State of Vermont
2016 Water Quality Integrated Assessment Report

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Vermont Agency of Natural Resources
Department of Environmental Conservation
Watershed Management Division

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STATE OF VERMONT

2016 WATER QUALITY INTEGRATED ASSESSMENT REPORT

Clean Water Act Section 305B Report

Vermont Agency of Natural Resources
Department of Environmental Conservation
Watershed Management Division
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This assessment is issued as a reporting element of the Vermont Surface Water Management Strategy

Table of Contents

Executive Summary 1
Overall Description 1
Assessment Methodology 3
Rivers and Streams Assessment 3
Lakes and Ponds Assessment 4
Wetlands Assessment 4
Listings of Waters 5
Groundwater 5
Major State Water Quality Issues 6
Part A: Introduction 7
Part B: Background Information 10
B1. Atlas of Total Waters 10
B2. Water Pollution Control Programs 11
B3. Nonpoint Source Program 13
B4. Costs and Benefits of Water Pollution Control Programs 15
B5. Issues of Special State Concern 16
Part C. Surface Water Monitoring and Assessment27
C1. Surface Water Quality Monitoring Program 27
C2. Surface Water Assessment Methodology 28
C3. Assessment Results for Surface Waters 30
C4. Wetland Program 51
C5. Trends Analysis for Surface Waters 54
C6. Statewide Probabilistic Survey Results or Progress 54
C7. Public Health Issues 55
Part D. Groundwater Monitoring and Assessment 59
D1. Introduction 59
D2. Groundwater Reclassification Issued in this Reporting Period 59
D3. State Regulations 60
D4. Underground Injection Control Program 60
D5. Information & Public Education 61
D6. Recommendation 61
Part E. Public Participation 62

Appendix A:Vermont Department of Health Fish Consumption Advisory63

Appendix B: The remaining 68 CSO outfalls in Vermont, as of September 28, 2015 65

***Appendix C: EPA and Vermont Long-term Vision for the 303(d) TMDL Program* 69**
EPA's 303(d) Vision 70
2014 *Priority* 303(d) Listed Waters 74

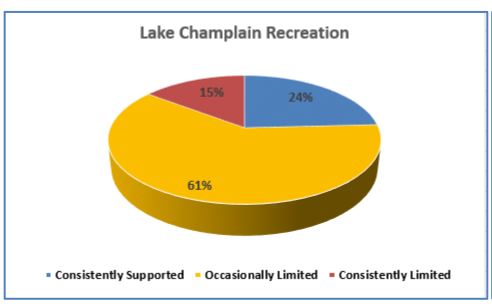
Executive Summary

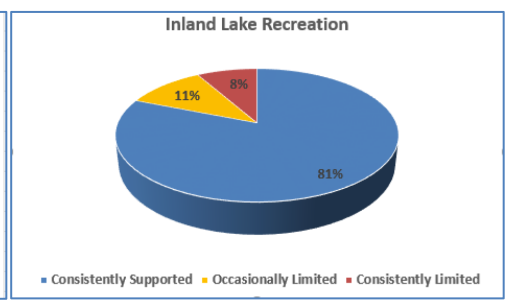
Overall Description

Section 305(b) of the Federal Water Pollution Control Act (also known as the Clean Water Act or CWA) requires each state to submit a report about the quality of the state's surface and ground waters to the US Environmental Protection Agency (EPA) on a biennial basis. This 2016 Water Quality Integrated Assessment Report (*305(b) Report*), prepared by Vermont's Department of Environmental Conservation (DEC) summarizes water quality conditions throughout Vermont with the known conditions as updated with information and data from the 24-month reporting period of January 1, 2014 through December 31, 2015.

Within its borders, Vermont has approximately 7,100 miles of rivers and streams based on 1:100,000 scale maps or approximately 24,500 miles based on 1:5,000 scale mapping. Vermont also has 300,000 acres of fresh water wetlands and 812 lakes and ponds (those at least 5 acres in size or those named on US Geological Survey maps) totaling about 230,900 acres. Surface waters (not including wetlands) are classified as Class A or Class B. As of this writing, Vermont's Water Quality Standards are being amended to create a new water quality classification of B(1), representing surface waters where one or more designated uses are of consistently and demonstrably higher quality than Class B, but that do not rise to the level of Class A.

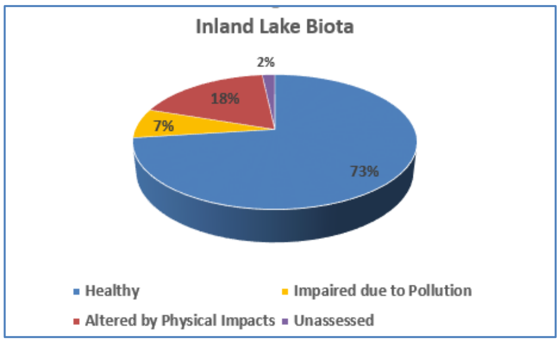
Vermont's water quality policy states that rivers, streams, lakes and ponds should be of high quality, and as a result, the water quality criteria against which surface waters are evaluated are very stringent. For example, in the early 1990s, Vermont adopted baseline water quality criteria for phosphorus in Lake Champlain that were designed to ensure that users experienced nuisance algal conditions no more than 1% of the time in the majority of the Lake's segments, while recognizing that certain areas, such as St. Albans Bay, Missisquoi Bay, or South Lake Champlain, exceeded these baseline criteria by a significant margin. It is therefore important to interpret results of this Integrated Report in the context of the stringency of Vermont's water quality criteria, particularly for nutrient pollution.

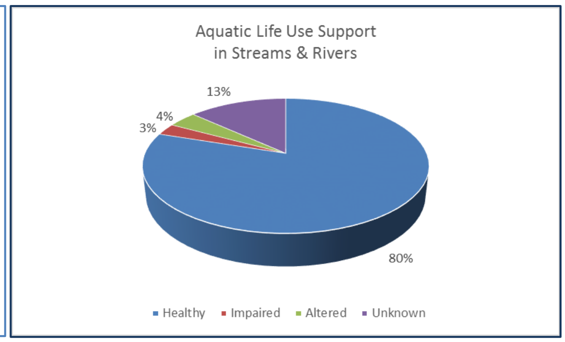




In Lake Champlain, although phosphorus pollution impairs swimming uses in the majority of lake acres, many of these acres only feature occasional limitations. Only 15% of Lake Champlain's 174,175 acres exhibit consistent limitations to recreational uses, but these impacts may be severe in nature, and algal growth is excessive. Certainly, consistent limitation of over 1,700 acres of Lake Champlain's waters is unacceptable. Therefore, Vermont is working diligently under new authority vested by the Vermont Clean Water Act, and in conjunction with the new 2016 Lake Champlain TMDL for phosphorus, to address these severe pollution issues. Inland lakes, however, fare better for recreation use support with recreation consistently supported on 81% of inland lake acreage, occasionally limited on 11%, and consistently limited on 8%.

Vermont has recently incorporated its Clean Water Act assessments into statewide indicators of environmental health that are reported to citizens and the General Assembly on an annual basis. Using all of these criteria, Vermont is able to describe the quality of the State's rivers and streams, lakes and ponds, by examining the co-occurring pollutants or stressors occurring, and deriving integrated indicators of use support. While detailed results are provided in Part C of this Report, aquatic life use support for Vermont's surface waters are summarized in the figures below.





The US Environmental Protection Agency has requested that Vermont also assess the attainment of fish consumption use in light of the advisory originally issued by the Vermont Department of Health in June 1995, and updated most recently in May 2013. The advisory was issued as the result of fish tissue sampling that documented the occurrence of mercury in the tissue of all fish, particularly in walleye and lake trout, and also PCBs in lake trout in Lake Champlain. Taking the fish consumption advisory into consideration, the fish consumption use of all the state's waterbodies ranges from stressed to impaired. Deposition of mercury from the atmosphere is the overwhelming source of mercury in fish. The fish consumption advisory is in Appendix A.

The Wetlands Program of DEC's Watershed Management Division (WSMD) has assessed and monitored wetland condition in the state for over ten years, in conjunction with administration of the Vermont Wetland Rules. The Wetlands Program has recently focused on analyzing permitting data, assigning Floristic Quality Indices to past wetland data, and beginning a probabilistic sampling method for wetlands on the rotational basin schedule also used for stream and lake monitoring.

In 2008, the legislature declared that groundwater in Vermont is a public trust resource. In mid-2011, the Department of Environmental Conservation completed an interim procedure implementing the public trust doctrine for groundwater quality. DEC continues to incorporate the groundwater public trust doctrine in the Groundwater Protection Rule and Strategy.

Assessment Methodology

As described in DEC's Assessment Methodology, miles of rivers and streams and acres of lakes and ponds are placed into one of four categories by degree of support of designated uses - full support, stressed, altered or impaired. Fully supporting and stressed waters are those that meet the goals of the water quality standards, although stressed waters show some degree of impact from land use activities. Impaired waters do not meet goals of the water quality standards because of one or more particular pollutants. Altered waters do not meet water quality standards because of non-pollutant impacts (e.g., alteration of flow to generate electricity).

During the two years since the 2014 305(b) Report, assessment work has now been done in a targeted fashion to assist in providing timely information to the tactical basin planning process. The 2016 305(b) Report contains updated water quality information primarily for the following watersheds: Hoosic River, Batten Kill, Stevens River, Wells River, Waits River, Ompompanoosuc River, West River, Williams River, Saxtons River, Lamoille River and Missisquoi Bay watershed. Basin-specific assessment information is always available from DEC upon request and many reports are located on the DEC Watershed Management Division website.

DEC conducts its monitoring, assessment, and listing of waters consistent with the most recent Assessment and Listing Methodology. The 2015 Water Quality Monitoring Strategy contains a thorough description of the Watershed Management Division's monitoring programs and the goals and objectives of the division's monitoring efforts.

Rivers and Streams Assessment

Vermont's river and stream surface water quality and aquatic habitat conditions have been updated from the 2014 305(b) assessment with water quality information and data generally from waters monitored and assessed during the January 1, 2014 to December 31, 2015 reporting period. Of the 6683 miles identified in the DEC river and stream assessment database, approximately 5798 miles or 87% were assessed for this 2016 305(b) report.

Vermont has developed biological water quality criteria that are scientifically-derived to directly measure the quality of the ecological functioning of streams and lakes. The maintenance of high-functioning aquatic ecosystems is a central tenet of the Federal Clean Water Act, and the use of biological criteria to directly measure the quality of aquatic life is at the core of Vermont's approach to managing rivers and streams. In 2013 and 2014, 372 biological monitoring sites were assessed (the complete assessment for 2015 was not yet available) and the results are included in this report. The DEC Biomonitoring Section has performed both targeted monitoring and a probabilistic site selection design in its assessments reported here. While site selection is based generally on the rotational monitoring schedule, targeted sites are also selected outside the rotation based on the need for biological data requested by an ANR/DEC program or a monitoring requirement incorporated into various permits. These include Act 250, 401 WQ certificates, 1272 orders, NPDES direct discharge, and Vermont Indirect Discharge permits.

The major causes of impairment and stress to Vermont rivers and streams include sediments, physical habitat alterations, nutrients, temperature, pathogens, flow alterations, turbidity and metals. The major sources of these pollutants or stream habitat changes are streambank erosion, loss of riparian vegetation, agricultural land use and activities, developed land runoff and hydrology changes, hydro-electric and snowmaking facilities, channel instability, and atmospheric deposition.

Lakes and Ponds Assessment

The assessment of Vermont's lake surface water quality and aquatic habitat conditions have been updated from the 2014 305(b) assessment with respect to invasive exotic species impacts, water level fluctuations, and chloride concentrations from waters monitored and assessed during the January 1, 2014 to December 31, 2015 reporting period. All lakes and ponds within the borders of Vermont are considered as inland lakes or ponds except for the 11 segments of Lake Champlain. Moore Reservoir and Comerford Reservoir on the upper Connecticut River, Lake Memphremagog and Wallace Pond are transboundary waters that are reported as "inland lakes."

In Lake Champlain, none of its 174,175 acres found in Vermont fully support all designated uses due to the combined effects of mercury and other contamination, nutrient accumulation, and non-native species. No acres in the Vermont portion of Lake Champlain support fish consumption use due to elevated levels of mercury or polychlorinated biphenyls (PCB) in fish tissue. Pollution by phosphorus, and the cyanobacteria blooms that result, are significant issues on Lake Champlain.

In the 55,561 inland lake/pond acres that were partially assessed for the 2014 305(b) Report, the causes of impacts to those acres include mercury, phosphorus, pH (acidification), water level fluctuations, and aquatic invasive species.

The Lakes and Ponds Program continues to support its long-term monitoring projects, volunteer monitoring programs, and lake associations. Over the next 18 months, the Lakes and Ponds Program will be revising its lake assessment protocols to incorporate new legislation and new monitoring approaches. Discussion of the changes will be provided in the next cycle.

Wetlands Assessment

The Wetlands Program of the Watershed Management Division is responsible for documenting wetland loss every 5 years for the EPA, and is in the process of reporting permitting program findings for years 2011-2015. Contained in the permitting data is information about known functions and values of specific wetlands, and an analysis of these data are included in this report. In addition to the program's regulatory review of wetlands, wetland condition data was collected for 10 wetlands using a probabilistic sampling approach. These data have not been fully analysed due to lack of funding. During this monitoring period the Floristic Quality Index was calculated for 56 wetlands sampled over the 2007, 2010, 2011, and 2014 field seasons. Additional potential Class I wetlands were identified, but no evaluations were conducted during this monitoring period. In the coming biennium, the Division will participate in the National Wetlands Assessment, which is a national-scale assessment of wetlands quality.

Listings of Waters

Development of Vermont's 2016 303(d) List of Impaired Waters runs concurrently with the development of this 2016 Section 305(b) Integrated Report. Consequently, the 2016 303(d) List, which needs approval by EPA, is available in draft form as of this writing. Vermont's complete List of Priority Waters that includes altered or impaired waters in addition to the 303(d) List and Vermont's stressed waters list are also in draft form. This 305(b) report plus the various lists of waters together comprise Vermont's Integrated Water Quality Report.

Vermont's 2014 303(d) List of Impaired Waters was approved by EPA Region 1 during the 2016 reporting period (September 2014). The 2014 303(d) listing identified a total of 81 waters as being impaired (68 river/stream segments and 13 lakes/ponds). The draft 2016 303(d) List potentially adds 20 segments. This reporting cycle appears to show the effectiveness of the monitoring and assessment programs by thoroughly identifying all existing impairments in the state. By knowing which waters are of concern, the proper interventions can be brought to improve water quality.

Vermont's 2014 listing of other priority waters outside the scope of 303(d) was also finalized in 2014. This list included: impaired waters that do not need a TMDL (Part B); stressed waters; impaired waters with EPA-approved TMDLs (Part D); waters altered by exotic species (Part E), and flow regulation (Part F).

To date, the New England regional office of EPA has approved a total of 119 TMDLs since 2001. These TMDL waters are in various stages of implementation, and while many remain impaired, there have been considerable successes as well. The Department is pleased to point out that in New England, Vermont leads the way in the numbers of so-called §319 Nonpoint Success Stories posted to EPA's website (http://www.epa.gov/owow/NPS/Success/) and expects more to be added after 303(d) List approval.

Groundwater

Groundwater is fundamental to the ecosystem and as a drinking water resource. It recharges wetlands, streams, rivers, lakes, and ponds, which is critical to wildlife. This interconnection of water resources, however, has not had significant attention. Groundwater is also a source of drinking water for most of the State's population. While groundwater is addressed through the Safe Drinking Water Act, this Act's prime focus has been on monitoring, treatment, operation, and infrastructure needs of public water systems. Additional regulations that address groundwater are often in reaction to contamination. Yet, the quantity and quality of groundwater which define its use remain largely unknown. Characterizing the groundwater resource is progressing slowly relative to the continuing threats of contamination, the pressures and pace of economic development, and the importance of this resource, due to ongoing fiscal restraints.

In the 2016 305(b) reporting period, two new contaminated areas were re-classified to Class IV Groundwater, and the Underground Injection Control (UIC) program finalized and implemented an amended rule effective on October 29, 2014. There were also thorough reviews of active UIC permits and existings floor drains with follow-up where necessary.

Major State Water Quality Issues

Vermont surface water quality issues of concern are detailed in Section B5 below:

Agricultural runoff
Atmospheric deposition of pollutants
Chlorides and water quality
Climate change and Vermont's waters
Dams and dam removal
Invasive exotic plants and animals in surface waters
Lakeshore development and loss of littoral habitat
Lake and reservoir drawdowns and aquatic biota impacts
Pharmaceuticals, personal care products, and other contaminants in waters
River corridors and water quality
Stormwater TMDLs Implementation
Water quality standards critieria

Part A: Introduction

Section 305(b) of the Federal Water Pollution Control Act (also known as the Clean Water Act or CWA) requires each state to submit a report about the quality of the state's surface and ground waters to the US Environmental Protection Agency (EPA) on a biennial basis. The 2016 Water Quality Integrated Assessment Report (often called the *305b Report*) summarizes known water quality conditions throughout Vermont updated with information and data from the 24-month reporting period (January 1, 2014 through December 31, 2015). Also included are brief descriptions of water resources monitoring/assessment program information for rivers and streams, lakes and ponds, wetlands and groundwater. The report contains information on certain costs and benefits, monitoring progress, swimming beach closures and special concerns.

Within its borders, Vermont has approximately 7,100 miles of rivers and streams (at 1:100,000 scale mapping), 300,000 acres of fresh water wetlands and 812 lakes and ponds (those at least 5 acres in size or those named on US Geological Survey maps) totaling about 230,900 acres. Surface waters (not including wetlands) are classified as Class A1 or A2 or Class B. Class A1 waters are managed to maintain a natural ecological condition, while Class A2 surface waters are managed as as public drinking water sources (with disinfection when necessary). Class B waters are managed for aquatic biota and wildlife sustained by high quality habitat; good to excellent aesthetic value; suitable swimming, fishing and boating among other uses. Certain Class B waters have an overlay Waste Management Zone for public protection below wastewater discharges. As of the publication of this Report, the Vermont General Assembly has passed a new law that significantly improves the classification system for Vermont's surface waters. The law creates a new classification of surface waters, called Class B1, to which specific individual uses can be designated through rulemaking.

There are approximately 1,192 miles of Class A rivers and streams and 3,383 acres of Class A lakes and ponds in Vermont. Approximately 908 stream miles are Class A(2) public water supplies and 284 miles are Class A(1) ecological waters. For lakes and ponds, there are about 2,990 acres of Class A(2) public water supplies and 393 acres Class A(1) ecological waters.

Approximately 315 miles of the Class B rivers and about 15 acres of Class B lakes have a Waste Management Zone. The Waste Management Zone (WMZ), similar in effect to an overlay zone in land use regulation, is created on a site-specific basis to accommodate the direct discharge of treated sewage effluent to surface waters. The length of the zone must meet Class B standards but it recognizes an increased risk in the stretch of water for contact recreation.

The Vermont portion of the Batten Kill along with the West Branch of the Batten Kill (totaling about 33 miles), the Lower Poultney River (about 22 miles), a 3.8 mile segment of the Ompompanoosuc River and a 1.3 mile segment involving Pikes Falls on the North Branch of Ball Mountain Brook have each been designated as an Outstanding Resource Water (ORW). The 3.8 mile segment of the Ompompanoosuc was designated ORW in 1996. All other ORWs noted above were designated in 1991.

