882)	37522 (35908)	8015 (8874)	9910 (9910)	17825 (19434)	245 (162)
Aesthetics	37882	11593	49475	3443	2529	5872	245
Aquatic Life Use Support	23624	17455	41079	7389	6979	14268	245
Drinking Water Supply	1268	0	1268	0	123	123	123
Fish Consumption	47025	0	47025	0	8115	8115	452
Secondary Contact Uses	37091	9839	46930	4946	2559	7405	1257
Swimming Uses	38461	10616	49077	3358	2559	5234	1281

Note: All Vermont waters are subject to contamination by atmospheric mercury.

Overall use support, expressed as proportion of lake/pond acres supporting/not supporting uses, by assessed waterbody, is shown in Figure 3.D.1 on the following page.

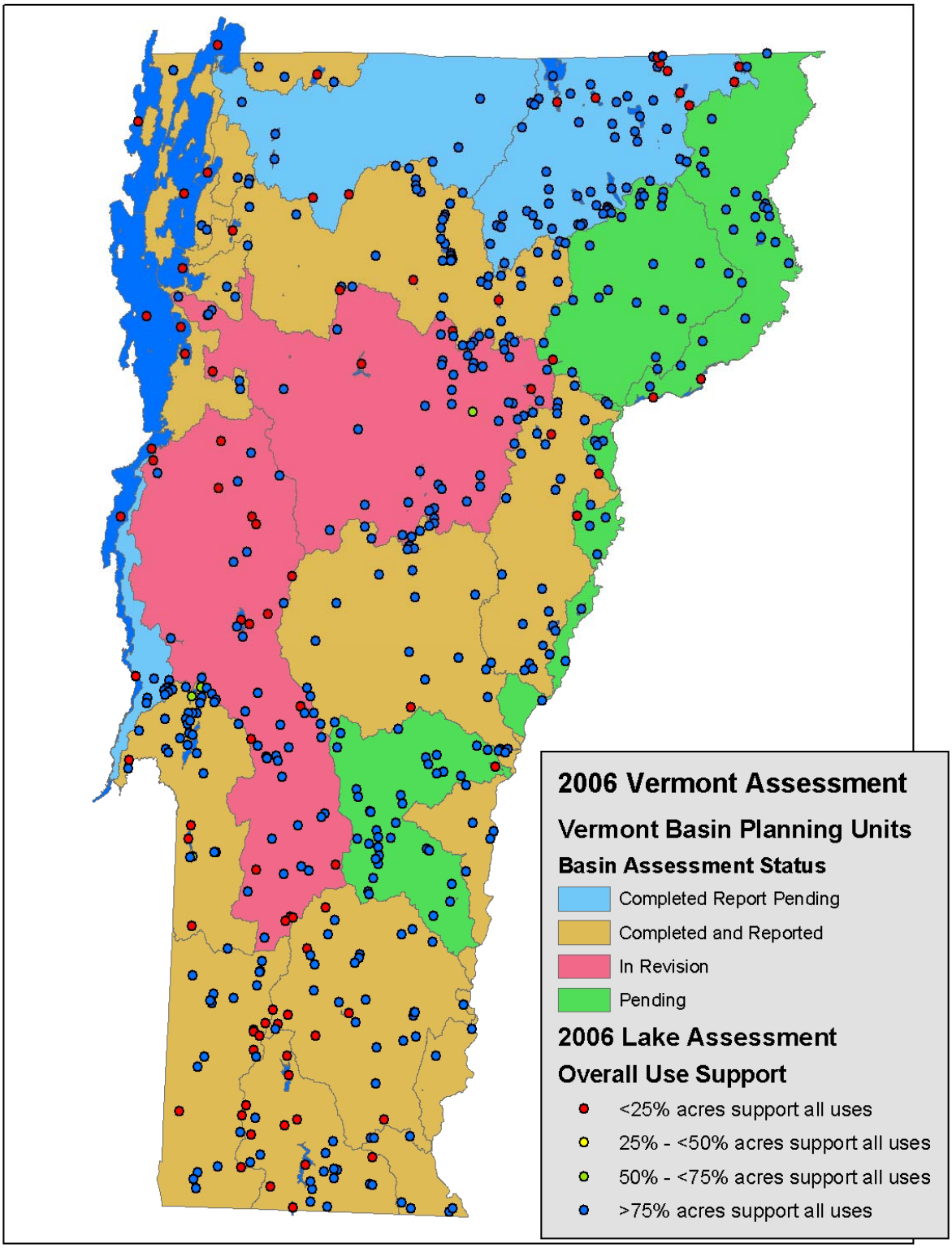


Figure 3.D.1. Overall Use Support for Vermont Lakes and Ponds.

2) Summary of causes and sources for inland lakes

The causes and sources of impairments, alterations, and stresses to Vermont inland lakes are shown simultaneously in Table 3.D.2. Metals and mercury remain the greatest cause of impairment to Vermont inland lakes, causing 8,115 acres not to meet fish consumption uses. This is due to the fact that mercury (Hg) contamination is quite elevated in fish tissues of the component reservoirs within the Fifteen Mile Falls (Connecticut River near St. Johnsbury, VT – Littleton, NH) and Deerfield River hydroelectric projects. Atmospheric deposition is the most important source of Hg to Vermont's landscape and, accordingly, is listed as the most important source category. Flow alteration is the second most important cause of alterations to aquatic life and other uses in Vermont inland lakes, resulting in loss of use to 6,615 acres, due to hydromodification. These flow-altered acres have been reduced by over 1,000 acres during the 2004-2005 reporting period due to operational and/or structural changes in several hydroelectric and flood control projects. Lake acidification, caused by low pH, is the third most prevalent cause of impairment to Vermont inland lakes and the source of this low pH is atmospheric deposition of acid precursors, along with natural factors such as low catchment buffering capacity. In Vermont, 4,420 lake acres are impaired by cultural acidification and an additional 6,999 acres are stressed. Total Maximum Daily Load determinations addressing acid deposition to all 37 of Vermont's acid-impaired lakes have now been approved by EPA.