Wetlands within Vermont are classified as Class I, Class II or Class III. Class I wetlands are those wetlands that are exceptional or irreplaceable in their contribution to Vermont's natural heritage and that merit the highest level of protection. Class II wetlands are those wetlands, other than Class I wetlands that, are so significant, either taken alone or in conjunction with other wetlands, that they merit protection. Class III wetlands are those wetlands that have not been determined to be so significant that they merit protection either because they have not been evaluated or because when last evaluated were determined not to be sufficiently significant to merit protection. The majority of wetlands within Vermont are Class II.

The 2016 Water Quality Assessment Report describes whether or not the state's surface water uses as defined by EPA and the State Water Quality Standards fall into one of four use support categories. The four use support categories used by the Vermont Department of Environmental Conservation are *full support, stressed, altered,* or *impaired.* The four use support categories are described below starting on page 29.

Water uses (or *Designated Uses*) include, but are not limited to, aquatic biota and habitat, recreation (swimming, fishing, boating), drinking water supply, fish consumption, and aesthetics. A determination of use support is made following the Vermont Surface Water Assessment Methodology and using information gathered and provided to the Department of Environmental Conservation by water resources personnel, fish and wildlife biologists, aquatic biologists, lake and river organization members and other qualified individuals or groups. The 2016 Water Quality Assessment Report identifies the distance in miles of rivers and streams and area in acres of lakes and ponds that were assessed.

For Section 305(b) reporting purposes, river or stream segments and lakes and ponds where one or more uses are not fully supported (i.e. either altered or impaired) are considered not to be meeting the Water Quality Standards.   However, for Section 303(d)[1] listing and reporting purposes, impaired waters are those where one or more criteria of the Water Quality Standards are violated by a pollutant. Violations of Water Quality Standards are substantiated by chemical, physical or biological water quality data collected through monitoring. The 2016 303(d) list of waters is being developed concurrently to the 2016 305(b) Report. Because the 2016 303(d) list needs EPA approval, that information is presented separately from the 2016 305(b) Report. The 305(b) Report, the 303(d) list, and the other lists of priority waters, when taken together however, represent Vermont integrated reporting because this information is inextricably linked.

A rotating basin schedule is used when monitoring and assessing the state's waters, focusing on roughly one-fifth of the state each year, from the 15 major basins found in Vermont. The 2016 305(b) Report contains updated water quality information primarily for the following watersheds: Hoosic River, Batten Kill, Stevens River, Wells River, Waits River, Ompompanoosuc River, West River, Williams River, Saxtons River, Lamoille River and Missisquoi Bay watershed. It also contains updates from the last two years of biological monitoring statewide.

For 2016 assessment reporting and listing purposes, DEC used an updated Assessment and Listing Methodology that is dated March 2016. The 2016 Assessment and Listing Methodology can be read on DEC's Watershed Management Division web site (www.vtwaterquality.org). A map with the 15 Vermont planning basins and the year in which they are scheduled for monitoring is below.

[1] Section 303d of the Act requires each state to identify those waters for which technology-based pollution controls are not stringent enough to attain or maintain compliance with applicable State water quality standards.

The 305(b) Integrated Report is a required report for communicating to EPA and Congress about the progress being made in maintaining and restoring the state's water quality and describing the extent of remaining problems. The 305(b) Report has become increasingly important to support funding award decisions to the state made at the federal level under the Clean Water Act Section 106 formula. EPA's Watershed Assessment, Tracking and Environmental Results website relies upon information submitted from this Report. Also, the 305(b) reporting process is an important tracking tool for the performance of water quality protection initiatives under the Core Performance Measures of the Performance Partnership Agreements, and the information contained in this report is used to derive Vermont-specific Results Based Accountability metrics, required pursuant to State law. Finally, the 305(b) water quality assessments are one of several important sources which assist in the identification of impaired waters under Section 303(d) of the Clean Water Act. This report, as well as earlier 305(b) Reports, can be found on the Watershed Management Division's [Monitoring, Assessment, and Planning Program website.]

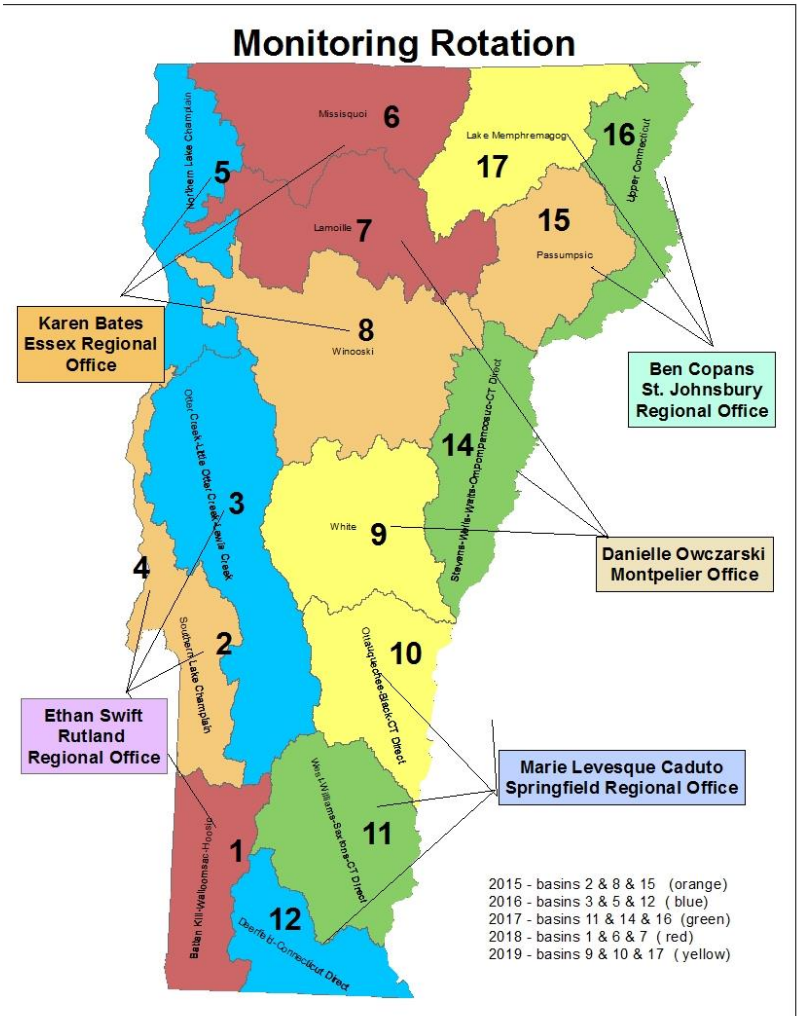


Figure 2. Water Quality and Aquatic Habitat Rotational Monitoring Schedule

Part B: Background Information

B1. Atlas of Total Waters

Vermont has approximately 7,100 miles of rivers and streams based on EPA's Total Waters Database, which uses 1:100,000 scale maps. This is the scale at which Vermont's assessments are presently made, and Vermont DEC currently uses 6683 measured miles as the total on which to base assessed and unassessed miles. Vermont has 230,900 acres of lakes, reservoirs and ponds and 300,000 acres of freshwater wetlands. The surface area of lakes, ponds and wetlands represent approximately 828 square miles of water or about 8.6% of the state's total 9,609 square mile area.

Vermont's border waters include the Connecticut River on the east (border with New Hampshire), Lake Memphremagog and Lake Champlain on the north (partial border with the Province of Quebec) and the Poultney River and Lake Champlain on the west (partial border with New York). The 15 major river basins of Vermont shown on Figure 2 drain to one of four large regional drainages: Lake Champlain, the Connecticut River, Lake Memphremagog, or the Hudson River. Additional surface water resource information is contained in Table 1 below.

Table 1. Atlas

State population (July 1, 2015 estimate)	626,042
State population change (2010-2015)	0%
State surface area	9,609 square miles
State population density	65 persons/sq mi
Miles of perennial rivers & streams	7,099 (includes the Conn River)
Border miles of shared rivers/streams (subset)	262 (Conn R. 238, Poultney 24)
Longest river in the state (not including Conn R.)	100 miles (Otter Creek)
Largest river watershed in the state (not including Conn R.)	1080 sq miles (Winooski R watershed)
Number of lakes, reservoirs & ponds over 20 acres	280
Number of lakes, reservoirs & ponds from 10 to 20 acres	190
Number of lakes, reservoirs & ponds (at least 5 acres but less than 10 acres)	148
Number of significant lakes, reservoirs & ponds less than 5 acres(or size unmeasured)	206
Deepest in-land lake (Willoughby)	308 feet
Greatest depth of Lake Champlain (off Thompsons Point)	394 feet
Acres of lakes, reservoirs & ponds[1]	230,927
Acres of freshwater wetlands[2]	300,000

1 Number includes the Vermont portion of Lake Champlain, some private waters and some waters less than 5 acres in size. This figure also accounts for two CT River impoundments, Moore and Comerford Reservoirs, which are 1,255 and 777 acres in size respectively. The figure also accounts for newly inventoried ponds that were not previously tracked in Vermont's Lake Inventory Database and for some minor lake size changes that were identified via GIS analyses.

2 Number does not include wetlands found on agricultural lands that are actively used for agricultural purposes

B2. Water Pollution Control Programs

The Vermont Department of Environmental Conservation is designated as the lead water quality management agency for the State of Vermont. In that role, DEC administers a variety of programs that are intended to control, reduce or prevent pollution from point and nonpoint sources to the State's surface and ground water resources. There are also a number of other agencies and organizations that work to control nonpoint source (NPS) pollution through their programs. Good descriptions of Vermont DEC as well as other programs working to protect water quality and prevent pollution can be found in Appendix D of the Statewide Surface Water Management Strategy and in the 2013 Vermont DEC Ecosystem Restoration Program report to the legislature.

Act 64 - The Vermont Clean Water Act

During the 2015 legislative session, the Vermont General Assembly passed a sweeping bill aimed at controlling nutrient and sediment pollution to all waters of the State. While a driving force behind passage of Act 64 was the development and impending promulgation of the EPA-led TMDL for phosphorus in Lake Champlain, the water quality benefits associated with the bill's regulatory mechanisms will provide for improvements throughout Vermont. In addition to existing water quality protection permitting programs, the new Vermont Clean Water Act requires:

- Revision of the Vermont Accepted Agricultural Practices to Protect Water Quality to become "Required Agricultural Practices to Protect Water Quality," with significant increases in the level of required practice implementation for all regulated farms in Vermont;
- Improvement in the Acceptable Management Practices for Forestory operations in Vermont;
- Development of a Municipal Roads General Permit to control sediment and nutrient runoff from paved and gravel roads maintained by all State municipalities;
- Expansion of the Transportation Municipally Separated Storm Sewer System (MS4) permit program to all State-managed highways;
- Stormwater Management on all parcels not presently regulated to the most current version of the Vermont Stormwater Management Manual, beginning with parcels containing three acres or more impervious surface;
- Implementation planning via a tactical planning process that has been further improved over the 2011 tactical planning process initially promulgated by the Vermont Surface Water Management Strategy;
- Direction of up to $7M per year in State funds towards priority projects identified by the tactical planning process;
- Development of a publicly-accessible and robust monitoring, assessment, and project implementation data system.
- Development of an Antidegradation Rule to complement the Vermont Water Quality Standards.

Water Quality Standards

The Water Quality Standards are the foundation of the state's water pollution control and water quality management and protection efforts. The Water Quality Standards used when preparing this report were last amended as of October 30, 2014.

The Standards establish narrative and numeric criteria to support designated and existing uses. Designated uses, as established in Sections 3-02(A), 3-03(A) and 3-04(A) of the Standards, mean any value or use, whether presently occurring or not, that is specified in the management objectives for each class of water. The Vermont General Assembly has recently passed, and the Governor has enacted, Act 79, which creates a new classification structure for Vermont waters. Under Act 79, there are four specific classes:

- A1: Waters with Significant Ecological Values
- A2: Public Water Sources
- B1: Waters where one or more uses are of demonstrably and consistently higher quality than Class B2 uses.
- B2: Waters that are suitable for aquatic biota, good fish habitat, public water source with filtration and disinfection, recreational uses, and irrigation of crops.

This legislation was passed in recognition that the classification structure in place as of 2016 was not adequate to fully protect the wide range of quality inherent in Class B surface waters. The law specifically recognizes that individual uses should be designated to a higher level of protection when those waters exhibit those specific higher use-level attainments. Vermont is in the process of updating the Water Quality Standards to reflect the new classification structure, to include specific criteria protective of Class B1-levels designated uses. All of this work is a precursor to the development of a comprehensive antidegradation rule for Vermont, as required by Act 64. For the purpose of this 2016 Integrated Report, uses have been assessed consistent with the existing classification structure in place prior to Act 79.

Table 2. Designated Uses based on Water Classification contained in the Vermont Water Quality Standards, as of 2015.

Designated Uses	Class A(1) – Ecological Waters	Class A(2) – Public Water Supplies	Class B Waters
Aquatic Biota, Wildlife & Aquatic Habitat	✓	✓	✓
Aesthetics	✓	✓	✓
Swimming & Other Contact Recreation	✓		✓
Boating, Fishing & Other Recreation Uses	✓		✓
Water Source		✓	✓
Agricultural Uses (Irrigation of Crops ...)			✓

Watershed Planning Process

Since 2011, Vermont has been implementing a revised tactical planning approach to developing water quality/watershed management plans that is considered the core implementation structure for Vermont's Surface Water Management Strategy. This Strategy sets forth goals and objectives for managing Vermont's surface waters in light of the goals of the federal Clean Water Act and Vermont's state surface water quality policy. The Strategy is continually being updated to reflect changes in statute and water quality policy. A longer description of the Strategy can be found in the 2012 305(b) Integrated Report.

In the past year, and in response to the requirements of Act 64, the tactical planning process has been enhanced by the development of robust water quality modeling tools, and partnerships with Regional Planning Commissions. More information about this evolution is available in the 2016 Annual Report to the Vermont General Assembly on Progress Implementing Basin Planning.

Direct Discharge Program

Vermont administers a comprehensive direct discharge water pollution control program consisting of planning loans and advances, construction grants and loans, permitting, and compliance monitoring. In March 1974, Vermont received from EPA the delegation authority to administer discharge permits under the National Pollutant Discharge Elimination System. Within Vermont, there are 172 wastewater treatment facilities.

With the construction of the state's last originally identified municipal wastewater treatment facility (WWTF) and completion of the upgrades from primary to secondary, the program now places emphasis on refurbishment of existing WWTFs, the completion of phosphorus reduction upgrades, advanced waste treatment, correction of combined sewer overflows, control of toxics, pollution prevention activities and facility enlargements. A summary of the projects that have been awarded loans was provided to the Vermont General Assembly by Vermont ANR DEC January 15, 2016 in the report: Annual Report of Loan Awards The Vermont Environmental Protection Agency (EPA) Pollution Control Revolving Fund – Also Known as the CWSRF, State Fiscal years 2015 – 2016.

Status reports on the permitting cycle and refurbishment for specific WWTF are found within relevant Tactical Basin Plans, including specific wasteload allocations for phosphorus that have been assigned by the Lake Champlain TMDLs Phosphorus, or other relevant TMDLs.

CAFO Permit

The Vermont statewide CAFO (Concentrated Animal Feeding Operation) general permit was issued in June, 2013. Any farm that discharges pollutants to a surface waterbody can be required to obtain a permit. The CAFO general permit is for medium farms; an individual permit would be required for a small or large farm. The CAFO permit requires farms to properly design, construct, operate, and maintain production areas to control waste and to develop and implement a nutrient management plan, which is available to the public. The permit prohibits a discharge of manure, litter, or wastewater, except when direct precipitation equivalent to or greater than a 25-year, 24-hour storm event causes a discharge.

The CAFO permit program is complemented in Vermont by Medium Farm and Large Farm Operating Permits issued by the Vermont Agency of Agriculture, Food, and Markets. These permits feature numerous conditions designed to preclude discharge to surface waters.

In 2016, as required by Act 64, the Agency of Agriculture is also updating the Required Agricultural Practices that are the baseline regulations for all farms in Vermont. Information about agricultural practices, requirements and water quality can be at the Agency of Agriculture website.

B3. Nonpoint Source Program

319 Nonpoint Source Management Program

Vermont has been able to effectively target areas, design work plans, compete for and capture funding, and implement NPS projects directed at restoring and protecting water uses and values. In the twenty-five years of Clean Water Act Section 319 NPS implementation funding (1990-2015), Vermont has received a cumulative total of about $30.4 million to implement a variety of activities.

The goal of the NPS management program is to encourage the successful implementation of best management practices (also referred to as “BMPs”) by diverse interests such as farmers, developers, municipalities, lakeshore residents, landowners and riparian landowners in order to prevent or reduce the runoff of NPS pollutants. Effective BMPs can be structural, vegetative or management-based as well as regulatory or advisory.

Activities carried out with Section 319 funding during this 305(b) reporting period (2014 –2015) were largely those undertaken by personnel with the Vermont Department of Environmental Conservation and the Vermont Agency of Agriculture, Food and Markets (AAF&M). Section 319 funding used by DEC personnel were focused on NPS program administration, tactical basin plan development and implementation, river corridor management, storm water management, lakes and ponds management and total maximum daily load determination. Some of the 319 funding received by AAF&M was, in turn, passed through to a few Natural Resource Conservation Districts and then used for activities carried out by Agricultural Resource Specialists. Importantly and to remain eligible to receive Section 319 funding for NPS pollution control, DEC completed its work on finalizing the Vermont Nonpoint Source Management Program report (a plan concerning NPS management between 2015-2019) and EPA approved the document in August 2015.

Because of the diffuse but widespread nature of NPS pollution, there are several other important programs that are prominent features of Vermont’s overall nonpoint program. Some elements are part of DEC while other elements are conducted outside of DEC. Examples of the former include stream stability assessments and floodplain management, construction sediment and erosion control, hazardous and solid waste management, responding to spills and leaks and the control of stormwater from construction sites and developed areas. Grant funding from DEC’s Ecosystem Restoration Program (ERP)[2] has assumed a significant and expanded role when combating NPS pollution. Examples of NPS work conducted outside DEC include logging erosion control carried out by the Vermont Department of Forests, Parks and Recreation, controlling runoff and erosion from unpaved back roads by the Vermont Transportation Agency and agricultural runoff control by the Vermont Agency of Agriculture, Food and Markets. The US Department of Agriculture and US Fish and Wildlife Service are important federal NPS management partners in both forestry and agriculture arenas, providing significant federal funding support to improve water quality.

Specific details regarding the NPS program and project activities are available from DEC's Watershed Management Division. DEC has maintained a listing of Section 319 and ERP-assisted project titles by funding year. Vermont will continue to pursue and apply state and Section 319 NPS funding in targeted areas that are likely to result in the successful implementation of BMPs and programs and in the improvement of water quality.

A comprehensive summary of NPS practices and programs can be found in the legislative report done recently to describe the measures needed to insure Lake Champlain water quality improvements.

2 The Clean Water Funds appropriated by the Vermont Clean Water Act will be made part of annual ERP grant funding notifications starting in 2016.