Phosphorus and nutrients are the fourth most important cause of impairment to Vermont inland lakes, limiting or precluding uses on 2,515 lake acres and stressing approximately 4,700 acres. Siltation is tracked separately from phosphorus, but is the result of similar sources. Siltation impairs 1,723 acres and stresses an additional 3,023. Several sources simultaneously account for nutrients, phosphorus, and siltation, including agricultural, silvicultural, and developed land, road runoff, unstable streams, and residential property management. Finally, non-native species alter several uses and are spread by recreational uses or natural spread vectors. The most important non-native species on Vermont's inland lakes are the Eurasian watermilfoil *Myriophyllum spicatum*, the zebra mussel (*Dreissena spp.*), water chestnut (Trapa natans), and most recently, alewife (*Alosa pseudoharaengus*). Non-native species currently alter 1,214 acres and stress an additional 6,896 acres. Further discussion regarding aquatic nuisance species is provided in Section 5 of this chapter.

Table 3.D.2. Causes & Sources of Impacts to Inland Vermont Lakes.
Causes and sources are ranked in decreasing order of total acreage impaired/altered.
(Note: listed causes and sources are not linked)

Cause of impact	Magnitude of **Cause** (acres)		**Source** of impact	Magnitude of **Source** (acres)	
	Not meeting WQS	Use stressed		Not meeting WQS	Use stressed
0500 Metals	8115	0	8100 Atmospheric Deposition	10212	5702
0560 Mercury	8115	0	7400 Flow Regulation/Modification	8627	4781
1500 Flow alteration	6615	4695	7000 Hydromodification	6615	4741
1000 pH	4420	6999	8600 Natural Sources	4420	7848
0900 Nutrients	2515	4728	1000 Agriculture	2413	2120
0910 Phosphorus	2515	4672	9070 Vt-Unspecified Nonpoint Source	2151	825
2210 Noxious aquatic plants – Algae	2515	3245	1100 Nonirrigated Crop Production	1908	858
1100 Siltation	1723	3023	1400 Pasture Grazing-Riparian And/Or Upland	1908	962
2600 Exotic Species	1214	6896	1800 Vt-Animal Holding/Management Area	1456	796
1200 Organic enrichment - DO	1187	1035	7900 Marinas And Recreational Boating	1314	6911
2200 Noxious aquatic plants – Native	502	1326	7910 In-Water Releases	1314	6872
0000 Cause unknown	0	7	7550 Habitat Modification (Other Than Hydromod)	612	409
0800 Other inorganics	0	6	7700 Streambank Modification/Destabilization	612	448
1300 Salinity - TDS - chlorides	0	9	0200 Municipal Point Sources	521	0
1700 Pathogens	0	808	6000 Land Disposal	452	10
2300 Filling and Draining	0	49	6400 Industrial Land Treatment	452	0
2400 Total Toxics	0	1	3000 Construction	200	3099
			3200 Land Development	200	3079
			7600 Removal Of Riparian Vegetation	85	1107
			8530 Internal Nutrient Cycling (Lakes)	54	72
			8300 Highway Maintenance And Runoff	51	3102
			2000 Silviculture	35	1345

Cause of impact	Magnitude of **Cause** (acres)		**Source** of impact	Magnitude of **Source** (acres)	
	Not meeting WQS	Use stressed		Not meeting WQS	Use stressed
			2100 Harvesting, Restoration, Residue Management	35	1050
			4000 Urban Runoff/Storm Sewers	1	1015
			0100 Industrial Point Sources	0	6
			1410 Pasture Grazing-Riparian	0	5
			3100 Highway/Road/Bridge Construction	0	12
			4300 Other Urban Runoff	0	148
			4500 Highway/Road Bridge Runoff	0	166
			4600 Erosion And Sedimentation	0	3
			5000 Resource Extraction	0	21
			5100 Surface Mining	0	21
			6300 Landfills	0	14
			6500 Onsite Wastewater Systems (Septic Tanks)	0	54
			7300 Dam Construction	0	37
			8520 Debris And Bottom Deposits	0	20
			8700 Recreational And Tourism Activities (Not Boating)	0	156
			8950 Other	0	140
			9000 Source Unknown	0	1040

3) Assessment of use support for Lake Champlain

A summary of Lake Champlain use support is provided in Table 3.D.3 on the following page. In Lake Champlain, due to the combined effects of mercury contamination, nutrient accumulation and non-native species, none of Lake Champlain's 174,175 acres in Vermont fully support all designated uses. Proportionally, aquatic life use is most highly supported (88% of Champlain waters), followed by secondary contact use (83%). Due to phosphorus concentrations in excess of Vermont Water Quality Standards in most areas of the lake, only 23% of Lake Champlain fully supports swimming uses, and only 20% supports aesthetics. No acres support fish consumption use due to mercury and polychlorinated biphenyls (PCBs) in fish tissue that result

in no-consumption advisories for children and women of childbearing age. Figures for overall uses do not differ from those reported in the 2004 305b Report.

Table 3.D.3. Lake Champlain Acres Supporting or Not Supporting Uses.

Use	Full Support	Stressed	Total Meeting WQS	Altered	Impaired	Total Not Meeting WQS	Not Assessed
Overall Uses	0	0	0	13201	174175	174175	0
Aesthetics	35290	0	35290	11394	132053	138885	0
Aquatic Life Use Support	152672	0	152672	21503	5388	21503	0
Drinking Water Supply	121872	0	121872	15673	0	15173	18183
Fish Consumption	0	0	0	0	174175	174175	0
Secondary Contact Uses	144300	0	144300	12994	0	29875	0
Swimming Uses	35290	0	35290	15595	132063	138885	0

4) Summary of causes and sources for Lake Champlain

The causes and sources of impairments, alterations, and stresses to Lake Champlain are shown simultaneously in Table 3.D.4 below. Mercury is the greatest cause of impairment to Lake Champlain, precluding fish consumption use on the entire lake for a subset of Vermont's citizens. Priority organics (PCBs) also impair fish consumption use on the majority of Lake Champlain acres. Atmospheric deposition is the most important source of mercury to Vermont's landscape and is listed as the most important source of mercury to Lake Champlain. The source of PCBs in lake trout was identified in 1994 as a residual "dump" of PCBs in the vicinity of the Wilcox Dock in Plattsburg Bay, New York. The PCB source and contaminated sediments were cleaned up in the late 1990s by the New York State Department of Environmental Conservation. Fish tissue data from Vermont sections of Lake Champlain are undergoing analysis to verify that fish tissue PCB levels have declined.