B4. Costs and Benefits of Water Pollution Control Programs

Point Sources

The total commitment and expenditure of state, federal and local funds for all municipal wastewater treatment facilities and appurtenances to date has been over $750 million. These facilities have improved the quality of many river miles and a number of lakes including Lake Champlain. The $750 million figure includes almost $8 million in improvements that were funded in the 2015 and 2016 fiscal years. Refer to the CWSRF report noted on page 13 for the location and estimated cost of recent improvements.

The money spent on stormwater pollution has included geomorphic assessments, subwatershed mapping, flow and precipitation monitoring, and modeling work in impaired watersheds in order to develop the best management practices needed to understand the impairment and clean up the streams. To date, at least $1.39 million have been spent on the stormwater impaired streams through grants and contracts for the work described above.

In addition, over $20.7 million have been spent in private and/or public projects in about 16 towns retrofitting existing stormwater systems or enhancing stormwater treatment. Some of this work has provided stormwater offsets for new development by allowing the developers to purchase their offset credits rather than find an appropriate project themselves.

Nonpoint Sources

Unlike point sources, quantifying the financial resources spent on nonpoint source control of pollutants is not as easy to determine or link to specific river miles/lake acres of improvement. This is due to several factors: contributions of resources come from various state, federal and local agencies as well as from landowners, volunteer groups, foundations, businesses; NPS controls take many shapes and forms and can be applied as structural or non-structural measures; some NPS controls may be implemented one year and not applied the following year (e.g. cover crops); some NPS efforts are focused on education as a way to encourage adoption of recommended practices.

During state fiscal year 2015, the Ecosystem Restoration Program received and made available about $2 million for ecosystem restoration grants. Close to 60 grants were issued which enabled NPS pollution reduction work across Vermont.

Funding for the two CWA programs under DEC administration from 1989 through 2015 has amounted to about $1.7 million (604b) and over $30 million (319). The 604b Program’s 40% pass-through has helped the 11 Vermont regional planning commissions (RPC) conduct a wide variety of water quality planning activities that are a priority to the State and to each RPC. In one year (2009), Section 604b funding was increased by $194,000 which was money from the American Recovery and Reinvestment Act. Forty percent of that amount was distributed to the RPCs and linked to low impact development planning. Subsequent to those dollars and the LID related effort by the RPCs, DEC created a Green Stormwater Infrastructure coordinator position that is shared with the Lake Champlain Sea Grant Program, to further expand knowledge and use of such “green” techniques.

With passage of the Vermont Clean Water Act, Vermont is working in concert with RPCs in the development and implementation of tactical basin plans, activities for which RPCs were previously limited partners. The inclusion of RPCs as a statutory partner to the planning process recognizes their role as a primary liaison to municipalities charged with implementing the Vermont Clean Water Act. Also, prior to FFY2012, a portion of the 319 Program has provided varying levels of grant funding to government and non-profit organizations across Vermont to carry out a wide variety of NPS implementation efforts.

Another state funded water quality and aquatic habitat program (besides the Ecosytem Restoration Program) is the Vermont Conservation License Plate program. In the 17 years of its existence (1998-2015), the license plate program and associated Watershed Grants Program have awarded over $1.2 million in state money to many diverse groups for a wide variety of water quality or aquatic habitat projects. Many of these projects provide water quality and/or aquatic habitat benefits that have some connection to NPS management. Fifty percent of the revenues from the Vermont Conservation License plate go towards the Watershed Grant Program. The other half of revenues go towards the Vermont Natural Heritage Program.The grant program, administered by DEC and the Vermont Fish and Wildlife Department, would not be possible without the assistance of citizens who serve on a committee that reviews the numerous proposals submitted each year.

B5. Issues of Special State Concern

The following issues of state concern are generally updates on topics in the 2012 and 2014 305(b) reports with one addition. The 2012 305(b) report, however, has several flooding impacts issues (following Tropical Storm Irene) described that are not carried over and those discussions can be found in the 2012 305(b) report on the ANR DEC Watershed Management Division website.

Agricultural Runoff

Controlling agricultural nonpoint source pollution is a key element in reducing nutrient loading to Vermont’s lakes and streams and to meeting water quality standards. The control of nonpoint source pollution presents a major challenge due to the diffuse nature of nonpoint source contributions, which can originate from farm fields and production areas. Some of these sources, especially from field practices, are difficult to identify, quantify, and control.

In working to control nutrient runoff, Vermont has invested heavily in programs to provide technical and financial assistance to farmers to help improve farmstead runoff, and incentivize soil-based conservation practices such as cover cropping, reduced tillage, and improved nutrient and manure management that may be new or innovative. In Vermont, a strong agriculture conservation partnership exists between state and federal agencies, as well as the non-profit sector that provides non-regulatory outreach and education about these programs to the farming community.

However, concerns about the impacts of agricultural runoff continue to exist, especially from small farms and fields that have been less regulated due to unavailable staffing resources at the Vermont Agency of Agriculture (VAAFM). In 2015, VAAFM visited over 300 small farms in the northern lake region to assess actual and potential water quality concerns, primarily on small farms and fields, and has contracted with three NGOs to help farmers address these. In 2015, DEC received a $16M grant from USDA/NRCS to implement agricultural BMPs on farms in priority areas in the Lake Champlain watershed, and in 2016, DEC collaborated with the Orleans County Conservation District to receive a $650,000 USDA/NRCS grant for BMPs in the Memphremagog watershed.

As required in Act 64, VAAFM is updating the Required Agricultural Practices, to increase the regulations on farms in Vermont, and meet the commitments of the Lake Champlain TMDL. These will be finalized in the summer of 2016. An important component of this work is a requirement that VAAFM work with DEC in the preparation of a comprehensive report on the impacts of tile drainage to water quality in Vermont. Tile drainage, while providing for greater agricultural yields and reduced field erosion, is also known to be a significant source of nutrients to surface waters.

Atmospheric Deposition of Pollutants

The long-distance transport and deposition of air-borne pollutants (mercury, sulfate, and nitrous oxides) to the Vermont landscape from the atmosphere has been principally responsible for the impairment of fish consumption uses on 8,165 inland lake acres, all of Lake Champlain, and 54 river and stream miles. Acidity due to atmospheric deposition of pollutants impairs aquatic life uses on 2,398 inland lake acres and has resulted in 38 lakes now listed as impaired because of acidity and placed on the 303(d) list. This acreage reflects a reduction of 2,084 acres due to the documented recovery of two Vermont ponds, a hopeful sign that acidification impacts to surface water will continue to ameliorate.

Over the past 34 years, various regional US (and Canadian) emission control programs have resulted in substantial reductions in the deposition of sulfate, nitrate and acidity as measured at the Bennington, Vermont National Atmospheric Deposition Program (NADP) site. Reductions in deposition have translated into significant reductions of in-lake concentrations of acidifying pollutants.

Figure 3 shows trends in the annual average precipitation chemistry in Bennington, VT. Since 1981, sulfate ion concentrations in precipitation have declined by more than 80%. Nitrate concentrations have since declined by more than 60%. Concentrations of ammonium ion and base cations (Ca, Mg, K, and Na) have remained relatively constant. Average precipitation pH has increased from 4.3 to nearly 5.0.

Figure 3. Annual Average Precipitation Chemistry at Bennington, VT NADP site, 1981-2014.

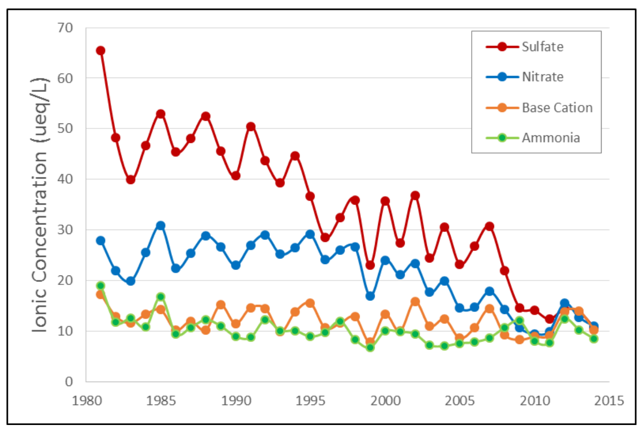
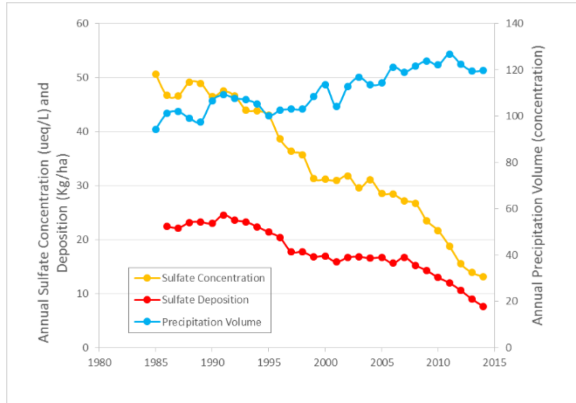


Figure 4 compares changes in sulfate concentration (µeq/l) with wet sulfate deposition (kg/ha), expressed as 5-year running averages. Sulfate deposition has decreased by 60% from the early 1980s. This improvement, however, is not as great as the 80% reduction in sulfate concentration over this same time period.

Figure 4. Five year Running Average Sulfate Concentration and Deposition and Precipitation Volume at Bennington, VT NADP site, 1981-2014.

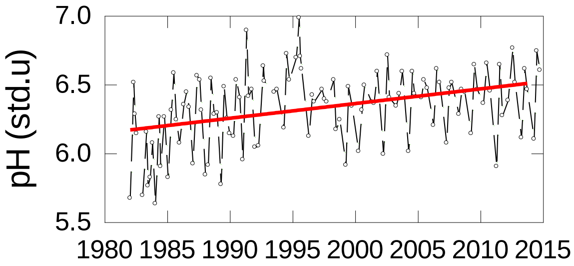


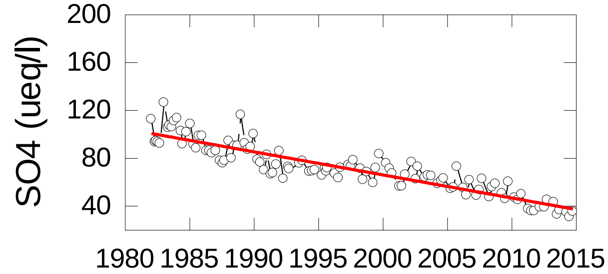
The reductions in concentration appear to have been partially offset by increases in the quantity of precipitation, which has increased by about 30% over the past 30 years. This increase in precipitation amount is consistent with observations from the [2009 report of the US Global Change Research Program (GCRP)], which noted a 50-year trend of increasing precipitation in the Northeast through 2008, along with a large (67%) increase in the amounts of "very heavy" precipitation events over the past 50-year period.

Future projections summarized in the GCRP report include continued increases in northeastern US precipitation volumes and extreme events, especially during winter and spring, with decreases during the summer, increasing soil and surface water temperatures, shorter winters and earlier snowmelt. These changes will have an impact on the water chemistry of all waterbodies in Vermont.

Acid lakes in Vermont have responded to these changes in deposition with reduced in-lake sulfate concentrations and increasing pH levels as shown on Hardwood Pond (Elmore, VT) from 1981-2014 (Figures 5 and 6). Two acid-impaired lakes have chemically improved enough to be removed from the 303d list: Hardwood Pond in Elmore and Harriman Reservoir in Whittingham. Hardwood Pond has been monitored for acid rain impacts since the early 1980s and as such has been a sentinel lake for acidification. Harriman's recovery represents a large waterbody which has improved from acid impaired to acid stressed. However, on most acid lakes, in-lake calcium concentrations remain too low to support sensitive aquatic organisms such as fingernail clams. Additional reductions in acid deposition and increases in calcium and other base cation concentrations are necessary for healthy waterbodies.

Climate change is beginning to affect acid lakes in unforeseen ways. As sulfate deposition and concentration has diminished, dissolved organic carbon has increased leading to the "brownification" of some lakes. Extreme weather events such as severe drought or wet periods are occurring and are having an additive affect. Extreme dry years can lead to sulfur transport from wetlands after rain events leading to episodic acidification. Wet years can flush dissolved organic matter from soils into streams and lakes, leading to this brownification. As emissions reductions continue to have a positive influence on acid sensitive lakes, climate change forces will need to be monitored for their impact on these waterbodies. Recent research conducted nationally indicates that nutrient concentrations are increasing in the most remote and undeveloped lakes and rivers in the United States. This trend is thought to reflect the impacts of climate-driven changes in the hydrology and chemistry of watersheds and soils, and will continue to be monitored closely in Vermont.





Figures 5 and 6. pH and sulfate concentration on Hardwood Pond, Elmore, VT. 1981-2014.

Recent federal regulations such as the 2014 EPA Tier 3 Motor Vehicle Emission and Fuel Standards are expected to further reduce the acidifying pollutants in the atmosphere and in Vermont lakes. It is anticipated that these reductions will improve the water quality of Vermont's acid lakes. However, changes in precipitation volume and intensity due to climate change will have on going unpredictable effects on Vermont's acid sensitive lakes.

Chlorides and water quality

Chloride concentrations are monitored in streams through the Ambient Biomonitoring Program, in lakes and ponds through the Spring Phosphorus and Acid Rain Programs, and on Lake Champlain by the Lake Champlain Long-term Water Quality and Biological Monitoring Program. Current trends on Lake Champlain can be found on the program website. The Watershed Management Division has added chloride criteria for the protection of aquatic biota to the Vermont Water Quality Standards Appendix C (860 mg/L and 230 mg/L, for acute and chronic criteria respectively). Two lakes have been identified as stressed due to chloride and in need of further investigation and two streams are currently considered impaired with chlorides as the pollutant.

Climate Change and Vermont's Waters

As a result of climate change, Vermont and the region are expected to experience changes that could have critical consequences for hydrology, water quality, ecological integrity, and human infrastructure from more extreme and less predictable weather patterns.

With more extreme precipitation events, flooding and erosion concerns are likely to become more pressing. Vermont communities have already experienced an increase in the frequency of damaging floods in recent years including the record setting flows and floods of 2011. This trend is likely exacerbated by greater development in flood-prone areas, as well as chronic instability from historic and current channelization of rivers and streams.

In addition to flooding, intensified stormwater runoff will increase water pollution as flows carry pesticides, fertilizers, sediments, oils, heavy metals, animal waste, inundated septic systems and combined sewage overflows, and other pollution into rivers and lakes. Wastewater treatment facilities that are not completely disconnected from storm sewers may be overwhelmed by storm water volumes, allowing for the possibility of pathogen contamination of lakes or rivers. Warmer, nutrient-rich waters may encourage more frequent cyanobacterial blooms and elevated populations of the bacterium *E.coli.*

Aquatic life could face severe challenges. One concern is that warmer waters hold less dissolved oxygen and this low-oxygen condition can be detrimental to many aquatic species. Changes in the timing and duration of high and low flows could interfere with the life cycles of migratory fish or aquatic insects. Species interactions may be disrupted as more tolerant species gain competitive advantages and aquatic communities become less resistant to invasive species.

Particular species vulnerabilities may include species sensitive to warmer temperatures and oxygen-poor waters (e.g., brook trout), rare species or species sensitive to sedimentation (e.g., freshwater mussels), species with pronounced susceptibility to mercury contamination (e.g., loons), or species that may provide benefits to other species (e.g., tree species important for riparian buffers that may themselves be vulnerable to warming temperatures).

Aquatic ecosystems may be especially vulnerable wherever habitats are already compromised. For example, locations with little or no vegetated buffer will experience higher thermal stress. Critical ecosystem processes that have been altered (e.g., where floodplain function is diminished by flow regulation or excessive encroachment or where habitats are fragmented due to barriers to aquatic species movement such as culverts or dams) may already limit habitat diversity and availability.

Dams and Dam Removal

There are over 1,200 inventoried dams on Vermont's rivers, streams and lakes. Recent stream assessments indicate that there are many more that are not included in the state dam inventory. While many of these dams continue to serve one or more useful purposes – such as recreation, flood control, water supply and hydroelectric power generation – many more, literally hundreds, do not. Most of the dams that are no longer serving a useful purpose were built many years ago, often to provide power for a mill that has long since ceased to operate and may no longer exist. The dams remain, and continue to have significant ecological impacts. Fundamentally, these dams change free-flowing streams to unnatural impoundments, impacting species that depend on riverine habitat for their survival and altering ecosystem processes.

While the 2012 305(b) report noted increased interest in the use of existing dams particularly for hydroelectric power generation and flood control, it is important to note that interest in dam removal has also increased recently. This interest is not surprising given the many ecological benefits of dam removal, which include reduced water temperature, increased dissolved oxygen concentrations, increased habitat connectivity, and the restoration of natural flow and sediment regimes. Removal of unused dams often resolves other issues too including addressing public safety hazards (dams may exacerbate upstream flooding and many are poorly or not maintained) and providing economic benefits (the cost of dam ownership to towns, the state, and private individuals can be significant).

In response, efforts have been undertaken to build additional capacity in the state to restore free flowing rivers. For instance, the Vermont Dam Task Force, a public-private advisory group formed in 2000, identifies potential removal projects and provides technical assistance to dam owners and watershed groups. The state has also created a modest revolving loan fund to help facilitate the removal of unsafe dams. There was legislation in the statehouse in the 2015-2016 sessions that would have compelled owners to register dams and pay registration fees, but the legislation did not pass. Future passage could drive further interest in dam removal.

Several recent projects that highlight the impacts of old dams, as well as the benefits that can be captured through their removal, include the removal of the Dufresne Dam in Manchester, which stood as the only dam on the mainstem of the Batten Kill in Vermont. Originally built in 1908 to power a saw mill, the dam's adverse impact on aquatic habitat was substantial. Data from the Dufresne impoundment showed water temperatures reached 75° F, only a few degrees below the upper lethal limit for trout. The removal of this structure in 2013 not only reduced in-stream temperature, but also allowed for the restoration of thousands of feet of riverine habitat and opened five miles of upstream habitat to the Batten Kill's populations of wild brook and brown trout.

The Marshfield-8 Dam, which stood without a use for close to 40 years, is another exemplary recent dam removal project. Sediment analysis prior to removal demonstrated the extent to which the dam altered the natural sediment regime, revealing 2,375 cubic yards of sediment had accumulated behind the dam, up to a depth of nine feet. Dam removal restored natural sediment dynamics, stabilizing the reach while also improving aquatic habitat.

Other recently completed dam removals include the Henry Bridge Dam in Bennington, which had become a safety hazard for swimmers, the Beaver Pond Dam in Mendon, which had become a haven for invasive Eurasian water-milfoil, the Kendrick Pond Dam in Pittsford, as well as the Franconia Paper Company Dam and Groton-9 Dam, both on the Wells River in Groton. In these instances, dam removal provided recreational benefits, while simultaneously improving connectivity and habitat quality. Several projects are currently in the planning phase including the East Burke Dam in East Burke, the Sargeant Osgood Roundy Dam in Randolph, the Clarks Saw Mill Dam in Cabot, and the Greer Dam in West Fairlee, while many other potential projects are being evaluated for feasibility.

The degree to which dams disrupt river ecology make them one of the most significant alterations humans have wrought on river systems. The recent removals described above demonstrate the multiple benefits that can be captured through restoration of free flowing rivers. As pressure to dam rivers persists, it is becoming increasingly important to effectively communicate the benefits of free flowing rivers to the public and to ensure that resources are available to resolve the conflict presented by dams that have outlived their utility, but continue to exert an ecological impact on riverine systems.

Invasive exotic plants and animals in surface waters

Non-native aquatic plants and animals are established in Vermont - at least 51 non-native aquatic species are known – and many of the state's waters, especially lakes, have a history of impacts related to these invasions. Although the number of new introductions of species already known from Vermont increases annually, many of these populations are found early in the invasion when control efforts can be more successful.

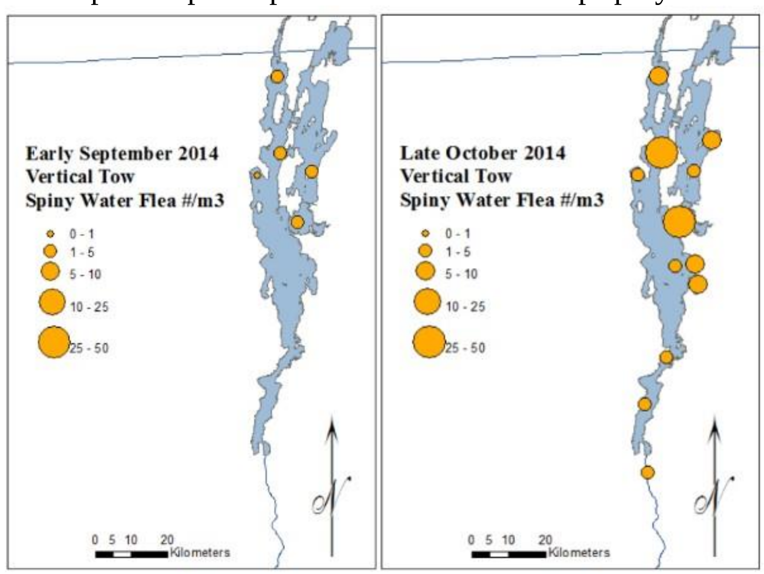
During the 2016 305(b) reporting period, there were a number of invasive species expansions or events:

- New sightings of two aquatic invasive plant species known to already exist in the state were confirmed. One new Eurasian watermilfoil (*Myriophyllum spicatum*) population was confirmed in Lime Pond in Barnard in 2014, bringing the total number of infested lakes to 68 in Vermont. Other waters with Eurasian watermilfoil remains at 30. Four new water chestnut (*Trapa natans*) infestations were found: in 2014, in the outlet area of Lake Carmi, Franklin and a drainage ditch on private land in Benson, and in 2015, in Coggman Creek in West Haven, downstream from already infested Coggman Pond, and Blissville Wetland, in Blissville. The total number of waterbodies known to support water chestnut rises to 30, however, as a result of hand harvesting, 9 of these have not supported a population in a number of years.

- Control and search efforts continued on Vermont's first variable-leaved watermilfoil (*Myriophyllum heterophyllum*) population in Halls Lake in Newbury (confirmed in 2008). Surveys conducted annually 2012 -2015 found no variable-leaved watermilfoil. Variable-leaved watermilfoil has not been found in the lake since June 2011. The only other populations known from a Vermont waterbody is in Lake Champlain confirmed in both Missisquoi and South (NY) bays.

- One species not previously confirmed in the state, the macroalgae starry stonewort (*Nitellopsis obtusa*) was confirmed in an isolated cove of Lake Memphremagog. The sighting was made by a trained volunteer invasive patroller (VIP) on Memphremagog, and confirmed by WSMD staff. This is the first time this species has been recorded in Vermont.

- The aquatic invasive zooplankton, spiny water flea (*Bythotrephes longimanus*) – a crustacean, not a flea as the name implies – was confirmed in one sample from Lake Champlain in late August 2014. A few more sites documented their presence in September. By late October, individuals of this species were confirmed in samples from 12 of 14 long-term monitoring sites located throughout the lake. Spiny water flea is the 50th aquatic invasive species known from Lake Champlain. Spread prevention efforts to keep spiny water flea confined to Lake Champlain is a high priority for VTDEC. See figures 7 and 8 to the right.



- Alewives (*Alosa pseudoharaengus*) were first confirmed in Lake Champlain in 2005. Alewives of all age classes have now been documented in the lake, and schooling alewives were observed for the first time during summer 2007 indicating a significant population increase. These fish have the potential to seriously alter trophic conditions and food chain dynamics as they have in the Great Lakes and Finger Lakes. A fish kill of millions of alewives in the winter of 2008 resulted in fouled beaches and shorelines along the entire length of Lake Champlain.

- Zebra mussels (*Dreissenia polymorpha*) are pervasive in Lake Champlain and Lake Bomoseen but have not emerged or become established elsewhere.

Additional aquatic invasive species information for the 2016 reporting period can be found at: Vermont Aquatic Invasive Species Program 2015 Update, November 2015.

Lakeshore development and loss of littoral habitat

Roughly 45% of all the lakeshore in the state has been developed using development practices that harm lakes. In 2014, Vermont passed the Shoreland Protection Act for all lakes and ponds 10 acres and greater in the state. The standards in this act were modeled after those used by the decades-old Maine Mandatory Shoreland Zoning Act. Much of the impetus for the passage of this law came from the results of monitoring conducted by Vermont DEC as part of the EPA's National Lake Assessment and Vermont's Littoral Habitat Assessment programs which showed Vermont was developing its lakeshores with practices in conflict with the Vermont Water Quality Standards.

While the new Shoreland Protection Act will ensure that any new development and redevelopment of our lakeshores will be conducted in a manner consistent with the Vermont Water Quality Standards, 45% of Vermont's lakeshore in the state (672 miles) has been developed using poor practices. Under current regulations, these existing properties are grandfathered unless re-development activity is proposed.

In 2013, Vermont DEC launched Lake Wise, a program to reward owners of these grandfathered properties who voluntarily embrace best management practices to make their residence more lake friendly. Landowners meeting the program's requirements receive a sign that tells lake users and neighbors they are a model property. Through direct outreach efforts and development of demonstration properties, this voluntary program encourages lakeshore residents to restore the 45% or 672 miles of lakeshore in the state that has been degraded. Lake Wise has begun a series of contractor trainings, whereby contractors can learn more lake friendly development practices and be aware of regulations when working within the 250-foot protected shoreland zone. Contractors completing the course are highlighted on the LakeWise resources page.

Vermont is developing an approach to list lakes as stressed, altered and possibly impaired due to the stressor of lakeshore disturbance. Working in conjunction with Lake Wise and the shoreland permitting process, a listing approach will enable us to better focus resources on shoreland protection and restoration.

Lake and reservoir drawdowns and aquatic biota impacts

Vermont lists a number of its lakes and reservoirs as altered due to flow alteration, which in the case of these lentic systems is in the form of water level fluctuations. It is understood that aquatic biota living in the nearshore environment need water and the nature of drawdowns is such that water is removed from this critical part of Vermont's lentic ecosystems. While the effect of drawdowns has been well demonstrated in the literature, the effect drawdowns have on littoral habitat has not. Using the same methods Vermont DEC used to study the effects poor shoreland development practices had on littoral habitat, VTDEC is now studying the effect drawdowns have on littoral habitat. Results from this study will help VTDEC to come up with a restoration plan for lentic systems in the state currently experiencing drawdowns.

Pharmaceuticals, personal care products, and other contaminants in waters

Perflourinated Octoanoic Acids (PFOA)

On March 10th, 2016, the Department of Environmental Conservation (DEC) sampled surface waters and sediments from eleven different locations in North Bennington (9 sites) and Bennington (2 sites) near the former Chemfab facilities. The sampling targeted rivers, creeks,and ponds near the former Chemfab facility at 1030 Water Street in North Bennington, and near the old location of the Chemfab plant at 108 Northside Drive in Bennington. Testing was performed to provide DEC with further data to evaluate the degree and extent of PFOA contamination after hundreds of drinking water wells showed levels of contamination above Vermont's standards.

Results from 10 surface water samples showed PFOA concentrations ranging from no detection (less than 7 parts per trillion) to 79 parts per trillion. The PFOA concentrations found in the waters tested are much lower than concentrations that could be harmful to freshwater organisms, and are much lower than levels that would be a risk to people who swim there.

Of seven sediment samples collected in early March, three sediment samples contained concentrations of PFOA from 1.2 to 2.4 ng/g (parts per billion), and four samples were found to be non-detect. The highest sediment concentration of PFOA (2.4 ppb) was found in the Walloomsac River, and is considerably lower than the concentration in sediment that would pose a risk to human health or the most sensitive aquatic species.

Mercury and perflourinated compounds

In 2008, EPA's Office of Water launched the National Rivers and Streams Assessment (NRSA), which included a national study of contaminants in the fillet tissue of fish collected from randomly selected sampling locations in the Nation's rivers. Field teams began collecting water and composite fish samples at sites that included several sites in Vermont in 2008 and 2009. EPA has analyzed the water and fish fillet samples for an expanded list of PPCP chemicals and has also analyzed the fish fillets for persistent contaminants, including mercury, selenium, PCBs, pesticides, and flame retardants (PBDEs).

The fish tissue results for mercury were published byWathen et al. (2015) and all fillet samples analyzed for the NRSA contained quantifiable levels of mercury. Results indicated that 13,144 river miles nationwide have concentrations above the 0.3 ppm human health based water quality criteria. The streams from which fish were collected in Vermont included the Connecticut River, White River, and Winooski River, with only the Connecticut River exceeding the 0.3 ppm threshold.

Fillet tissue samples at 162 urban sites across the U.S. were analyzed for 13 PFCs, including PFOA and PFOS (Stahl et al 2014). Six of the 13 PFCs were detected in the fillet samples and 80% of the samples contained some detectable PFCs. PFOS was the most frequently detected chemical (found in 73% of all samples). PFOA, which is currently the PFC of concern detected at the North Bennington site was not detected in any of the fish sampled in the NRSA study. PFOS is the only PFC that has been shown to accumulate to levels of concern in fish tissue.

For a wide variety of additional chemicals (including selenium, pesticides, polychlorinated biphenyls (PCBs) and polybrominated diphenyl ethers (PBDEs), analyses are complete and results will be presented in future publications.

Intersex fish at Missisquoi National Wildlife Refuge

A report published in 2015 (Iwanowicz et al., 2015), found 60-75 percent of male smallmouth bass in the Missisquoi River near Swanton Vermont were intersex. USGS researchers identified several potential causes of Missisquoi River's intersex fish, all of them resulting from agricultural practices. The widely used herbicide atrazine can trigger animals to develop traits of both sexes. Confined animal feeding operations can also cause bass to become intersex as high levels of natural hormones can enter waterways near these operations. Phytoestrogens found on farms can mimic estrogens produced by animals and affect fish biology researchers said. The study covered rivers in 10 northeastern states and Vermont did have the lowest rate of intersex fish in the study. Background levels of intersex fish to help interpret these "new" biomarkers are not fully understood at this time.

Microbeads in Vermont

Microbeads are found in hundreds of personal care products in the State, including facial cleansers, shampoos and toothpastes. These beads, along with the products in which they occur are flushed down drains as part of the intended use of the product. Municipal wastewater treatment plants do not effectively filter microbeads from water. Thus, microbeads originating in all properties connected to municipal sewers can discharge to rivers and lakes in the State. Plastic microbeads are made of persistent organic plastics, which themselves attract other pollutants commonly present in the environment, many of which are recognized to have deleterious impacts on human health or ecological integrity. These include residuals of banned pesticides such as DDT, legacy poly-chlorinated biphenyl (PCBs), flame-retardants (PBDEs), PAHs, and other organic contaminants. The microbeads are of similar size to the natural plankton that inhabit lakes, and are thus consumed by small fish. The chemicals within or attached to the microbeads are transferred to fish tissue during digestion, and subsequently, the contaminants may bioaccumulate. Microbeads and other micro-debris were studied in Lake Champlain in 2014.

River Corridors and Water Quality

The Agency is pursuing river corridor protection as the primary tool to restore and protect dynamic equilibrium in rivers. River corridors consist of lands adjacent to, and including, the present channel of the river. Delineations are based primarily on floodplain function, the lateral extent of stable meanders, i.e., the meander belt width, and a wooded riparian buffer to provide streambank stability. The meander belt width is governed by valley landforms, surficial geology, and the length and slope requirements of the river in its most probable stable form.

A River Corridor Easement Program established in 2007 focuses on conserving river reaches identified as high priority sediment and nutrient storage areas. The opportunity to purchase and sell river corridor easements was created to augment River Corridor zoning which, if adopted, avoids future encroachment and flood damage, but does not restrict channelization.

The Rivers Program works closely with state and federal farm service agencies, the Vermont Housing and Conservation Board (VHCB), and land trust organizations to combine corridor easements with other land conservation programs. The easement ensures that watercourses and wetlands are not manipulated to alter natural water level or flow, or intervene in the natural physical adjustment of the water bodies. To date, the program and land trusts have completed 52 river corridor easements on 27.9 river miles and 1089 acres.

Stormwater TMDLs Implementation

On December 5, 2012, DEC issued a General Permit (3-9014) for Stormwater Discharges from Municipal Separate Storm Sewer Systems (MS4s). The 2012 permit includes new requirements for MS4 entities including the development of a Flow Restoration Plan (FRP) for each stormwater impaired watershed to which they discharge by no later than October 1, 2016. The FRPs must include an identification of the suite of necessary stormwater best management practices (BMPs) that will be used to achieve the flow restoration targets. The MS4 permit, scheduled for revision and readoption in 2017, will also include requirements to address phosphorus wasteload allocations for municipalities subject to the Lake Champlain TMDL for phosphorus, and to address wasteload allocations promulgated within other relevant TMDLs.

The Department has also issued NPDES General Permit 3-9030 under its residual designation authority (RDA) to discharges in five of the 12 urban stormwater-impaired waters with BMP implementation requirements. The Department had planned to issue permits to discharges in the remaining urban impaired waters in 2014, but that has yet to happen. Flow monitoring toward the goal of creating a Flow Restoration Plan is expected to begin in July 2016. Decisions about expired stormwater permits were due in fall 2015, but most towns have asked for an extension on this.

The mountain stormwater impaired streams identified in 1998 or earlier now have some form of remediation plan or plan framework, but the plans vary in terms of the degree of implementation. All these streams remain impaired.

Water quality standards criteria

In the 2014 edition of this report, efforts to amend the Water Quality Standards to accomplish the following were described:

- Amend the *E. coli* criteria to reflect a scientifically defensible criteria based on EPA's 2012 Recreational Water Quality Criteria recommendations;
- Promulgate the Northeast's first comprehensive combined numeric nutrient criteria;
- Adopt chloride as a toxic contaminant; and
- Update 94 individual toxic criteria within the Standards.

These amendments were adopted by the Vermont Secretary of State on October 30, 2014, and were approved by USEPA in September of 2015. As noted above, Vermont is in the process of further updating the Standards to incorporate the classification provisions of H517, and further update certain toxics criteria, implement certain reclassifications as recommended by tactical baisn plans, and improve the antidegradation policy language as a precursor to promulgating an Antidegradation Rule.

Part C. Surface Water Monitoring and Assessment

C1. Surface Water Quality Monitoring Program

During 2014 and into 2015, DEC conducted a comprehensive review and redesign of its 2011 Water Quality Monitoring Strategy (WQMS). A summary of that re-design can be found here. In addition, other surface water monitoring program accomplishments were thoroughly described in the 2012 305(b) Integrated Report starting on page 49. In brief, during this reporting period, the Department implemented the following accomplishments, pursuant to agreements with USEPA on the use of supplemental Clean Water Act §106 funding:

River Biomonitoring Program:

I) Continued sampling Vermont rivers using a randomized, rotating-basin probability design to produce a statewide probability assessment while contributing to the overall rotational assessment.

II) Continued upstream-downstream WWTF sampling on identified facilities in the current year basin rotation

III) Completed the second year of the National Rivers and Stream Assessment.

IV) Completed macroinvertebrate biocriteria for wadeable low gradient streams

V) Incorporated sampling for the NY/NE Regional Monitoring Network (RMN) to look at long term changes in temperature, hydrology and biology resulting from climate change.

Lake Monitoring Program:

I) Continued development of a phosphorus TMDL for Lake Memphremagog by coordinating an international sampling initiative on that lake. As the model nears completion, the program will transition to focus on TMDL implementation tracking.

II) Completed several littoral habitat assessment studies which culminated in the development and implementation of a new Shoreland Protection Act in July 2014.

III) Finalized the Next Generation Lake Assessment protocol and began using it routinely for summer lake assessments.

IV) Continued to collect data from Vermont's lakes and ponds through our established long-term monitoring programs (Lay Monitoring – 36 years, Spring P – 35 years, Summer Assessment, Lake Champlain)

V) Continued to work with local volunteers to monitor for invasive species on water bodies and operate boat inspection stations throughout the state, celebrating 13 years.

VI) Continued to collect data on aquatic plants through our established long-term aquatic plant monitoring program, celebrating 34 years.

VII) Continued to monitor for invasive aquatic plants on infested waterbodies through our established aquatic invasive species program, celebrating 31 years.

VIII) Continued to monitor for zebra mussels through the Lake Champlain long-term monitoring program and the aquatic invasive species management program. In 2015, monitoring for spiny waterflea on inland lakes was added.

Wetlands Monitoring Program:

I) Followed the progress of the National Wetlands Condition Assessment

II) Completed a preliminary analysis of Floristic Quality Indices for a portion of our existing monitoring data

III) Improved coordination of invasive monitoring by attending the newly formed Vermont Invasive and Exotic Plant Committee meetings

IV) Continued coordination with enforcement staff to insure prevention of illegal wetland encroachment

V) Developed funding sources to conserve wetlands

Assessment:

I) Continued to submit 303(d) lists and other assessment findings to EPA for incorporation into ATTAINS using the combined lakes and streams Vermont ADB.

II) The Lakes and Ponds Program has begun a full revision of their assessment process to better incorporate new goals and science (see pg 35).

Data Management:
Used the resources of our data management staff to build online data access tools and internal reporting mechanisms that greatly increase efficiency of data extraction and analysis. As a highlight, the Vermont WQData water quality archive surpassed one-million individual datapoints as the 2013 monitoring data were stored into the system. In addition, a comprehensive online monitoring data retrieval tool, the Vermont Integrated Environmental Watershed Viewer (VIEWS) was launched.

Staff Development:
Supported staff participation at annual regional environmental biologists conferences or other national meetings. Several staff participated in the regional NEAEB meetings, staff participated in all NARS trainings.

Vermont Water Monitoring Council:
DEC continues to partner with USEPA, USGS, and the Vermont Monitoring Cooperative, and watershed associations to support a Vermont Water Monitoring Council. This group meets biannually, and serves as a forum for Vermont monitoring groups to share information, learn about Vermont, regional, and national montoring efforts, and to engage in technical training.

C2. Surface Water Assessment Methodology

The methods used to derive Vermont's statewide assessment of water quality conditions are found in the *Vermont Surface Water Assessment and Listing Methodology March 2016*. This 2016 305(b) Water Quality Integrated Assessment Report describes whether or not the state's surface water uses as defined by EPA and the State Water Quality Standards fall into one of four use support categories. The four use support categories used by the Vermont Department of Environmental Conservation are *full support, stressed, altered,* or *impaired.* Definitions of these categories are:

Full Support **-** This assessment category includes waters of high quality that meet all use support standards for the water's classification and water management type.