Nutrients, phosphorus, and associated algal growth impair 132,053 acres of Lake Champlain, and related siltation contributes to that impairment, by stressing uses on 5,388 acres. Unspecified nonpoint sources of nutrients are the largest source of the nutrient pollution, although a suite of sources also contribute nutrients to Lake Champlain, as discussed above (Section 3.D.2). Urban runoff, including stormwater, is also an important nutrient and sediment source in certain segments of Lake Champlain. The Lake Champlain phosphorus-based TMDL continues to serve as the centerpiece of Vermont Governor Douglas' *Clean and Clear Water Action Plan*, which is being implemented as of this writing. Exotic species are a significant problem in Lake Champlain, impairing several uses on 21,503 acres. In Lake Champlain, there is a mix of Eurasian watermilfoil, water chestnut (*Trapa natans*) and zebra mussel (*Dreissena polymorpha*) infestations which all impact aquatic life, aesthetics, swimming, boating, and drinking water uses.

Table 3.D.4. Causes & sources of impacts to Lake Champlain (acres).
Causes and sources are ranked in decreasing order of total area impaired/altered.
(Note: listed causes and sources are not linked)

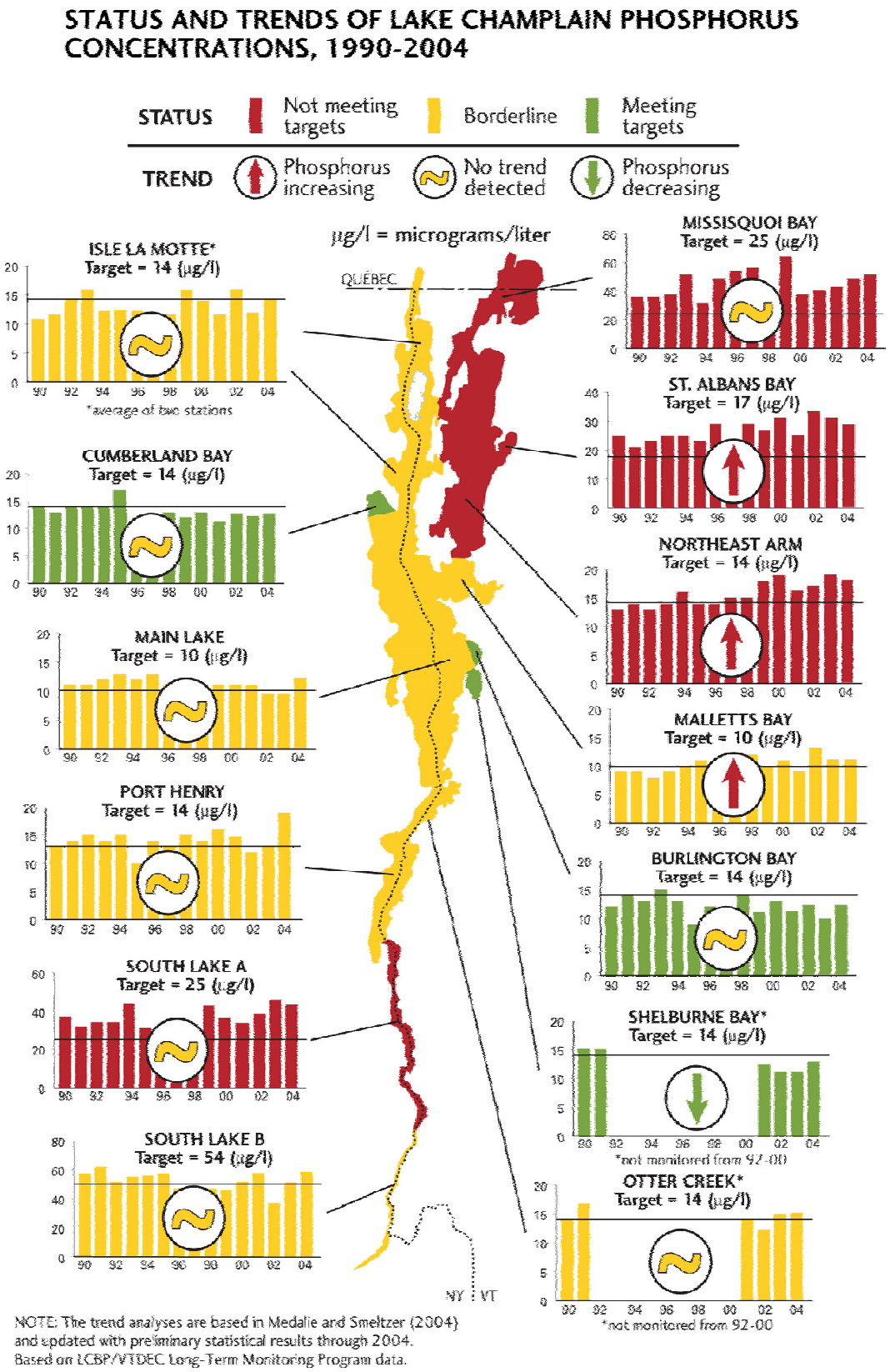
Cause of impact	Magnitude of **Cause (acres)**		**Source** of impact	Magnitude of **Source (acres)**	
	Not meeting WQS	Use stressed		Not meeting WQS	Use stressed
0500 Metals	174175		8100 Atmospheric deposition	174175	
0560 Mercury	174175		9070 VT-unspecified nonpoint source	132053	
0300 Priority organics	163678		0200 Municipal point sources	73869	
0900 Nutrients	132053		1000 Agriculture	31859	
0910 Phosphorus	132053		7910 In-water releases	24803	
2210 Noxious aquatic plants - algae	132053		7900 Marinas and recreational boating	21503	
2600 Exotic Species	21503		0100 Industrial point sources	21362	
1700 Pathogens	19	222	4000 Urban runoff/storm sewers	13744	
1100 Siltation	0	5388	3000 Construction	13725	
2200 Noxious aquatic plants - native	0	500	8300 Highway maintenance and runoff	13725	
			8600 Natural sources	5388	6
			9000 Source unknown	0	216

5) Status and Trends of Lake Champlain Phosphorus Concentrations[5]

Human activities, such as sewage treatment, farming, lawn care and urban living, produce and concentrate the nutrient phosphorus. Although phosphorus is not harmful to people, too much of it in Lake Champlain is a problem because it promotes algae growth and causes a deterioration of water quality. The increased algae affect many other organisms and interfere with recreational enjoyment.