Stressed **-** These are waters that support the uses for the classification but the water quality and/or aquatic biota/ habitat have been disturbed to some degree by point or nonpoint sources of pollution of human origin and the water may require some attention to maintain or restore its high quality; the water quality and/or aquatic habitat may be at risk of not supporting uses in the future; or the structure or integrity of the aquatic community has been changed but not to the degree that the standards are not met or uses not supported. Data or other information that is available confirms water quality or habitat disturbance but not to the degree that any designated or existing uses have become altered or impaired (i.e. not supported).

Altered **-** These are waters where a lack of flow, water level or flow fluctuations, modified hydrology, physical channel alterations, documented channel degradation or stream type change is occurring and arises from some human activity, OR where the occurrence of exotic species has had negative impacts on designated uses. The aquatic communities are altered from the expected ecological state. This category includes those waters where there is a documentation of water quality standards violations for flow and aquatic habitat but EPA does not consider the problem(s) caused by a pollutant or where a pollutant results in water quality standards not being met due to historic or previous human-caused channel alterations that are presently no longer occurring.

Impaired **-** These are surface waters where there are chemical, physical and/or biological data collected from quality assured and reliable monitoring efforts that reveal 1) an ongoing violation of one or more of the criteria in the Water Quality Standards and 2) a pollutant of human or human-induced origin is the most probable cause of the violation.

Water uses include aquatic biota and habitat, contact recreation (swimming, wading) and secondary contact recreation (fishing and boating), aesthetics, public water supply, fish consumption, and agricultural water uses. A determination of use support is made using information gathered by DEC from many sources including water resources staff, fish and wildlife biologists, aquatic biologists, watershed organizations, and other individuals or groups who have qualified data and information.

As in prior years, Vermont is presenting assessment results along with a series of lists that are analogous to EPA's reporting categories. The Vermont Part A list of 303(d) waters impaired by pollutants corresponds to EPA "Category 5" impaired waters. The Vermont Part B list of impaired waters not in need of a TMDL analysis corresponds to EPA "Category 4B." The Vermont Part D list is a list of waters that have approved TMDLs, which is analogous to EPA "Category 4A." In Vermont, so-called altered waters are those where water quality impairments exist due to non-pollutants. These occur on the Vermont Parts E and F lists (exotic species and flow altered respectively), and all are analogous to EPA "Category 4C." This report also provides a tabular assessment of waters by EPA reporting category.

During the 2016 305(b) reporting period, ANR used EPA's Assessment Database (ADB) application for both lake and stream water quality assessment information. For the lakes database, ANR staff updated lakes altered by invasive exotic species, water level fluctuations, and chloride stress. For the river and stream ADB, staff updated the impaired and altered stretches of water using all available biological, chemical, flow, or exotic species data and information.

C3. Assessment Results for Surface Waters

C3.1 Assessment Results for Rivers and Streams

Designated Use Support Status

Vermont has approximately 7,100 miles of perennial rivers and streams based 1:100,000-scale maps, of which 6683 miles are tracked within Vermont's assessment databases. Of the 6683 miles, approximately 87% are assessed and 13% are not assessed. Of the approximately 5,798 river and stream miles assessed for this report, overall about 89% of those miles are in compliance with the state's water quality standards and support designated uses, and 11% do not meet water quality standards or do not fully support the designated uses. Of the 89% meeting standards, approximately 15% are considered stressed by some pollutant or activity. These percentage results are similar to those in the 2014 305(b) Report.

Table 9 is a summary of the number of miles of rivers and streams throughout Vermont that support (full support or stressed) or do not support (altered or impaired) designated uses of the waters. For example, river miles that support aquatic biota have macroinvertebrate and fish communities in good to excellent health in the sampled reaches based on a number of metrics for each community. River uses can be impaired by pollutants or altered by flow reductions or fluctuations and they can be stressed by a pollutant, condition, or direct instream activity.

The number of miles in each support category are provided for the designated uses shown below, and for "overall use," which 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 9. Summary of Use Support for Vermont Rivers & Streams (in miles)

Designated Use	Full support	Stressed	Altered	Impaired	Total Assessed	Total Measured
Overall	4389.1	785.2	258.8	365.2	5798.3	6682.9
Aquatic biota/habitat	4479.6	871.2	260.3	187.2	5798.3	6682.9
Contact recreation	4975.7	372.1	17.3	176.4	5541.5	6682.9
Secondary contact recreation	4891.3	589.7	84.4	37.1	5602.5	6682.9
Aesthetics	4882.1	630.9	147.0	96.1	5756.1	6682.9
Fish consumption	0	6621.5	0	61.4	6682.9	6682.9

Table 10 below provides overall use attainment for Vermont rivers and streams using nationally-consistent EPA categories.

Table 10. Size of Rivers or Streams in EPA Assessment Categories (as per ADB).

Category	Description	Total size (miles)	Number of stream segments
1	All uses met	0	0
2	Some uses met, others indeterminate	6,041.9	210
3	Insufficient information to assess any use	0	0
4A	Impaired, TMDL approved	126	32
4B	Impaired, no TMDL needed	8.8	9
4C	Impaired, but not by pollutant	235.7	51
5	Impaired	234.2	88

Note: Segment is defined as a unique portion of a stream. More than one segment may be present for an individually named stream. Figures are provisional, pending outcome of 2016 303d list approval by EPA and final updating and proofing of the EPA database. There are actually miles and waterbodies with all uses met and public water supply unassessed but the ADB query puts these waters into Category 2.

Causes & Sources of Impairment, Alteration, and Stress for Rivers and Streams

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 11 and 12 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 the tables. For this reason, the two columns on each table <u>are not additive</u> 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 <u>relative size</u> of the impact from different pollutants or conditions on Vermont's waters and from which land uses or activities they may originate.

<u>Causes</u>

Sedimentation has been listed as the main cause of stress and impairment of aquatic life use support affecting the most river and stream miles since Vermont began reporting the impacts of nonpoint source pollution. Sedimentation occurs in a stream reach when the capacity to transport a sediment load is exceeded by the actual load. This process may occur when either the load is increased or the transport capacity is decreased. In either case, the sediment that is deposited stresses or impairs habitat. Unnatural levels of sediment alter or destroy macroinvertebrate habitat and fish spawning areas and fill in swimming holes among other impacts.

Sources of sediment include runoff from construction sites, developed land, roads, and cropland; channel erosion from stormwater runoff; and streambank erosion. Streambank erosion is associated with the loss of riparian woody vegetation as well as channel downgrading and widening due to stream channel instability. A research project with the US Department of Agriculture (USDA) Agriculture Research Service National Sedimentation Laboratory, in conjunction with a Lake Champlain Basin Program modeling effort showed that streambank erosion from channel instability contributed approximately 29-42% of the total suspended sediment load, and approximately 50% of total phosphorus at the mouth of the Missisquoi River.

The watersheds with the most documented miles of sediment impacts are the Winooski River, the Lamoille River, and the Otter Creek watersheds as was the case in 2014.

Table 11. Summary of Causes of Impact to Vermont Rivers & Streams (in miles).

Cause of impairment, alteration or stress	Length impaired or altered by cause	Length stressed due to the cause	Total length on which causes have an impact
Sediments	137.2	786.2	923.4
Physical habitat alterations[1]	134.6	490.7	625.3
Nutrients	67.0	472.2	539.2
Temperature	66.6	469.9	536.5
Pathogens	173.5	190.8	364.3
Turbidity	45.8	229.2	275.0
Flow alterations	200.9	70.7	271.6
Metals	68.1	84.9	153.6
pH	45.8	31.8	77.6
Total toxics [2]	1.4	73.5	74.9
Organic enrichment	26.6	48.0	74.6
Organic compounds	38.4	8.0	46.4
Pesticides	0	44.0	44.0
Stormwater	38.4	4.7	43.1

1 These numbers do not necessarily include all the miles of river and stream channelized and dredged post Tropical Storm Irene. The Vermont F&W Department has estimated 77 miles of major impact but also note that they were unable to survey all the streams at the time of their summary and report.
2 Toxic pollution lumped – organic compounds and metals or unknown toxic effect on biota. Most of this information is old and needs re-visiting.

The "cause" that has the second greatest number of miles of impact is one called "physical habitat alterations" ("other habitat alterations" in earlier 305(b) reports). This cause is different from the others that are more obviously pollutants such as pathogens or sediments. However, dredging, instream gravel mining, channelization, berming (captured in the "Sources" section below), all lead to physical alterations in-channel, which is the direct habitat of the aquatic communities that the WQS and Vermont DEC, among others, strive to protect. The Winooski and Lamoille watersheds have the highest number of miles documented with habitat alterations.

Nutrients are known to impair about 67 miles and stress about 472 miles. Given the agricultural heritage of Vermont and the fact that villages and towns lie along rivers and streams in Vermont valleys, it has always been a challenge keeping nutrients on the land in the soil and vegetation and out of surface waters and wetlands. The Otter Creek, Winooski River, and Missisquoi River watersheds have the most miles of nutrient impacts.

Temperature increases in surface waters are also a challenge to control due to the removal of riparian vegetation and warm impervious surface runoff affecting coldwater streams. Streams with onstream impoundments and high turbidity also suffer from increased temperatures. The watersheds with the most miles of temperature impacts are the White River, Basin 11 watersheds (West, Williams, Saxtons Rivers), and the Missisquoi River watershed.

Pathogens get to Vermont rivers and streams in limited instances from CSOs, and more frequently from barnyard and pasture runoff, from city and suburban runoff, and from failed waste treatment or storage systems large and small. Elevated *E. coli* also can result from concentrations of wildlife and separating natural from anthropogenic loads is difficult at times.

Elevated levels of turbidity are another significant stressor and one that is probably under estimated in rivers and streams due to lack of sampling and difficulty documenting impacts. Practices that target erosion control and stormwater runoff as well as channel instability to reduce sedimentation should reduce the extent of turbidity.

At the same time that progress is made in dam removal and improving flow through licensed projects, increased development with its impervious surfaces and stormwater runoff especially in areas of steeper slopes causes increased flows that affect aquatic habitat and communities. In addition, an impact not well quantified is the alteration of natural hydrologic patterns when private roads and driveways, ski slopes, and some stormwater infrastructure shifts flows from one stream and its watershed to a different one.

Miles labelled as impaired or stressed from metals have been slowly increasing as more areas are identified where either old landfills exist or development disturbs certain soils or adds fill resulting in iron pollution. DEC pursues remediation of these situations as they become known.

The other substantial causes identified include pH, toxics including organic compounds and pesticides, organic enrichment and stormwater.

Sources

The sources of pollution identified as having the greatest impacts, or causing the greatest stresses, on miles of river and stream are streambank erosion/de-stabilization; removal of riparian vegetation; agricultural land uses and activities; developed land runoff, which includes road runoff; flow alteration from hydroelectric facilities, snowmaking water withdrawals and other sources; channel instability and developed land runoff. Additional significant sources of impacts include atmospheric deposition, flood impacts resulting from poorly sited or designed human structures or activities, land development (active development as opposed to runoff from existing roads and development), and upstream impoundments. See Table 12 below.

Streambank erosion is described above as a source in and of itself, but this 'source' results from other 'sources' such as riparian vegetation removal and channel instability processes, which are well described in the Channel Erosion and Encroachment Chapters of the Surface Water Management Strategy. In addition, the interrelationship and overlap between several of these sources such as agricultural activities, riparian vegetation loss, streambank erosion, channel instability, channelization 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 of the numbers in the table.

Table 12. Summary of Sources of Impact to Vermont Rivers & Streams (in miles).

Source of impairment, alteration or stress	Length impaired or altered due to source	Length stressed due to source	Total length on which sources have an impact
Streambank erosion/ de-stabilization	108.1	656.7	764.8
Riparian vegetation removal	74.5	564.9	639.4
Agriculture	140.0	457.0	597.0
Developed land runoff [1]	95.5	326.7	422.2
Channel instability	53.8	220.4	274.2
Flow modification (hydro, snowmaking withdrawals..)	200.9	66.1	267.0
Atmospheric deposition	87.5	73.2	160.7
Channelization	23.5	134.3	157.8
Flooding (including infrastructure failures)	31.5	112.3	143.8
Impoundment	39.0	71.8	110.8
Land development	41.4	61.3	102.7
Hazardous waste sites	8.0	58.7	66.7
Resource extraction	20.8	37.5	58.3
Recreational activities	12.1	45.9	58.0
Municipal point sources	26.8	27.8	54.6

1. Developed land runoff includes road/bridge runoff.

Vermont will continue to use stream geomorphic data and other sources to identify stream erosion/sedimentation as a source of alteration or stress emanating from:

1. Channel instability – associated with disequilibrium from watershed hydrology changes, floodplain encroachment, stream loss of access to its floodplain among others;
2. Bank and adjacent land erosion – not associated with disequilibrium, i.e., bank erosion due to sources such as loss of woody vegetation, animal trampling, construction development too close to banks, among others.

Removal of riparian vegetation continues to be a ubiquitous problem in the state. Residential and commercial landowners, developers, ski areas, utility companies, 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, and this increases a stream's vulnerability to geomorphic instability.

Agricultural land uses can affect water quality in several different ways including nutrient runoff from barnyards, pasture land, and manure storage or spreading; tile drainage; inadequate buffers to protect adjacent streams or wetlands from direct or indirect impacts; and occasionally the formation of gullies that cut through stream buffers directly delivering sediment and nutrients from lands within stream corridors and floodplains, into streams.

Developed land as a source includes runoff from any urban, suburban, village or other developed areas such as roads, bridges, parking lots, and driveways. Developed land changes the amount and timing of runoff reaching rivers and streams and the runoff contains many pollutants including sediment, metals, nutrients, pathogens, and organic compounds. The impact from ongoing residential sprawl as well as commercial development seems to outpace progress in erosion and runoff control, streamside vegetation re-establishment, and stream stabilization efforts.

Channel instability can be a result of stormwater runoff, flood impacts, flood “repair” work, instream gravel mining, and watershed hydrology changes. Channel instability is a source of both sedimentation and habitat alteration. As discussed above, this source of habitat impact and loss will continue to identified as new physical assessments are done.

Flow modifications come largely from hydro-electric facilities but can also be the result of snowmaking water withdrawals and to a lesser extent, water supply water withdrawals. Channelization is the dredging and straightening of channels and occurs often adjacent to roads and railroads or other development too close to the rivers and streams. It can be the result of post-flood work and has the same consequences of channel instability resulting in instream habitat impacts.

Atmospheric deposition is primarily responsible for mercury and acidified conditions in Vermont’s surface waters. While these conditions are exacerbated in lake systems, stream biological communities do exhibit quantifiable impacts, particularly due to acidification.

The flood impacts are those from poorly sited or designed human structures (road, bridges, culverts), which blow out during a flood resulting in more damage than would be otherwise.

Stream & River Biomonitoring

The DEC Monitoring Assessment and Planning Program Biomonitoring Section has performed both targeted monitoring and a probabilistic site selection design (reported in section C6 starting on page 49 in this report) in its assessments as reported here for 2013 and 2014. As of this writing, the 2015 assessments have not been completed. While site selection is generally based on the rotational monitoring schedule (Figure 2), targeted sites are also selected outside the rotation based on the need for biological data requested by an ANR/DEC program or a monitoring requirement incorporated into various permits. These include Act 250 permits, 401 WQ certificates, 1272 orders, NPDES and Indirect Discharge permits.

A total of 372 biological assessments were reported out in the 2013-2014 period. A summary of the purpose of all assessments done from 2013 and 2014 fall into 17 general categories listed in table 13 below. The greatest number of stream reaches were monitored to determine the effectiveness of storm water management practices on Vermont’s streams in urban, ski area, and wind farm development areas. A significant number of reaches were also selected in support of the joint EPA-States National Aquatic Resource Survey initiative, and the need for data to complete macro-invertebrate biocriteria for low gradient streams. A substantial number of reference quality streams were also monitored to identify very high quality waters to support reclassification recommendations contained in tactical basin plans. Vermont also participated in a joint EPA-State regional long term sentinel monitoring network.

Table 13. Summary of the purpose for stream biological assessments in the period 2013-2014.

# of Sites	% of Sites	Assessment Purpose[1]
60	16.1	Ski Area Development
47	12.6	Very High Quality Water Identification
33	8.9	Wastewater Treatment
32	8.6	Urban Development
28	7.5	Probabilistic Sampling
28	7.5	Wind Energy Development
27	7.3	Indirect Discharge Compliance
23	6.2	Sentinel/Long Term Reference
19	5.1	Agriculture
18	4.8	Rural Development
17	4.6	Biocriteria Development
13	3.5	Hazardous Waste Management Program
11	3	Solid Waste Management Program
9	2.4	Forest Service Partnership Agreement
3	0.8	Enforcement
2	0.5	Dam (removal/operation)
2	0.5	Forestry Management

1. Assessments are either performed by the DEC or approved by DEC under a permit condition.

The assessment outcomes for the period 2013 and 2014 are summarized by community type in Table 14 below. This table includes all assessments evaluated by DEC. Over 50% of the streams reaches assessed using macroinvertebrate community integrity were of very high quality (i.e. *Very Good* or better). Only 18% were found to be in non-support of Class B aquatic life support, with 7% in need of further assessment or indeterminate for aquatic life support. A total of 154 fish community assessments were completed in 2013-2014. These assessments showed that nearly half should be considered as very high quality waters, 19% are high quality waters supporting Class B biocriteria (i.e. *Good*), and 33% are non-supporting of Class B biocriteria. An additional 34 sites were sampled but were unable to be assessed because they were low gradient streams, showed biological alteration due to a nearby upstream impoundment, or only supported a brook trout population.

Table 14. Summary of macroinvertebrate and fish community assessment outcomes for 2013-2014.

Assessment Rating	Macroinvertebrate Community (n=368)	Fish Community (n=154)
Excellent - Very Good (VHQ)	190 (52%)	57 (48%)
Good (Class B)	85 (23%)	23 (19%)
Fair/Good (Indeterminate)	27 (7%)	-
Fair - Poor (Non-Support)	66 (18%)	40 (33%)

Toxic Impacts to Rivers and Streams

Sites of Known Sediment Contamination

During the reporting period of 2014- 2015, sediment characterizations were conducted at several locations. Assessments were conducted at former landfills, in urban watersheds and behind low-head impoundments that are being considered for remediation or removal in order to restore stream connectivity. These are described below. Sediment characterization at these sites includes priority metals and organic compounds. Results are compared to Vermont ANR Sediment Quality Guidelines (SQGs) for protecting aquatic biota. In addition to those described below, there are also documented contaminated sediments in Stevens Branch in Barre, Stevens Brook in St. Albans, in a tributary to Muddy Brook in South Burlington, and in the Walloomsac River (see page 24).

Pownal Tannery Dam – Hoosic River, Pownal

Sediment chemistry results (draft report) from Phase II Environmental Assessment for the Pownal Dam Remediation were provided by Lincoln Applied Geology. Sediment Quality Guidelines used to evaluate risk to aquatic biota indicate PCBs are elevated at depth and there are several exceedances of PAHs, though few above PEC. A final Report will be submitted in 2016.