The Lake Champlain Basin Program has funded water quality monitoring for phosphorus and other indicators since 1992. Monitoring data were examined to see if there have been increasing or decreasing phosphorus trends between 1990 and 2004. Four lake segments (3 of which are in Vermont) have consistently failed to meet their target water quality standard concentrations. Two of these three Vermont segments plus another Vermont segment are showing trends towards increasing phosphorus concentration. Five other lake segments which sometimes meet the concentration target are not showing any phosphorus trend. Three lake segments (two of which are in Vermont) consistently meet the target water quality standard. The figure appearing on the following page illustrates the status and trends of measured Lake Champlain phosphorus concentration.

[5] Information for this section of the report has been taken from: 2005 State of the Lake. Lake Champlain Basin Program. Grand Isle, Vermont.



Source: Lake Champlain Basin Program 2005 State of the Lake Report

6) Aquatic Nuisance Species

At least 48 aquatic non-native plants and animals are known from Vermont. Fortunately, most of these species have not become invasive. Those that have become invasive - Eurasian watermilfoil, water chestnut, purple loosestrife, zebra mussels - have had significant economic and ecological impacts. Current management efforts in the state seek to slow or stop the spread of aquatic nuisance species (ANS) to new waterbodies and reduce the density of nuisance populations in infested waterbodies. By their very nature, non-native ANS tend to be easily spread between waterbodies. An ounce of prevention is truly worth a pound of cure, as the cost of preventing an infestation in an uninfested waterbody is significantly less than the annual cost of managing an infestation once it occurs.

Eurasian watermilfoil, currently Vermont's most problematic nuisance non-native aquatic species, was first discovered in Vermont in St. Albans Bay of Lake Champlain in 1962. In the next two decades, the plant population spread to only three additional lakes. However, watermilfoil began to quickly spread to new lakes in the early 1980s, after it had infested and become established in a few of the larger, heavily used recreational lakes. Water chestnut has been in Lake Champlain since at least the 1940s, but it was not found elsewhere until 1994. Early detection of new infestations of watermilfoil and water chestnut is critical if there is to be any opportunity to successfully prevent lakewide spread and the resulting impairment to the ecology and recreational uses of the infested lakes. Water chestnut has actually been successfully eradicated from one lake where a small population was found in the mid-1990s.

Zebra mussels were first found in Lake Champlain in 1993. Currently, there are no effective control methods to reduce or eliminate zebra mussel populations. Zebra mussel veligers found in several lakes since 1993 apparently were unsuccessful in establishing viable populations as no adult zebra mussel populations have been found. The exception to this statement is Lake Bomoseen.

Vermont is fortunate to have relatively few problematic species in the state, but many more nuisance species are found in neighboring states, so constant vigilance and a quick response to the introduction of a new species are imperative to protect our water resources from new invaders. Purple loosestrife, a serious pest of wetlands, lake shores, stream banks and pastures, has a significant foothold in the state. Purple loosestrife has now been identified in 175 Vermont towns.

As of October 2005, Eurasian watermilfoil was confirmed in at least 60 lakes or ponds and 20 other waters (wetlands, rivers, streams) in Vermont. Water chestnut has been confirmed in 8 lakes and ponds and 6 other Vermont waters. Zebra mussels have been confirmed in two Vermont lakes (see figure below).

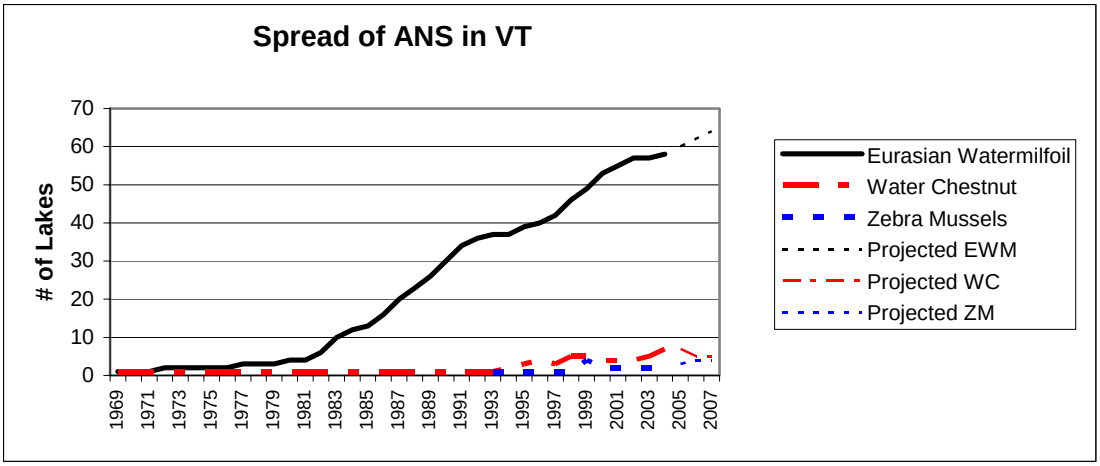


Figure 3.D.5. Spread of aquatic nuisance species (ANS) in Vermont.

Water chestnut is particularly problematic in southern Lake Champlain. Fortunately, it is an annual plant that can be effectively controlled through mechanical harvesting and handpulling if mature plants are harvested prior to dropping their seeds. Since chestnuts can remain viable in the sediment for up to ten years before germinating, areas must be harvested or handpulled annually for many years before total control is achieved. After control is achieved, vigilance is needed to assure re-infestation does not occur. In the late 1960s, a two-person handpulling crew was effectively managing the water chestnut population in Lake Champlain, with only eight bushels of chestnut plants handpulled in 1967. However, the annual control program was stopped in 1971, and over the next ten years, the population in the lake exploded to the point where dense plant beds covered 270 acres in 1980. One chestnut seed can produce 10 to 15 rosettes, each of which can produce 15 to 20 seeds, resulting in up to 300 chestnut seeds from a single seed in one year. Missing just one year of control means the chestnuts produced that year are available to continue the infestation for years to come. On Lake Champlain, the impact of inadequate funding for water chestnut control for even one year can dramatically expand the range of dense water chestnut populations (see Figure 3.D.6 below). Many years of sustained funding levels are then needed to regain the lost ground. The Department of Environmental Conservation seeks to maintain a sustained level of funding that supports a water chestnut control program in Lake Champlain which annually reduces the extent of water chestnut in the lake and will ultimately result in the population in the lake being manageable again by handpulling only.