Moon Brook Sediment Chemistry – Urban Stream Stressor Identification

Sediment samples from seven locations within Moon Brook watershed were analyzed for SVOCs, PAHs, pesticides, herbicides and metals. Several metals (Cu, Zn and Pb) and PAHs were elevated above SQGs. Copper significantly exceeded the PEC at one site; Zn and Pb were just above the PEC. The high Zn and Cu observed may be related to wood preservatives from an industrial center nearby.

Jones & Lamson – Black River

Recent sediment chemistry assessment results at the former Jones & Lamson site indicated PCBs were significantly elevated (25,000 – 63,000 ppb) nearshore adjacent to swarf piles. The likely source of PCBs in the river sediment is the swarf pilings which contain metal shavings and cutting oils that contained PCBs. VTDEC is currently preparing a sampling plan to further delineate zone of contamination with assistance from EPA.

Lampricide Impacts

During the reporting period, 9.5 miles of Lewis Creek, 12.5 miles of the Poultney and Hubbardton Rivers, and 10.5 miles of the Winooski River were treated with lampricide to control sea lamprey, which affect the recreational fishery of Lake Champlain. DEC maintains records of non-target mortalities and the following summarizes some results of this tracking.

Lewis Creek – 2014 and 2015

The mortality of non-target species in Lewis Creek at the end of September 2014 were assessed in ten pre-defined sections of Lewis Creek, which represent about 20% of the treated reach. During the assessment, the non-target fish killed included: 21 logperch, 8 brown bullhead, 5 northern pike, 5 tesselated darters, 3 yellow bullhead, 3 blacknose dace, 3 spotfin shiners, 2 white suckers, 2 yellow perch, and 2 unidentified minnows.

Fifty-six dead two-lined salamanders were found in the post-treatment assessment. No mudpuppies were found, a species that has not been seen in post-treatment surveys since the 1990s treatments.

Lewis Creek was treated again in 2015. The non-target deaths included 89 tesselated darters, 65 longnose dace, 47 white suckers, and 18 logperch among others.

Poultney & Hubbardton Rivers - 2015

Non-target mortality surveys found 58 mudpuppies in the "official" survey stretches, however, 61 mudpuppies were given to the Vermont Natural Heritage Program biologists for study. There were also 98 dead logperch found and smaller numbers of other fish.

Winooski River 2015

Very few non-target species were found following the Winooski treatment.

C3.2 Assessment Results for Lakes and Ponds

The Watershed Management Division has five major monitoring programs upon which to base this assessment: the Lake Champlain Long Term Water Quality and Biological Monitoring Project, the Lay Monitoring Program, the Long Term Acid Rain Monitoring Program, the Aquatic Invasive Species Program and the Lake Assessment Program.

The Lake Champlain Long Term Monitoring Project has been collecting water quality data at sites on Lake Champlain and its major tributary sites since 1992. Currently, Vermont samples 15 lake sites and 15 tributaries annually, in conjunction with New York. This program monitors the status and trends on Lake Champlain for:

Secchi transparency	Silica
Temperature	Chlorophyll a
Dissolved oxygen	Zooplankton
Conductivity	Phytoplankton and cyanobacteria
pH	Alkalinity
Chloride	Total calcium, total magnesium, total potassium, total sodium
Total nitrogen	Zebra mussel veligers and settled juveniles
Total and dissolved phosphorus	

The phosphorus data collected early in the program were used in the development of the original 2002 Lake Champlain TMDL, which will be superceded by the forthcoming 2016 EPA TMDL for Phosphorus in Lake Champlain. The project now provides the data to evaluate compliance with the TMDL and Vermont's Water Quality Standards. Currently, 132,053 acres of the 174,175 acre lake are impaired for aesthetics by phosphorus pollution, due to exceedances of Vermont's extremely strict in-lake phosphorus standards. The fact that the criteria are conservative in many areas of the lake (Otter Creek segment to Isle LaMotte) does not counterbalance the severe water quality issues in the St. Albans Bay, and Missisquoi Bay segments of the lake, where cyanobacteria blooms occur every summer with significant impairments to recreational uses of all types.

Additional impairments include 174,175 acres and 166,177 acres for fish consumption by mercury and PCBs, respectively.

The Lay Monitoring Program (LMP) has been sampling Vermont's lakes and ponds since 1979.

The purpose of the program is to define the trophic condition of each lake and monitor trends. Since the program began, over 90 lakes have been sampled. In 2015, volunteers monitored 54 inland lakes and 16 stations on Lake Champlain. Data review for 2015 is underway, however the 2014 Annual Report is available on the Watershed Management Division website. LMP data support the biannual lake assessment process and inform management activities in the watershed. They also serve a powerful means to connect local volunteers to their lakes. Beginning in the next assessment cycle, Lay Monitoring Program data will be used to determine compliance with Vermont's new nutrient criteria for lakes.

The Vermont Acid Lakes Long-Term Monitoring Program assesses water quality in some of Vermont's most acid-sensitive lakes (see also Section B5). Since 1980, VTDEC has monitored 12 acid-impaired lakes during three index periods annually. Outlet monitoring also occurs in a subset of these during the spring runoff period in an effort to capture episodic acidification; a relatively short time when the waters are most acidic. The program also tracks trends on other acid-sensitive lakes. The data collected clearly demonstrates the success of the 1990 Clean Air Act and the subsequent amendments to the Act in curbing acid deposition. This program has provided a compelling argument that good policy leads to environmental recovery. Currently, 38 lakes in Vermont are listed on the acid-impaired waters list.

The Aquatic Invasive Species (AIS) Program monitors the status of existing populations of AIS, documents the presence of new invasive species, manages control activities and promotes spread prevention throughout the state. Staff support watershed associations and volunteers in outreach and survey efforts throughout the state as well as actively manage populations of invasive plants. During this assessment period, two new invasive species reached Vermont – Spiny Water Flea on Lake Champlain and Starry Stonewort on Lake Memphremagog. In 2016, invasive species have altered 42,999 acres on Lake Champlain and 3130 acres on Vermont's inland waters (4 species). An additional 10,366 acres on inland lakes are considered stressed by invasive species.

The Lake Assessment Program monitors the status and trends in water quality of the inland lakes, utilizing spring turnover sampling for phosphorus, a program which has been in place for four decades, and a full lake assessment protocol during the summer months. In addition to total phosphorus, the program also monitors trends in total nitrogen, chloride, alkalinity, earth metals, temperature, conductivity, dissolved oxygen and pH. Vermont has approximately 471 inland lakes at least 10 acres in size. For 218 of these, there are at least 5 years of spring turnover data, enough to identify phosphorus trends in those waterbodies. Twenty-nine lakes have statistically significantly increasing trends. One hundred eighty-three lakes have stable trends. Six lakes have statistically decreasing phosphorus trends. During this assessment cycle, 7,552 inland lake acres were identified as impaired due to nutrients (which affects aesthetics and in some instances, recreational and aquatic life uses).

In 2010, Vermont initiated a full lake assessment program, the Next Generation Assessment, which evaluates a large suite of parameters to provide an overall evaluation of each lake. More than 80 assessments have been completed to date and the Program anticipates completion of a database in the near future which will generate an electronic report card for each assessed lake. In addition, the program will transition to electronic data collection in 2016, streamlining data collection, processing and dissemination.

Vermont has completed its work to evaluate the usefulness of remote sensing technology to score lakes for the NLA metrics of Lakeshore Disturbance and Lakeshore Habitat. This effort concluded that GIS LULC data cannot be substituted for field assessments. However, it may be possible to use readily available imagery from providers such as Bing to assess lakeshore disturbance and develop a metric similar to those produced by NLA field teams. We will continue to explore the use of remote sensing tools to support assessment and protection efforts for Vermont lakes.

Vermont shares our information on inland lakes with the general public using the Vermont Lake Score Card. The Score Card is a simple graphic tool to explore the overall condition and water quality trends in Vermont's inland lakes, visualized through Google Earth. Both status and trend data collected by the Lake Assessment Program feeds into the water quality score for each lake as well as data from the Lay Monitoring Program. Data for the Lakeshore Disturbance metric from the NLA is collected during both the spring and summer sampling seasons by the Lake Assessment Program and are used to score the lakeshore habitat condition for each lake in the Vermont Lake Score Card. Data from the Acid Lakes program is combined with information on mercury deposition to generate an assessment of stress from atmospheric deposition. Invasive species status is compiled by the AIS Program. Additionally, lake data are available to users through the newly developed Vermont Integrated Watershed Information System (IWIS).

Designated Use Support Status

Table 15. Summary of Use Support for Vermont Lakes & Ponds (as per ADB)

Use Support →		Fully Supporting acres	Stressed acres	Altered acres	Impaired acres	Unassessed acres
Waterbody Type ↓	Use ↓					
Inland Lakes	Aesthetic	32679	9863	4501	7522	973
	Aquatic Biota, Wildlife, and Aquatic Habitat	16,722	23793	10,074	3954	995
	Boating, Fishing and Other Recreational Uses	31,457	14,723	5814	1556	1,007
	Fish Consumption	1,402	46,021	-	8115	-
	Public Water Supply	1192	-	-	-	15
	Swimming and Other Primary Contact Recreation	33,722	8677	3623	7522	1000
Lake Champlain	Aesthetic	35,290	-	6,832	132,053	-
	Aquatic Biota, Wildlife, and Aquatic Habitat	-	152,666	21,503	6	-
	Boating, Fishing and Other Recreational Uses	156,974	-	17,195	6	-
	Fish Consumption	-	-	-	174,175	-
	Public Water Supply	149,185	-	15,673	-	-
	Swimming and Other Primary Contact Recreation	35,284	-	6,832	132,059	-

Vermont's water quality policy states that lakes and ponds should be of high quality, and as a result, the water quality criteria against which surface waters are evaluated are very stringent. In the early 1990s, Vermont adopted baseline water quality criteria for phosphorus in Lake Champlain that were designed to ensure that users experienced nuisance algal conditions no more than 1% of the time in the majority of the Lake's segments. Similar criteria are in place for inland lakes.

Under the current approach, impairment is designated even when the vast majority of the time, users will encounter conditions suitable for recreational activities. In many locations of the Lake Champlain or Vermont's inland lakes, the recreational uses affected by the impairment are only occasionally limited. However, in other areas – such as Missisquoi Bay, St. Albans Bay, Lake

Carmi and Shelburne Pond - the use of the water is affected by frequent nuisance algal conditions, including the growth of potentially toxic cyanobacteria, and conditions may be severe. These limitations may be further exacerbated by the nuisance or invasive plants in areas of lakes and ponds that impede boating and swimming. In such areas, recreational uses are said to be consistently limited.

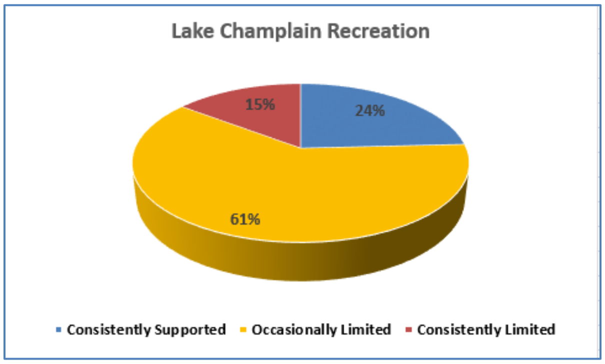


Figure 9. Recreational use support on Lake Champlain

When considered from this perspective, 24% of Lake Champlain acreage fully supports recreation – the boating and swimming uses are not impaired by cyanobacteria blooms or aquatic invasive species (Figure 9). 61% of the lake is sometimes limited by nuisance plants, cyanobacteria blooms and/or invasive species. Only 15% of Lake Champlain acres are consistently limited by cyanobacteria blooms and invasive species.

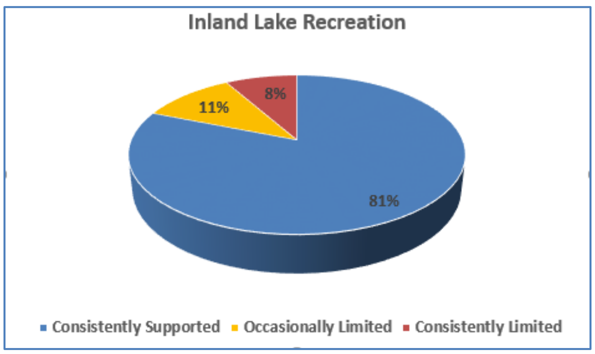


Figure 10. Recreational use support on inland lakes.

Similarly, recreation is consistently supported on 81% of inland lake acreage, occasionally limited on 11%, and consistently limited on 8% (Figure 10).

Aquatic biota, wildlife and aquatic habitat are fully supported and healthy on 88% of Lake Champlain (Figure 11). Invasive species have altered 12% of the lake. Only 6 acres of the lake are affected by pollutants that would harm biota (0%). Similarly, 73% of inland lake acres are fully supporting aquatic biota and their habitat (Figure 12). Invasive species affect 18% and identified pollutants affect 7% of total inland lake acreage.

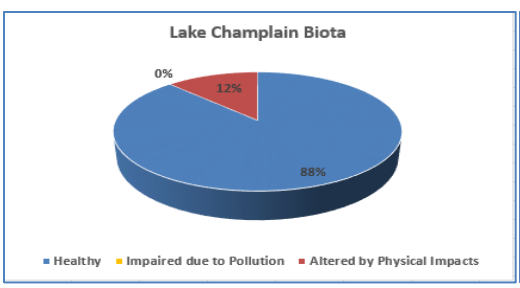


Figure 11. Biota Support on Lake Champlain

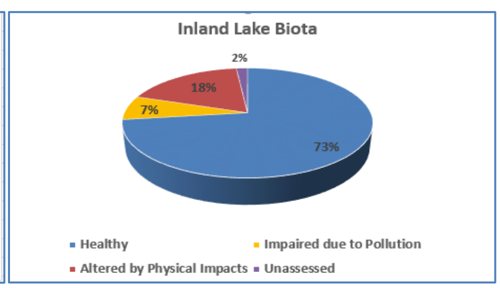


Figure 12. Biota support on inland lakes.

Size of Lakes & Ponds in EPA Assessment Categories

Table 16 below provides an ADB-based view of overall use attainment for Vermont lakes and ponds. By this view, the majority of lake acres are identified as impaired, falling in EPA Category 5, although this is the result of a relatively small number of large lake segments, where the size of Lake Champlain, and the stringency on the central lake criteria serve to overstate the severity of impaired waters in Vermont. It is important to note that where an impairment exists that is not yet subject to a TMDL, the acres associated with that impairment will be identified as Category 5, even if a TMDL has been completed for another pollutant on the same waters. For example, the existing impairments associated with PCBs cause all Lake Champlain acres to be assessed as impaired, even though TMDLs for other pollutants have been approved for those same lake segments. A more detailed display of use support for lakes segregated by use and Champlain/non-Champlain waters is shown in Table 15 above.

Table 16. Size of Lakes & Ponds in EPA Assessment Categories (as per ADB).

Category	Description	Total size (acres)	Number of lake segments
1	All uses met	28,857	440
2	Some uses met, others indeterminate	1,040	113
3	Insufficient information to assess any use	0	0
4A	Impaired, TMDL approved	16,701	53
4B	Impaired, no TMDL needed	0	0
4C	Impaired, but not by pollutant	8,806	63
5	Impaired	174,309	35

Note: Segment is defined as a unique portion of a lake or stream. More than one segment may be present for an individually named lake. Figures are provisional, pending outcome of 2014 303d list approval by EPA.

Summary of Causes & Sources of Impact (Impairment, Alteration, and Stress) - Lakes

Causes of impact to Lake Champlain and Vermont's inland lakes are shown in Table 17, and the related sources of impact are provided in Table 18. For Lake Champlain, the most widespread causes of impairment are mercury and PCB contamination in fish tissue, with atmospheric deposition of toxics and improper waste disposal being the respective sources. The third most widespread cause of impairment for Lake Champlain is phosphorus pollution. The sources of phosphorus vary by lake segment but arise from various categories of nonpoint source pollution, along with minor contributions from municipal wastewater effluents. Toluene and xylenes are the cause of impairment from contaminated sediments at the 6-acre Pine Street Barge Canal site in Burlington Bay. Eurasian watermilfoil, water chestnut, and zebra mussel infestations are the causes of alterations to Lake Champlain, which result from transport of plant fragments and larval zebra mussels through recreational boating and fishing activities.

For the inland lakes of Vermont, mercury in fish tissue impairs the largest number of lake acres, resulting largely from atmospheric deposition. In the case of two reservoirs in the Connecticut River, mercury levels are also attributed to water-level fluctuations. In the case of reservoirs within the Deerfield River drainage, mercury levels are also attributed to natural watershed susceptibility.

The cause of the second largest number of impaired acres for inland lakes is phosphorus pollution. For all nutrient-impaired lakes, the sources of phosphorus are largely nonpoint sources of a variety of types, including agriculture, road maintenance, and sediment losses related to development. Acidity due to atmospheric deposition of acid-forming precursors and natural susceptibility also impairs a significant number of lake acres in Vermont. The principal causes of alterations to inland lakes arise from water-level management and Eurasian watermilfoil infestations that originate from the transport of plant fragments through recreational boating and fishing activities.

The observed effects that stress uses on Lake Champlain include Eurasian watermilfoil, water chestnut and other exotic plants, alewife, spiny waterflea, sedimentation, native plants, and *E. coli* bacteria. The observed effects that stress uses on inland lakes are more diverse but principally include algae, Eurasian watermilfoil and other exotic species, acidity, flow alteration, phosphorus, and sedimentation.

Table 17. Summary of Causes of Impact to Vermont Lakes & Ponds (in acres).

Use →			Aesthetic	Aquatic Biota, Wildlife, and Aquatic Habitat	Boating, Fishing, and Other Recreational Uses	Fish Consumption	Public Water Supply	Swimming and Other Primary Contact Recreation
Waterbody Type ↓	Assessment of Waterbody ↓	Cause of Impact →						
Inland Lakes	Impaired	Mercury in Fish Tissue				8115		
		Organic Enrichment - DO		700				
		pH		2398				
		Phosphorus	7874	1908	1908			7874
		Sedimentation/Siltation	100	100	100			100
	Altered	Brittle naiad, *Najas minor*	100	100	100			100
		Curly Leaf Pondweed, *Potamogeton crispus*	452	452	452			452
		Eurasian Water Milfoil, *Myriophyllum spicatum*	2548	2548	2548			2548
		Water chestnut, *Trapa natans*	20	20	20			20
		Flow alteration	1507	7382	2820			629
	Fully Supporting but stressed	Alewife, *Alosa pseudoharengus*	904	904				
		Brittle Naiad, *Najas minor*	160	160	160			160
		Chloride		14				
		Common reed, *Phragmites australis subsp.australis*		10				
		Curly Leaf Pondweed, *Potamogeton crispus*	171	171	11			11
		Escherichia coli						10
		Eurasian watermilfoil, *Myriophyllum spicatum*	7034	7151	6672			6894
		European frogbit, *Hydrocharis morsus-ranae*	14	14	14			14
		Excess Algal Growth	27	27	27			
		Flow alteration	193	3568	193			3
		Mercury in Fish Tissue				45818		
		Noxious Aquatic Plants - Algae	9303	9295	9665			9683
		Noxious Aquatic Plants - Native	886	889	1346			1346
		Nutrient/Eutrophication Biological Indicators		7				
		Nutrients	3769	4011	3568			3665
		Organic Enrichment - DO		1419				
		pH		11248				
		Phosphorus	3769	4011	3568			3665
		Salinity		9				
		Sedimentation/Siltation	3328	3671	3141			3178
		Starry Stonewort, *Nitellopsis obtusa*	306	306	306			306

		Water chestnut, *Trapa natans*	1203	1203	1203			1203
		Zebra mussel, *Dreissena polymorpha*		472				472

Table 17 (cont.). Summary of Causes of Impact to Vermont Lakes & Ponds (in acres).