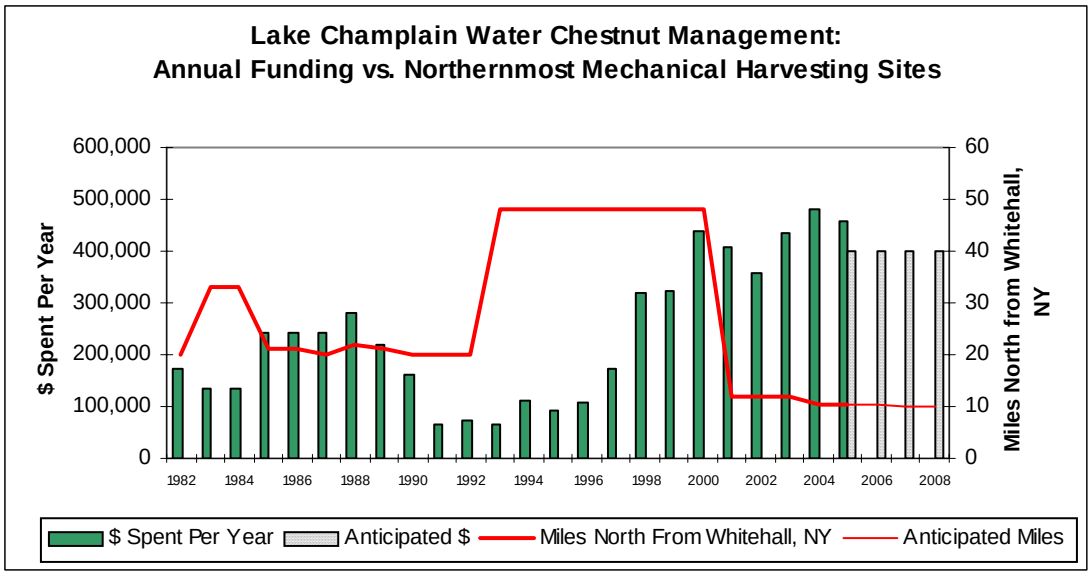


Figure 3.D.6. Lake Champlain Water Chestnut Management: Annual Funding vs. Northernmost Mechanical Harvesting Site.

E) Wetlands Assessment (Statewide)

Background

Vermont wetlands are significant resources that contribute to the economic, cultural, and physical well being of its residents. Wetlands provide numerous ecological functions and social values, including habitat for fish and wildlife, recreational and educational opportunities, habitat for threatened and endangered species, temporary storage of flood waters, and they aid in the maintenance of water supply and quality. However, these resources have been significantly affected by human land and water use activities.

The primary function of the Vermont Wetlands Program within DEC is to administer the Vermont Wetland Rules, which regulate most palustrine wetlands that have been mapped on the Vermont Significant Wetland Inventory maps, and therefore have a higher level of protection than unmapped wetlands. The Wetlands Program also provides comment on Act 250 applications that involve wetland issues and conducts pre-Act 250 determinations to assist potential developers in meeting the requirements of the Act. Wetlands Program staff provides comment and advice to other state agencies and they are called upon as wetland experts wherever testimony is deemed appropriate. DEC reviews projects that involve wetland filling under Section 401 of the Clean Water Act based on compliance with the Vermont Water Quality Standards and other applicable provisions of State law. On January 23, 1996, the Vermont Water Quality Standards included the statement that the Standards shall apply to “all waters of the United States,” as defined in 40 C.F.R. §122.2 (1995). This wording, therefore, includes wetlands as being part of “all water...” with respect to having met the goals of the Water Quality Standards.

Extent of Wetland Resources

The Vermont Agency of Natural Resources digitized all the National Wetland Inventory (NWI) maps for the state. For Vermont, a total of 232,000 acres of palustrine wetlands are depicted on the maps. Mapped wetland areas are considered significant and are designated as Class Two wetlands under the Vermont Wetland Rules. Wetland inventories conducted in selected towns around Vermont indicate there are considerably more acres of wetland than identified by the NWI project. A comparison of NRCS mapped hydric soils versus Class Two wetlands in the Lamoille River Watershed found that hydric soils covered approximately 3% more of the landscape than VSWI mapped wetlands, bringing total coverage of total wetland acreage in the watershed to 7%. The wetlands that do not appear on the NWI maps are considered Class Three by the Vermont Wetland Rules. Extrapolating the soil information in the Lamoille Watershed to the rest of the state indicates there may be approximately 90,000 acres of Class Three wetlands in Vermont. Class One wetlands are considered exceptional or irreplaceable in their contribution of Vermont's natural heritage and are therefore are afforded the highest level of protection under the Vermont Wetland Rules. In order for a wetland to be given Class One status, it must be petitioned for reclassification through the Water Resources Board.

Four wetland complexes, totaling 2,138 acres, have been evaluated and given the status of Class One since 1990. Dorset Marsh in Dorset is a 200 acre wetland complex that was successfully petitioned to Class One by the Dorset Citizens for Responsible Growth in 1991, and was also given a 100 foot buffer zone. The North Shore Wetland in Burlington is a 15 acre wetland complex on Lake Champlain that was petitioned by the Vermont Natural Resources Council (VNRC) and given Class One status and a 300 foot buffer zone in 2000. Tinmouth Channel in Tinmouth was reclassified to Class One in 2001. This 1,473 acre wetland complex was petitioned by VNRC, and in addition to Class One status, now contains a buffer zone that is 300 feet on the North End and 100 feet on the southern end. The Lake Bomoseen Wetland was successfully petitioned to Class One by VNRC in 2003. This 450 acre wetland complex in Hubbarton was given a 100 foot buffer in most places but retained a 50 foot buffer zone in one heavily developed area.

Wetlands Section Activities During the 2006 Reporting Period

Clean and Clear Initiative

In order to implement the phosphorus-based Total Maximum Daily Load for Lake Champlain, the Governor allocated funds towards an accelerated clean-up schedule for the lake. As part of that initiative, $250,000 was allocated for wetland restoration and protection. Two projects were identified for funding in 2004 and the funds were recently awarded. Also, money was allocated to develop a Wetland Restoration and Protection Plan for the Vermont portion of the Lake Champlain watershed. For the coming year a full-time position will be funded that will focus on this initiative in the Agency of Natural Resources Lands Division. The *Clean and Clear Wetland Protection and Restoration 2004 Progress Report* can be viewed on the web at: www.anr.state.vt.us/cleanandclear/rep2004/wetlands50-52.pdf.

As part of its FY'06 Clean and Clear legislative appropriation, the Department of Forests, Parks and Recreation received supplemental funding for a new position to coordinate wetlands

protection and restoration activities under the Agency's Clean and Clear program. Major duties will include coordinating/implementing restoration and protection of impaired wetlands and related planning efforts, public education and outreach on Vermont's wetland restoration and protection program, grant administration, and other associated activities. A Request for Proposals was issued by the Agency in the Spring of 2005 to solicit proposals for the development of a Wetlands Restoration Plan for the Vermont portion of the Lake Champlain watershed. When completed, this plan will identify impaired wetlands within the Vermont portion of the Lake Champlain Basin and will prioritize these wetlands for restoration. This information will, in turn, provide the basis for a watershed-wide wetland restoration implementation plan for guiding future wetland restoration and protection activities.

Two sites were funded for restoration projects by Clean and Clear in 2006: the Bissonette Farm Wetland Restoration Site (850 acre property) and the Benjamin-Wing Wetland Restoration Site (65 acre property). These sites will be restored with partners such as the Hinesburg Land Trust, in cooperation with the Trust for Public Land and the Vermont Land Trust, and the Nature Conservancy. The restoration of hydrology for these two properties may result in a net gain and improvement of 170 acres of wetland.

For readers interested in learning more about the Clean and Clear program initiative, one should go to the following web site: www.anr.state.vt.us/cleanandclear/wetlands.htm.

Vermont's Purple Loosestrife Biological Control Program

During the 2004 season, the Purple Loosestrife Biological Control Program released a total of 106,826 *Galerucella* spp. beetles throughout 29 towns and 50 sites totaling nearly 167 acres of new purple loosestrife affected area treated. The total number of beetles released in 2004 increased by 34,623 beetles (or nearly 48%) over 2003. This was due to the establishment of a spring redistribution program and an increased yield of beetles per plant. While the number of plants was reduced from 222 to 186, the number of beetles on each plant increased from an average of 325 to over 544 beetles.

In 2005, the Purple Loosestrife Biological Control Program released a total of 127,807 *Galerucella* spp. beetles throughout 38 towns and 52 sites totaling about 185 acres of new acres treated. The total number of beetles released in 2005 increased by 20,981beetles (or nearly 20%) over 2004. The increase in beetles was due to an expansion of the volunteer beetle-rearing program, which resulted in a 44% increase in the number of plants raised from 186 to 269. Though there was an overall increase in the number of beetles raised, there was a decrease in the number of beetles raised per plant from 544 beetles to 450 beetles between 2004 and 2005. The 2005 annual report regarding the Program can be inspected on the web at:
www.vtwaterquality.org/wetlands/docs/wl_loosestrife-report.pdf.

Education and Outreach Activities

A workshop for contractors was held during April 2004 with approximately 35 contractors in attendance. This group was targeted as they are the people who actually do work in wetlands. The Wetlands Section coordinated with the Stream Alteration Program, the Shoreline Encroachment Program and the Construction Erosion Prevention Program to present a well rounded view of water quality regulations as they pertain to construction. The half day training

was well received, and the contractors are interested in continuing their education in this area. Three workshops around the state were given to municipal officers in October 2004. The workshops offered an opportunity to provide municipal officers with an overview of wetland regulations at the local, state and federal levels. The Municipal Officers Training was offered by the Vermont League of Cities and Towns. Other education and outreach activities included the ongoing logging workshops, field days with conservation commissions, presentations to towns and municipalities, educational workshops for teachers, lectures for universities and other school groups, and regional conservation field days. Most of these efforts were undertaken in response to specific requests for the participation of the Vermont Wetlands Program. The purpose of these education and outreach activities was to provide information about Vermont's wetlands and the regulations that pertain to these wetlands.

Natural Resources Board

In the 2004 legislative session, Act 115 which pertained to permit reform was enacted. This act consolidated and clarified existing environmental permitting appeal routes so that acts or decisions of the nine District Environmental Commissions and the Secretary of the Natural Resources Agency are subject to appeal by the Environmental Court, as are decisions by local development review entities. The Act replaced the Environmental Board with a Natural Resources Board to consist of a full-time chair and two citizen panels, one being the Land Use Panel; the other being the Water Resources Panel. The Land Use Panel assumed the rulemaking functions previously exercised by the Environmental Board and manages the process by which Act 250 permits are issued, may initiate enforcement action, and may petition the Environmental Court for permit revocation. The Water Resources Panel assumed the rulemaking functions previously exercised by the Water Resources Board as well as outstanding resource waters designation and wetlands reclassifications, both of which were revised by the Act so as to take place by rulemaking. The Act gives the Land Use Panel party status before the Environmental Court and the ability to appeal to the Supreme Court in all matters related to Act 250 permits. The Act gives the Water Resources Panel party status before the Environmental Court as well as the ability to appeal to the Supreme Court in all matters related to water rules. The Act became effective on January 31, 2005. The Vermont Wetland Rules were examined by the new Water Resources Panel in 2005 and options for changing the Rules to incorporate changes in Act 115 are being explored.

Vermont Significant Wetland Inventory Maps Updates

A large effort to incorporate all of the changes to the Vermont Significant Wetland Inventory Maps made by reclassification and declassification since the inception of the Vermont Wetland Rules was undertaken in 2004. This included updating both the physical maps and the digital maps. Once the changes were incorporated, the Wetlands Section worked with the GIS Section of ANR to produce maps for each town. These maps are easier to read and more up-to-date than previous versions. In addition, the maps are in Adobe Acrobat format, which are easy to send, print and read for most computer users. The maps were printed in a large scale format in 2005 and will be distributed to the Natural Resources Board and to the towns throughout Vermont in winter of 2006.