Use →			Aesthetic	Aquatic Biota, Wildlife, and Aquatic Habitat	Boating, Fishing, and Other Recreational Uses	Fish Consumption	Public Water Supply	Swimming and Other Primary Contact Recreation
Waterbody Type ↓	Assessment of Waterbody ↓	Cause of Impact →						
Lake Champlain	Impaired	Mercury in Fish Tissue				174175		
		PCB in Fish Tissue				166177		
		Phosphorus	132053					132053
		Toluene		6	6			6
		Xylenes (total) (mixed)		6	6			6
	Altered	Eurasian Water Milfoil, *Myriophyllum spicatum*	17195	17195	17195			17195
		Variable-leaved milfoil, *Myriophyllum heterophyllum*	1600	1600	1600			1600
		Water Chestnut, *Trapa natans*	2701	2701	2701			2701
		Zebra mussel, *Dreissena polymorpha*		21503			13573	21053
	Fully Supporting but stressed	Alewife, *Alosa pseudoharengus*		174175				
		Escherichia coli						19
		Noxious Aquatic Plants - Native			500			500
		Sedimentation/Siltation	5388	5388				5388
		Spiny Waterflea, *Bythotrephes longimanus*		174175				

Table 18. Summary of Sources of Impact to Vermont Lakes & Ponds (in acres).

Waterbody Type ↓	Assessment of Waterbody ↓	Use → / Source of Impact →	Aesthetic	Aquatic Biota, Wildlife, and Aquatic Habitat	Boating, Fishing, and Other Recreational Uses	Fish Consumption	Public Water Supply	Swimming and Other Primary Contact Recreation
Inland Lakes	Impaired	Agriculture	1456	2156	1456			1456
		Animal Feeding Operations (NPS)	1456	2156	1456			1456
		Atmospheric Deposition - Acidity		2398				
		Atmospheric Deposition - Toxics				8115		
		Flow Alterations from Water Diversions	1280	7172	2803	2012		612
		Internal Nutrient Recycling	54	506	54			54
		Managed Pasture Grazing	1854	2554	1854			1854
		Natural Sources		2398		3692		
		Non-irrigated Crop Production	1908	2608	1908			1908
		Non-Point Source	7422	1456	1456			7422
		Post-development Erosion and Sedimentation	452	452	452			452
		Streambank Modifications/destabilization	100	100	100			100
	Altered	Flow Alterations from Water Diversions	1280	7172	2803			612
		Impacts from Hydrostructure Flow Regulation/modification	300	2198	235			215
		Other Marina/Boating On-vessel Discharges	3120	3120	3120			3120
Champlain	Impaired	Agriculture	31859					30259
		Atmospheric Deposition - Toxics				174175		
		Combined Sewer Overflows	13725					13725
		Contaminated Sediments		12	12			12
		Highway/Road/Bridge Runoff (Non-construction Related)	13725					13725
		Inappropriate Waste Disposal				166171		
		Industrial Point Source Discharge	4423					4423
		Natural Sources	5388			58184		5388
		Non-Point Source	132053					130453
		Post-development Erosion and Sedimentation	13725					13725
	Altered	Other Marina/Boating On-vessel Discharges	8404	38678	11945		6994	11016
All Waters	Stressed	Sources are not attributed to stressed waters.						

The Next Generation of Lake Assessment
With implementation of the Shoreland Protection Act in 2014, and the Vermont Clean Water Act in 2015, Vermont has significantly expanded protection and remediation efforts across the state which have a direct impact on lakes. New criteria for chloride and nutrients have been added to the Water Quality Standards. New tools, such as the Next Generation Assessment protocol and remote sensing, enhance the process by which we evaluate how well our lakes and ponds meet the goals set by the US Clean Water Act. Using the National Hydrography Dataset (NHD), the Lakes Program has updated the Vermont Lakes Inventory with current available data. As a result, there are now over 14,000 lakes in the inventory at least one quarter acre in size, up significantly from the previous estimate of 822. In the next year, the process of verifying and assessing these new lakes will get underway, focused initially on lakes over 10 acres in size and under the jurisdiction of the Shoreland Protection Act.

In light of the regulations, protection and management approaches now used by Vermont, the current Lake Assessment process will be reviewed and updated over the next 18 months. The update will incorporate new assessment tools and reflect the enhanced activities now undertaken by the Watershed Management Division. Input from our partners and stakeholders will be solicited as we develop the new lake assessment protocols and a full discussion of the changes will be included in the 2018 integrated report.

C3.3 Impaired Waters of Vermont – Lakes and Rivers

Total Maximum Daily Load Program & Summary of Impaired Waters
Under Section 303(d) of the Clean Water Act, all states are required to develop lists of impaired surface waters. These impaired waters are lakes, ponds, rivers and streams that do not meet the water quality standards developed by each individual state. In Vermont, these waters are described on the state's Part A 303(d) List of Impaired Waters in Need of a TMDL; Part B List of Impaired Surface Waters - No TMDL Determination Required; and Part D Surface Waters with Completed and Approved TMDLs. These lists can be found on the Assessment page of the Watershed Management Division's website. The Clean Water Act requires that a Total Maximum Daily Load (TMDL) be developed for impaired waters on Part A of the list and the list provides a schedule as to when TMDLs will be completed.

A TMDL is the calculation of the maximum amount of a pollutant that a waterbody can receive and still meet the water quality standards. A TMDL serves as a plan that identifies the pollutant reductions a waterbody needs to meet Vermont's Water Quality Standards and are typically accompanied by an implementation plan that articulates the means to achieve those reductions. TMDL determinations are unique to each individual waterbody but the general process by which they are developed can be summarized in the following manner:

> Problem Identification - the pollutant for which the TMDL is developed must first be identified. Examples might include sediment that impacts habitat for aquatic organisms, nutrients that cause excessive algal growth, or bacteria that creates an unsafe environment for swimming.
>
> Identification of Target Values - this establishes water quality goals for the TMDL. These may be given directly in the Water Quality Standards or may need to be interpreted.

Source Assessment - all significant sources of the pollutant in question must be identified in the watershed. This often requires additional water quality monitoring.

Linkage Between Targets and Sources - this process establishes how much pollutant loading can occur while still meeting the water quality standards. This step can vary in complexity from simple calculations to development of complex watershed models.

Allocations - once the maximum pollutant loading is established, the needed reductions must be divided among the various sources. This is done for both point sources and nonpoint sources.

Public Participation - stakeholder involvement is critical for the successful outcome of TMDLs. Draft TMDLs are also released for public comment prior to their completion.

EPA Approval - EPA approval is needed for all TMDLs as required by the Clean Water Act.

Follow-up Monitoring - additional monitoring may be needed to ensure the TMDL is effective in restoring the waters.

Current and upcoming TMDL projects

Lake Champlain Phosphorus TMDL revision

In response to a federal lawsuit filed by the Conservation Law Foundation, the EPA reconsidered its previous approval of the 2002 Lake Champlain TMDL and disapproved the Vermont portion of the TMDL in January 2011. Under federal law, upon such disapproval, the EPA is responsible for establishing a new TMDL to implement the water quality standards. The EPA initiated the process of developing a new TMDL for Lake Champlain in 2011 in cooperation with the State of Vermont. Several key steps involved in this process include:

- Review and revision of the in-lake water quality model to update the lake segment loading capacities
- Complete the study of effects that climate change may play on lake loading capacities
- Estimate phosphorus loads from subwatershed areas within tributary watersheds and estimate potentially achievable phosphorus reductions
- Identify programs and requirements to provide sufficient reasonable assurance that nonpoint phosphorus controls are achievable
- Public outreach and education regarding the TMDL development and proposed implementation process.

During 2013, and while awaiting final loading capacities and load and wasteload allocations, DEC responded to an EPA requirement for the development of a Phase I implementation plan that would achieve compliance with the TMDL. DEC responded by preparing a draft report on TMDL commitments, followed by an August 2015 draft Phase I Plan outlining extensive regulatory and implementation priorities to attain compliance in the Lake. During the Summer of 2015, EPA and VTDEC conducted a series of public outreach meetings in conjunction with the public comment period for the TMDL. As of this writing, EPA is developing the final TMDL and addressing public comments. Additional information regarding the development of the revised TMDL can be found on the EPA website.

Lake Memphremagog Phosphorus TMDL

VTDEC has been working to develop a TMDL for Lake Memphremagog, which is listed as impaired for phosphorus, and is a high priority for TMDL development. Initial work has included intensive lake sampling, tributary sampling to estimate watershed loading, and collaboration with partners in Quebec on a watershed phosphorus export model. A full lake model has been developed in cooperation with partners in Quebec, which more accurately represents phosphorus movement in the lake and watershed as a whole. The new model will be reviewed by an outside expert this year with the goal of completing the TMDL in 2016.

Also in 2016, DEC collaborated with the Orleans County Conservation District to submit a proposal for funding agricultural best management practices in priority areas of the Memphremagog watershed, as identified by extensive water sampling and assessment. A grant for $650,000 was received and will be implemented over the next five years.

Long Island Sound Nitrogen TMDL revision

The original LIS TMDL was finalized in 2001 and developed among NY, CT and EPA and set forth nitrogen reduction goals for point and nonpoint sources in those states. As part of that TMDL, a non-binding reduction of nitrogen from upstream states' treatment plants (VT, NH, MA) of 25% was set as a goal to help meet standards in the Sound.

For the past several years, the LIS TMDL has been under revision, this time with the participation of the upstream states. Several data gathering and monitoring projects have been undertaken to better understand the role of the upper states in their contribution of nitrogen to the LIS. Current projects include:

- Low cost retrofit project – working with NEIWPCC, a contractor has been hired to investigate low cost opportunities at wastewater treatment facilities in VT, NH and MA. It's hoped that several low cost operational changes at certain WWTFs can have a significant reduction in nitrogen released.
- Tracking Tool Development – working with NEIWPCC, a contractor has been hired to investigate the potential of developing a tool to facilitate the tracking of NPS projects implemented in the Connecticut River basin. Ultimately, the goal would be to calculate the number of BMPs installed and estimate nitrogen reductions.

At present, completion of the revised TMDL appears to be a few years off but a framework has been developed that lays out the tasks needed to be completed before the new TMDL can be developed. In the meantime, an interim plan has been developed to address point source permitting and other nonpoint source actions to be completed by all five states (NY, CT, VT, NH, MA).

The five states have jointly received a $10M USDA/NRCS grant for water quality improvements (agriculture, forestry, easements) that is being implemented between 2016 and 2021. Vermont is expected to received approximately $1M, mainly focused on agricultural nutrient management planning through the Vermont Association of Conservation Districts. DEC is a partner on this grant and the advisory board.

Agricultural area TMDLs

There are approximately twenty streams impaired for some combination of excess nutrient and sediment loading that occur in predominantly agricultural areas. VTDEC intends to develop a methodology to enable TMDL development for many of these areas beginning in 2016. Since many of these streams occur within the Lake Champlain watershed and tools are currently being developed to quantify loading from similar areas as part of the Lake Champlain TMDL, VTDEC envisions using tools developed as part of that process for these TMDLs.

Impaired Ticklenaked Pond Restoration

The Department executed a grant agreement with the Town of Ryegate to carry out implementation of an in-lake treatment to address internal nutrient recycling. This project was successfully carried out during spring of 2014. Initial lake response shows considerably improved clarity and monitoring will continue into the future to ensure water quality targets are being met.

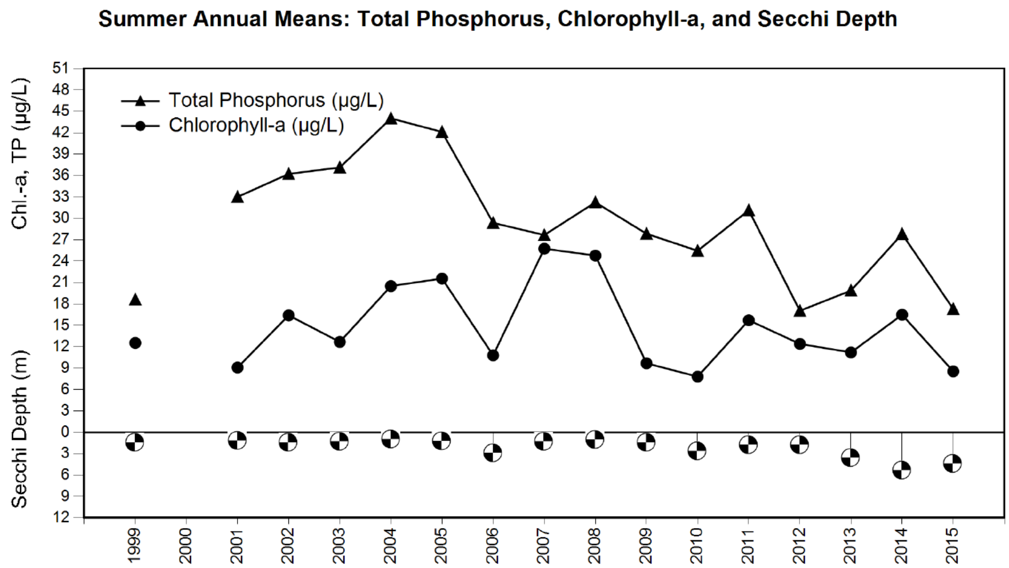


Figure 8 – Lay Monitoring Program data reflecting changes in phosphorus concentration, chlorophyll and Secchi transparency following the 2014 alum treatment.

Overview of the Vermont 2016 Priority Waters List including Section 303(d) List of Waters

Development of the 2016 Section 303(d) List of Impaired Waters is a process that is ongoing and concurrent to the development of the 2016 Section 305(b) Report. Consequently, the final 2016 303(d) List is not included directly in this report. The 2016 303(d) List will be prepared in a format consistent with the EPA-approved 2014 List and will be developed in accordance with DEC's Assessment and Listing Methodology (2016).

The 2014 303(d) List was approved in September 2014 during the 2016 305(b) reporting period and is available separately on the Watershed Management Division's web site. The 2016 draft and ultimately the EPA-approved 303(d) List will also be available on the web site when finalized.

A brief summary of the Vermont Priority Waters List is given in Table 19. It should be noted that the Section 303(d) List of Impaired Waters is only a portion of the overall Vermont Priority Waters List (Part A) and much of the Priority Waters List process occurs outside the scope of Section 303(d). However, it is important to be aware of the overall listing process because it is indirectly involved with the 303(d) listing process.

Table 19. Overview of Vermont Priority Waters List.

Vermont PriorityList Section	Description	Included as Part of 303(d) Listing?
Part A	Impaired Waters in Need of a TMDL	Yes
Interim List	Candidate Waters for Section 303(d) De-listing	Yes, until EPA approval. After approval these waters are removed from 303(d). EPA approved 303(d) list does not include de-listed waters.
Part B	Impaired Waters - No TMDL Required or Needed	No
Part D	Waters with Completed & EPA Approved TMDLs	No
Part E	Surface Waters Altered by Exotic Species	No
Part F	Surface Waters Altered by Flow Regulation	No

The number of waterbody segments listed as impaired on the 2016 draft Lists is given in Table 20.

Table 20. Number of Impaired Segments (taken from 2016 draft listings).

Impaired Segments	Lakes & Ponds	Streams & Rivers	Total
Listed in Part A – impaired waters needing a TMDL	15	86	101
Listed in Part B – impaired waters not needing a TMDL	1	10	11
Listed on Part D – impaired but TMDL complete	68	46	114
Total number of impaired segments	84	142	226

DEC has developed a new web-reporting format for all lists beginning with the 2014 Draft 303(d) and Priority Waters Lists, at: http://www.vtwaterquality.org/mapp/htm/mp_assessment.htm.

C4. Wetland Program

The Vermont Wetlands Program evaluated the significance of ten functions and values for 459 wetlands in association with permitting review over the past five years. The state defined functions and values of wetlands are: 1) water storage for flood water and storm runoff, 2) surface and groundwater protection, 3) fish habitat, 4) wildlife habitat, 5) exemplary wetland natural community, 6) rare, threatened and endangered species habiat, 7) education and research in natural sciences, 8) recreational value and ecomomic benefits, 9) open space and aesthetics, and 10) erosion control through binding and stabilizing the soil. The state regulates and permits activities in wetlands, which provide a significant level of one or more of these functions. Those wetlands are classified as Class I or Class II. Because this evaluation was based on areas which were proposed for wetland or 50 foot buffer zone encroachment, the sample is not random and likely skews toward data with existing disturbances. Data collection was concentrated in Chittenden County and the Champlain Valley (Figure 9). Wetlands associated with the permitted projects that were Class III (non-significant) were not included in the 5 year permit review analysis.

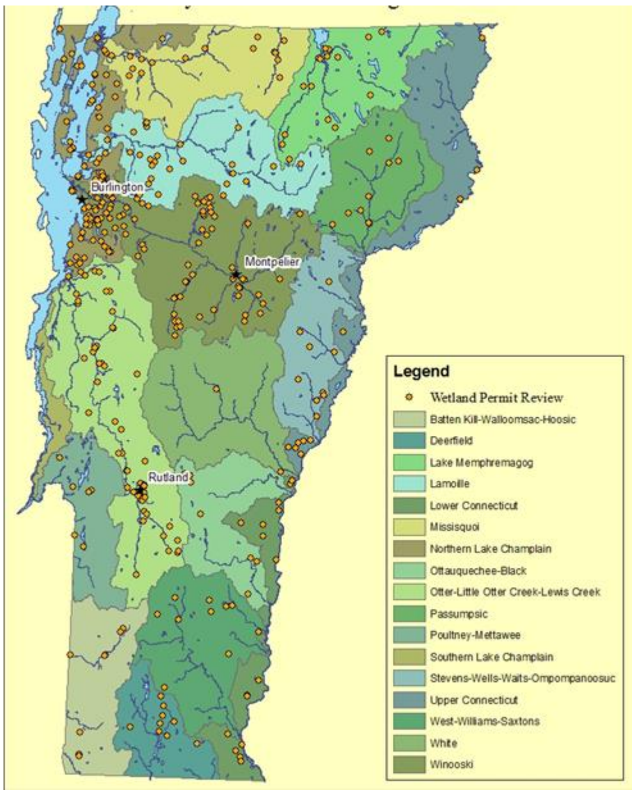
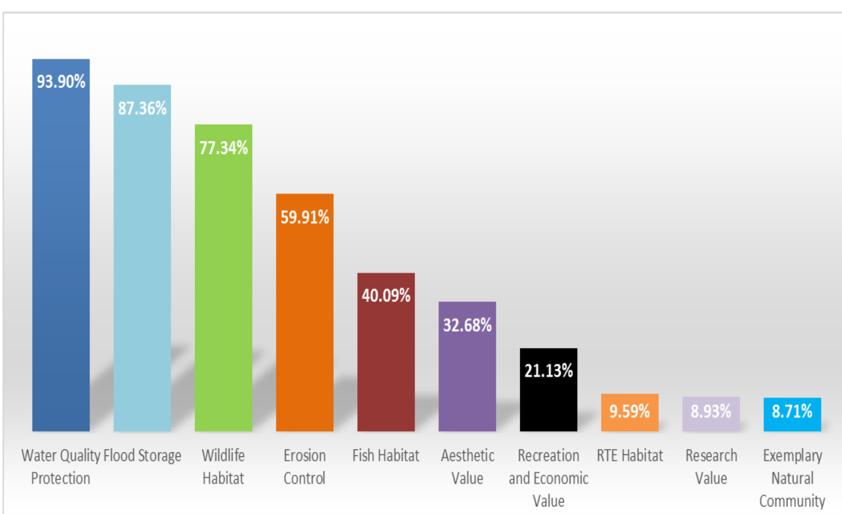


Figure 9: Wetland Function and Value Evaluation state distribution (n=459) for 2011-2015



Of the wetlands evaluated, over half were significant for water quality protection, flood water and stormwater storage, wildlife habitat, and erosion control (Figure 10). The least commonly found significant functions were rare, threatened and endangered species habitat, education and research in natural science, and exemplary natural community with less than 50 wetlands found with each of these values throughout the state permitting process.