New England Biological Assessment of Wetlands Working Group
Staff from the Wetland Section continued to participate in this workgroup. The annual meeting was held in conjunction with the New England Association of Environmental Biologists. A grant proposal was not funded this year but plans are underway to seek other funding in the future to develop a wetland bioassessment program. (Note: a grant was approved in 2005 to re-start the wetland bioassessment project.)

New Data Collection System
In 2004, the Wetlands Section began a new method of gathering data used for the annual report. This new system helps to clarify what types of wetland impacts are being permitted, such as temporary versus permanent impairments, and wetland loss through fill. The system also better tracks wetland restoration, enhancement, conservation and creation. A previous parameter for measuring the success of the program, "acres of wetlands saved," has been dropped as this was not considered a hard number by the program. Instead, the new data system records "staff interactions," which measures situations where the customer has avoided or minimized impacts as a result of interacting with the staff. The new data system has the potential to more clearly provide information which can be used drive program goals, educational efforts, and enforcement focus.

Meetings, Trainings & Conferences
Members of the Vermont Wetlands Program were able to attend a number of meetings and conferences this year for the purposes of keeping up to date on wetland science and regulation. These meetings, trainings, and conferences included:

- The Annual NEBAWWG (March 2004)
- The New England Wetlands Workgroup meetings at NEIWPCC headquarters in Lowell, Massachusetts.
- Basic Environmental Crimes Investigations Training by the Northeast Environmental Enforcement Project
- NRCS Soils Workshop
- NEIWPCC wetland delineation training

Regulatory Activities
The Vermont Wetlands Section is called upon to review a variety of projects including residential developments, commercial and industrial developments, roads, public works, utilities, agricultural projects, silvicultural projects and others. In more than 88% of the projects, our clients are private citizens, 9% are local governments, 2% of the projects our client is state government, and less than 1% is with federal government. The primary function of the Vermont Wetlands Section is to administer the Vermont Wetland Rules, which regulate most palustrine wetlands that have been mapped on the Vermont Significant Wetland Inventory maps. The Wetlands Section also reviews projects under the jurisdiction of Vermont's Act 250 Land Use Permits and Section 401 of the Federal Clean Water Act. Some projects are reviewed under each of the above authorities. Figure 3.E.1. represents a breakdown of the project categories the Vermont Wetlands Section reviewed in 2004.

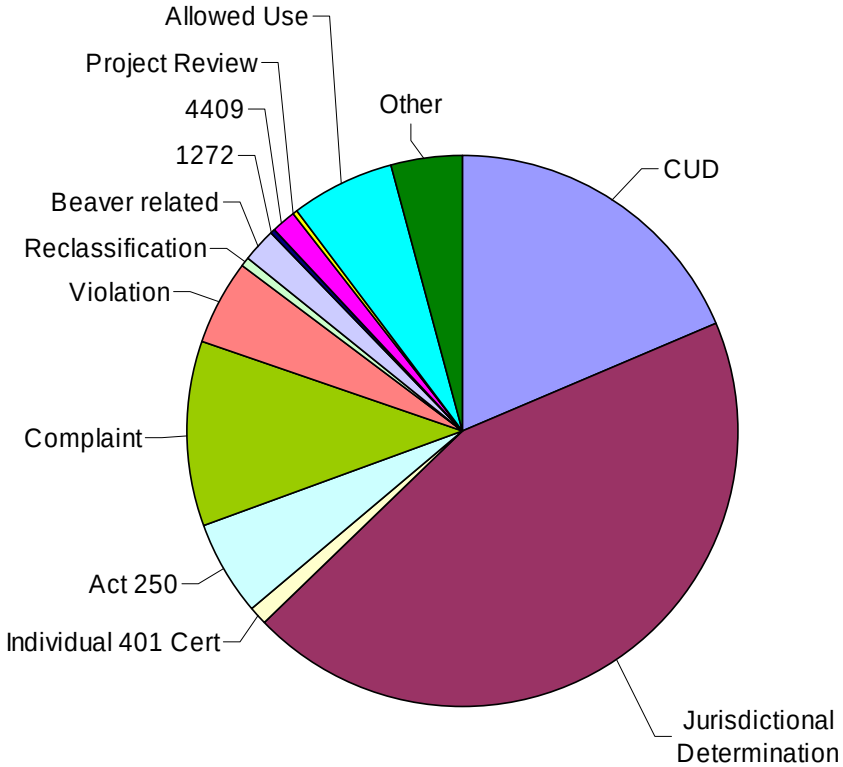


Figure 1: Review Categories for Wetland Projects 2004

The Wetlands Section logged in 512 new projects for the 2004 calendar year. A total of 2.44 acres of wetland were lost for projects started in 2004. Of the projects that were both started and completed in 2004, 1.61 acres of Class Two wetlands were lost, and 0.22 acres of wetland were permanently impaired, and 1.23 acres of Class Two wetlands were temporarily impaired. Of those projects reviewed by the Wetlands office in 2004, a total of 0.83 acres of Class Three wetlands were lost, and 0.36 acres were permanently impaired, and 0.32 acres of Class Three wetlands were temporarily impaired. A breakdown of Class Two and Class Three wetland and buffer zone impacts for projects started and completed in 2004 is summarized in Table 3.E.1.

Table 3.E.1. Wetland & buffer zone loss and impairment (in acres) for projects started in 2004.

Wetland Type	Wetland Loss	Permanent Wetland Impairment	Temporary Wetland Impairment	Permanent Buffer Zone Impairment	Temporary Buffer Zone Impairment
Class Two	1.61	0.22	1.23	6.00	0.70
Class Three	0.83	0.37	0.32	N/A	N/A

Vermont Conditional Use Determinations

The Vermont Wetland Rules designated all palustrine wetlands identified on the VSWI maps and contiguous wetland areas as significant (Class Two) wetlands. Any activity in a Class Two wetland or associated 50-foot buffer zone, other than the allowed uses specified in §6.2 of the Wetland Rules, requires a Conditional Use Determination (CUD) from the Agency of Natural Resources. The Agency may only grant such a determination if the applicant demonstrates that the proposed activity will not have an undue adverse impact on the protected wetland functions.

Wetland Loss through the CUD Process

In addition to the 512 project logged in during 2004, approximately 96 projects were continued from previous years. In 2004, the Wetlands Section received 88 new CUD applications, and 84 CUDs were issued, one was denied, and one was terminated. The following data was compiled from projects that were issued CUDs in 2004, even though many projects may have been started in previous years. The data was compiled from the CUD database, and represents the most accurate measurement of wetland impacts as regulated by the Vermont Wetland Rules. Of the CUDs issued in 2004, a total of 4.2 acres of Class Two wetland were lost, 0.83 acres of wetland were permanently impaired, and 0.45 acres of wetland were temporarily impaired. The CUDs issued in 2004 approved approximately 18.93 acres of permanent buffer zone impairment and 0.9 acres of temporary buffer zone impairment.

Wetland Gain through the CUD Process

A number of impacts permitted through the CUD process undergo some form of mitigation. Portions of the wetland and buffer zone may be restored from a previously impacted condition or enhanced through plantings. Wetlands can be created from an area that was not previously wetland, or simply protected through a conservation easement. Wetland gains can be the result of mitigation for permits, restoration for wetland violations, or the voluntary action of willing landowners, or a combination of these factors. Table 3.E.2. summarizes wetland gains from projects that went through the CUD process.

Table 3.E.2. Wetlands gain (in acres) for projects that received CUDs.

Gain as a Result of:	Restoration	Creation	Conservation	Enhancement
Mitigation and Voluntary	0 ac Wetland 0.106 ac Buffer Zone	0 ac Wetland 0 ac Buffer Zone	0 ac Wetland 0 ac Buffer Zone	21.24 ac Wetland 20.78 ac Buffer Zone
Mitigation and Violation	1.67 ac Wetland 0 ac Buffer Zone	0.37 ac Wetland 0 ac Buffer Zone	0 ac Wetland 0 ac Buffer Zone	0 ac Wetland 0 ac Buffer Zone
Mitigation	0.002 ac Wetland 0.05 ac Buffer zone	0 ac Wetland 0 ac Buffer Zone	0 ac Wetland 0 ac Buffer Zone	4.32 ac Wetland 8.06 ac Buffer Zone
Voluntary	0 ac Wetland 0.56 ac Buffer Zone	0.13 ac Wetland 0 ac Buffer Zone	0 ac Wetland 0 ac Buffer Zone	0 ac Wetland 0 ac Buffer Zone
Violation	0.06 ac Wetland 0.20 ac Buffer Zone	0 ac Wetland 0 ac Buffer Zone	0 ac Wetland 0 ac Buffer Zone	0 ac Wetland 0 ac Buffer Zone

CUDs by Project Types

Table 3.E.3. breaks down the number of CUDs and associated loss of Class Two wetlands by project type. Residential projects accounted for the greatest number of projects in 2004 (21 CUDs issued in 2004 for single family homes, and 31 issued for residential subdivisions). The Program is also able to break down what type of activity proposed within the project results in the most wetland and buffer zone impact. For single family homes, most of the impact occurs as a result of a combination of the construction of driveways and utilities (0.43 acres of wetland loss). For residential subdivisions, eight of the 32 projects have impacts from both roads and utilities. The largest amount of impacts in the residential subdivision category came from a single project that resulted in 0.57 acres of wetland loss, and 3.13 acres of permanent buffer zone impact. These impacts were the result of driveways, buildings, utilities, parks, and yards. Please note that a number of road projects received CUDs this year, but are not yet in the database.

Table 3.E.3. CUDs & associated loss of Class Two Wetlands broken down by project types.

Project Type	Number of CUDs Issued	Acres of Wetland Loss	Acres of Perm. WL Impair	Acres of Temp. WL Impair	Acres of Perm. Buffer Impair	Acres of Temp. Buffer Impair
Residential Single Family	21	0.68	0.10	0.02	1.76	0.15
Residential Subdivision	31	1.70	0.05	0.34	9.80	0.75
Industrial Commercial	10	0.34	0.30	0.00	2.43	0
Parks/Recreation	9	0.30	0.12		1.92	
Agriculture	0	0	0	0	0	0
Forestry	0	0	0	0	0	0
Transportation	1	0.01	0	0	0.09	0
Institutional	2	0	0.22	0	0.86	2

Technical Assistance

Technical assistance is provided to interested landowners, applicants, District Environmental Commissions, municipal conservation and planning commissions, the Natural Resources Conservation Service, and other Vermont Departments and Agencies. Projects range from consultation on Superfund natural resource damages and remediation to determining the boundary of a wetland for a landowner. The amount of technical assistance that is provided is reflected in the number of site visits made (937), phone calls (6,935), and letters sent (884) during the year. An important value of this technical assistance is communication and the opportunity for education and outreach. Program involvement with individual projects gives program staff an opportunity to educate the stakeholder about the value of wetlands and the particulars of wetland regulation. Through technical assistance and project involvement, wetland impacts were minimized by approximately 12 acres and buffer zone impacts were minimized by approximately 2 acres. At least 33 projects that initially proposed impacts to the wetland and buffer zone were completed with no impact whatsoever to these resources due to staff interaction.

Enforcement & Complaint Investigations

There were 80 complaints made to the Wetlands Section in 2004. Of these complaints, only 26 were actual violations. Ten additional violations were received by some other means than a complaint (referral from the enforcement division, or personal observation). It is practice to respond to all complaints, which could involve resolution over the phone, referral to another program, or to a thorough investigation with enforcement action through the Enforcement Division. Because these cases tend to be more complicated, violations usually take multiple years to resolve. Table 3.E.4. breaks down the acres of wetland and buffer lost and impaired due to violations. Of those projects involving a Wetland Rules violation, approximately 0.36 acres of Class Two wetlands were restored, 0.12 acres of buffer zone were restored, and 0.04 acres of Class Three wetlands were restored.

Table 3.E.4. Wetland & buffer zone loss and impairment as a result of violations.

Wetland Type	Wetland loss	Wetlands impairment (permanent)	Wetlands impairment (temporary)	Buffer impairment (permanent)	Buffer impairment (temporary)
Class Two	7.75	0.03	0.25	0.61	0.26
Class Three	0.32	0.60	N/A	N/A	N/A

The Vermont Wetlands Section continues to work and meet with the Environmental Enforcement Division to follow up on complaints and enforcement actions. Significant progress was made in 2004 on both an enforcement policy and protocol for the Wetlands Section and a protocol to ensure CUD compliance.