Figure 10: Distribution of wetland functions and values for 2011-2015

The focus of the wetlands biomonitoring program for 2014-2015 was a preliminary analysis of a floristic quality assessment index (FQAI) using data from 56 wetlands sampled over the 2007, 2010, 2011 and 2014 field seasons. To date, the program has collected data from 131 sites over 8 seasons of sampling. In 2014, a database was created to store the data and support analysis. Within the database, equations can now be programmed to automatically calculate indices such as a FQAI.

The FQAI was designed to assess the level of "naturalness" of an area based on the tolerance for the species found and their specificity to a particular habitat type. It rates the degree of human disturbance to an area by accounting for the presence of cosmopolitan, native species, and non-native taxa based on Coefficient of Conservatism (CoC) scores. The CoC scores are described in Table 21. A CoC is assigned by a regional expert or group of experts familiar with the flora of a geographic region (Vermont) based on what is known about the ecological tolerances of each taxa. There is, as a result, an inherent subjective element to the CoC score. However, when calculating a FQAI with the assigned CoC score to a particular species, the same score is applied objectively and consistently so that the relative comparison across sites is not affected by bias in assigning the CoC.

Table 21: Description of Coefficient of Conservatism Scores

Score	Description
0	Non native plants with a wide range of ecological tolerances. Often these are opportunistic invaders of intact undisturbed habitats.
1	A native invasive plant
2	Widespread native taxa that are not typical of (or only marginally typical of) many communities.
3	Native plants with an intermediate range of ecological tolerances that typify a stable phase of some native community but persist under some anthropogenic and natural disturbance.
4	
5	
6	Native plants with a narrow range of ecological tolerances that typify a stable community.
7	
8	
9	Native plants with a narrow range of ecological tolerances that exhibit relatively high degrees of fidelity to a narrow range of habitat requirements and demonstrates sensitivity to anthropogenic influences.
10	

The Floristic Quality Assessment Index is calculated as the average CoC of native species at a site, weighted by the square root of native species richness (Andreas and Lichvar 1995). Modified equations to the original FQAI have been developed accounting for the percent cover of each taxa ($FQAI_{Cover\ weighted}$) and the proportion of native to non-native plants ($FQAI_{Adjusted}$).

The FQAI data was compared with the Vermont Rapid Assessment Methodology (VRAM). The adoption of the Vermont Rapid Assessment Method (VRAM) in 2008 has improved on the Human Disturbance Rating (HDR) ability to distinguish wetland condition, offering a method that is generally more consistent in assessing the stressors impacting wetland condition. For instance, the VRAM metrics can be used to compare anthropogenic modifications to hydrology and water quality or vegetative communities, where the HDR did not. VRAM data exists for sites surveyed after 2007. VRAM scores ranged from 50 to 91 (n=44) out of a possible 100 points). Lower scores indicate a greater degree of disturbance. Sites with scores between 85 and 100 are considered to be of reference condition, this corresponds with sites in the 95th percentile. Disturbed condition is classified as scores between 0 and 65 (25th percentile). Of the sites analyzed 12 were disturbed, 29 moderate and 3 were reference condition.

Not all wetlands which received high VRAM scores received high FQAI scores, however, the distribution of condition quality between good and disturbed were very similar. The biomonitoring program needs to collect more reference site data and increase sample sizes before categorizing scores for a true assessment of condition through vegetation.

C5. Trends Analysis for Surface Waters

The phosphorus trends for segments of Lake Champlain and its major tributaries can be found on the Lake Champlain Basin Program website in their 2015 State of the Lake Report.

C6. Statewide Probabilistic Survey Results or Progress

Biomonitoring and Streams

Biomonitoring resources are generally divided into two categories. Targeted monitoring is directed towards streams of particular management interest. For example, efforts often focus on impaired streams undergoing remediation, compliance monitoring below discharges or development, or sampling at long-term reference sites to observe climate change affects. Targeted monitoring allows DEC to evaluate management or conservation efforts within a specific watershed, but doesn't give an unbiased assessment of the overall condition of Vermont's flowing waters.

To answer the question "what is the overall biological condition of Vermont's wadeable streams", DEC has implemented probability-based surveys. Probability-based surveys represent a subset of randomly selected wadeable stream reaches (1st-4th order) throughout the state. The biomonitoring program uses a rotational sampling model, where all watersheds of the state are monitored over a 5-year period. Probabilistic surveys are designed to coincide with DEC's rotational cycle, as well as to overlap with EPA's National Rivers and Streams Assessments (NRSA). By continuing probabilistic surveys on this cycle, we can investigate long-term trends in Vermont's stream biological condition, re-examine principal environmental stressors, and compare Vermont's biological stream condition to that found at regional and national scales by NRSA.

In 2012, DEC completed a second probability-based survey (2008-2012), which was reported in the 2014 305(b) Integrated Report. To date, 42 sites have been sampled for the third probabilistic survey (2013-2017), the results of which should be completed and analyzed for presentation in the 2018 305(b) Integrated Report.

Wetlands and Lakes

Wetlands

During 2016, DEC will participate in the second National Wetlands Assessment, a probability based survey of the nation's wetlands. During this assessment, staff will conduct side-by-side comparisons of Vermont's VRAM and FQAI assessments with nationally-derived indices.

Lakes

During 2017, Vermont will participate for the third time in the National Lakes Assessment. The National Lakes Assessment has provided an important opportunity to introduce new sampling methodologies and to compare the condition of lakes in Vermont to those of the northeast region and the United States. The most recent probability assessment for lakes may be found here.

C7. Public Health Issues

Mercury and Fish Consumption

During the reporting period, the Department did not process fish mercury samples directly. The most recent data are from a major reassessment of fish mercury and PCBs in Lake Champlain, sponsored by the Lake Champlain Basin Program (LCBP) in 2011. The data from that project were compared to data collected in 2003 to 2004 and for yellow perch and lake trout, the mean mercury concentrations were significantly lower. Further results are in the report done for the LCBP by Biodiversity Research Institute. Data are also available from required fish-tissue monitoring at the Fifteen Mile Falls Hydroelectric Project on the Moore and Comerford Reservoirs of the Connecticut River. In 2016, LCBP will conduct another five-year reassessment with data expected by mid 2017.

Cyanobacteria

Routine monitoring for cyanobacteria continued on Lake Champlain and selected inland lakes during 2014 and 2015. The Department of Health (VDH), the Lake Champlain Committee and their citizen volunteers continue to partner with the VT DEC (Watershed Management and Drinking Water & Ground Water Protection Divisions) in this effort. The VDH lab runs all toxin analyses and offers cyanotoxin test kits to the general public for a low fee. Results of the monitoring program and any additional cyanobacteria sightings are reported on the VDH web page (http://healthvermont.gov/enviro/bg_algae/bgalgae.aspx) through a weekly status statement and an interactive lake status map color-coded for alert levels. Historical data can also be viewed through the VDH's Tracking Portal (http://healthvermont.gov/tracking/.)

More than 1400 site-specific reports were submitted in 2014 and more than 1700 in 2015. The vast majority of these reports document generally safe conditions. Blooms, identified as high alert conditions on the tracking map, were reported 38 times from Vermont lakes in 2014 and 147 times in 2015. The increase in 2015 bloom reports reflects the addition of new sites into the monitoring program as well as daily reports from locations where blooms persisted for several days. The highest concentrations of microcystin in 2014 and 2015 were 2.29 and 0.77 µg/L, respectively. One detection of anatoxin occurred in 2014 (0.9 µg/L). None was observed in 2015. Cylindrospermopsin, included in 2015, also was not detected. The data continue to support the observation that potentially toxic cyanobacteria, though present, are typically present at levels considered safe for recreation. No confirmed reports of illness in people or pets were received in 2014 or 2015.

In 2015, the Vermont Department of Health (VDH) and the Drinking Water and Groundwater Protection Division at the DEC coordinated a cyanotoxin testing program at no cost for the 22 Vermont public water facilities on Lake Champlain. Facilities provided weekly samples of raw and finish water for analysis of microcystin, cylindrospermopsin and anatoxin. Three low-level detections of microcystin in raw water occurred during the 12 week testing period, but levels were below detection in subsequent samples. There were no detections of anatoxin or cylindro-spermopsin, and no detections at all in finish water. Results of the testing were posted online. The no cost service will be offered to the public facilities on Lake Champlain again in 2016. Testing is also available to all public water supplies across the state on an as needed basis

Vermont continues to work closely with New York and Quebec to communicate information about cyanobacteria densities on Champlain using common language and messaging. Vermont also works closely with partners in New England to support common language and approaches in this region. In 2014 and 2015, Vermont field staff on Lake Champlain participated in the phycocyanin monitoring effort coordinated by EPA Region 1. The goal here is to develop a simple indicator that could provide information on the occurrence of blooms on a regional scale. We have also made monitoring data from the Champlain cyanobacteria monitoring program and the Long-term Water Quality and Biological Monitoring Project available to the new CyAN project (NOAA, EPA, NASA) for ground-truthing purposes.

Small Community Untreated Waste Discharges

DEC provides direct funding and technical assistance to small communities without sewers to help them evaluate and plan for their wastewater needs. Funding is provided by either a low interest loan or planning advance, which is a loan that is paid back only when a project is built. It is anticipated that there will be a continuing need from small communities for wastewater evaluations and planning in the coming years. Most of these communities have not been identified in the past as being the sources of surface water pollution, but residents are now realizing that they may have problems with their small lot and older on-site sewage systems. Another factor is the economic viability of small communities, which cannot have commercial or residential growth due to limiting soil conditions for septic system leachfields.

During the 2015 - 2016 reporting period, the Towns of Addison and Waitsfield received planning loans to evaluate new wastewater treatment and disposal facilties to serve areas within these towns.

Restrictions on Bathing Areas During the 2016 Reporting Period

Vermont's standards for bacteria now are similar to those recommended by EPA. In Class A waters, *E. coli* is not to exceed the geometric mean of 126 organisms /100 ml obtained over a representative period of 60 days and no more than 10% of samples above the statistical threshold value of 235 organisms/100ml with none attributable to the discharge of wastes. It is the same for Class B waters, except for the preclusion of treated waste, and with criteria in a shorter averaging period for waters receiving CSOs.

Other restrictions on bathing areas in Vermont have recently included beach closures due to cyanobacteria blooms and animal fecal waste (e.g. geese and gulls defecating along shoreline), which can be a source of *E. coli* and other pathogenic contamination. The occurrence of a beach closure, however, should not be equated with the determination that the beach is impaired due to *E. coli* contamination.

Table 25. Count of public beach closures in 2014 and 2015 for Vermont portion of Lake Champlain, inland lakes with state parks, and U.S. Army Corps of Engineers (USACE) reservoirs.

Beach	2014 Closures		2015 Closures	
Champ - Northeast Arm	***E. coli***	***Other***	***E. coli***	***Other***
North Hero State Park	0	0	0	0
Knight Point State Park	0	0	0	0
Grand Isle State Park	0	0	0	0
Sand Bar State Park	1	0	0	0
Burton Island State Park	0	0	1	0
Champ - St. Albans Bay	***E. coli***	***Other***	***E. coli***	***Other***
St. Albans Bay Park Beach	0	0	0	7/27-9/7 (cyanobacteria)
Kamp Kill Kare State Park	0	0	0	6 (cyanobacteria)
Champ - Malletts Bay	***E. coli***	***Other***	***E. coli***	***Other***
Niquette Bay State Park	0	0	2	0
Bayside Beach	2 (warnings)	0	3 (warnings)	0
Rosetti Natural Area	1 (warning)	0	1 (warning)	0
Champ - Burlington Bay	***E. coli***	***Other***	***E. coli***	***Other***
Leddy Beach	0	0	1	4 (cyanobacteria)
North Beach	1	0	0	5 (cyanobacteria)
Blanchard Beach	3	0	2	1 (proximity to sewage leak)
Oakledge Cove Beach	0	0	1	0
Champ - Shelburne Bay	***E. coli***	***Other***	***E. coli***	***Other***
Red Rocks Park Beach	1	0	1	0
Shelburne Town Beach	0	0	0	0
Champ - Main Lake	***E. coli***	***Other***	***E. coli***	***Other***
Charlotte Town Beach	0	0	0	0
Champ - Otter Creek	***E. coli***	***Other***	***E. coli***	***Other***
Kingsland Bay State Park	2	0	2	0
Champ - Isle La Motte	***E. coli***	***Other***	***E. coli***	***Other***
Alburg Dunes State Park	1	0	3	2 (cyanobacteria)
Inland Lakes w/ State Parks	***E. coli***	***Other***	***E. coli***	***Other***
Adams Reservoir (Woodford)	0	0	0	0
Lake Bomoseen	0	0	0	0
Lake Carmi	2	0	1	0
Crystal Lake (Barton)	0	0	0	0
Lake Dunmore	0	0	0	8/21-8/23 (suspected norovirus)
Echo Lake (Plymouth)	0	0	0	0
Lake Elmore	0	0	1	0
Emerald Lake	0	0	0	0
Lake Groton	0	0	0	0
Half Moon Pond	0	0	0	0
Island Pond	1	0	0	0
Maidstone Lake	1	0	1	0
Ricker Pond	0	0	1	0
Lake Shaftsbury	0	0	0	0

Silver Lake (Barnard)	0	0	0	0
Spectacle Pond	0	0	0	0
Lake St. Catherine	0	0	0	0
Waterbury Reservoir	0	0	0	0
USACE Reservoirs	***E. coli***	***Rain > 0.5"***	***E. coli***	***Rain > 0.5"***
Ball Mountain Reservoir	4 days	15 days	3 days	7 days
North Hartland Reservoir	2 days	6 days	3 days	11 days
North Srpingfield Reservoir	6 days	11 days	0 days	4 days
Townshend Reservoir	4 days	20 days	16 days	10 days
Union Village Dam	1 day	10 days	20 days	9 days

Restrictions on Surface Drinking Water Supplies During the 2014 Reporting Period

This 305(b) cycle had only one surface water boil water notice or no drinking notification. In 2014, Fair Haven Water System was put on a boil water notice due to *E. coli* contamination. Lines were flushed, disinfection levels were increased, and contamination is no longer present. A preliminary engineering report has been submitted for sub-standard lines that may have contributed to the contamination.

Chronic or Recurring Fish Kills

The Vermont Department of Fish & Wildlife maintains a fish pathology laboratory and associated staff respond to significant fish kills and maintain records of all investigated and reported events.

The following four fish kills were reported in calendar years 2014/2015. These kills are likely due to natural causes and were not intensively investigated by the Vermont Fish & Wildlife Department. This set of fish kills were judged to be minor in overall significance to the total fish population.

April 2014 - Lake Champlain (Inland Sea) - large alewife die-off due to general immuno-suppression caused by low water temperatures.

July, 2015 - Lake Parker, Glover - small die-off comprised of multiple fish species.

April, 2014 - Lake Fairlee, small die-off due to low oxygen conditions under ice formation.

November, 2015 - Mill Brook below Little Hosmer Pond (outlet), Craftsbury **-** small fish kill of yellow perch. It is suspected that fish succumbed to being trapped in frazzle and anchor ice which formed in low water flow conditions.

The following fish kill was intensively investigated by a district Fisheries Biologist.

April, 2014 - Lake Abenaki, Thetford - winterkill due to low oxygen conditions under ice formation. Although not a total depletion of fish, the majority of the fish population perished. Documented species included: bluegill, yellow perch and largemouth bass.

Part D. Groundwater Monitoring and Assessment

D1. Introduction

The Groundwater Coordinating Committee (GWCC) met infrequently during the 2014 and 2015 biennial. The GWCC was established through legislation (Chapter 48: Groundwater Protection, 1985) with committee representation from the Department of Environmental Conservation, Department of Forests, Parks and Recreation, Agency of Agriculture, Food and Markets, Department of Health, along with representatives of other agencies and the private sector.

The purpose of the GWCC is to advise the Secretary of the Agency of Natural Resources (the Secretary) on the development and implementation of the groundwater management program. The administrative functions of the Committee are performed by the Drinking Water & Groundwater Protection Division (DW&GWPD) within the Department of Environmental Conservation. The groundwater program includes:

- Developing a groundwater strategy and integrating the groundwater management strategy with other regulatory programs administered by the Secretary,
- Cooperating with other government agencies in collecting data on the quantity and quality of groundwater and location of aquifers,
- Investigating and mapping groundwater currently used as public water supply sources and groundwater determined by the Secretary as potential future public water supply sources,
- Providing technical assistance to municipal officials, classifying the groundwater resources, and adopting technical criteria and standards for the management of activities that may pose a risk to their beneficial uses,
- Developing public information and education materials, and
- Cooperating with federal agencies in the development of programs for protecting the quality and quantity of the groundwater resources.

In carrying out these duties, the Secretary gives due consideration to the recommendations of the GWCC. This relationship has been realized through the development of the strategy for the management and protection of groundwater along with the adoption of the Groundwater Protection Rule and Strategy Chapter 12 (adopted February 1988, revised September 2005). The committee's interaction with the Secretary has most recently been to provide comment on the revision of the *Groundwater Protection Rule and Strategy* and with the reclassification of two contaminated groundwater areas to Class IV Groundwater.

D2. Groundwater Reclassification Issued in this Reporting Period

<u>Groundwater Class IV Areas:</u>
These are areas of groundwater that are contaminated above Vermont state drinking water standards for one or more chemical constituents. As a means to protect human health in Class IV groundwater areas, there is a prohibition on drilling any drinking water supplies within its boundaries. Newly classified Class IV Areas include:

- General Electric Aviation Plant, 210 Columbian Ave., Rutland, VT:
  The site is defined to include the facility at this address and various other properties located to the south, terminating at the north bank of East Creek. The site is contaminated above drinking water standards for tetrachloroethene, trichloroethene, and cis -1,2 – dichloroethene. The Class IV area is approximately 30 acres in size.
- Bradford Oil Site, 197 Clinton Street, Springfield, VT (former Springfield Manufactured Gas Plant):
  The site is defined to include the facility at this address and various other properties located to the south and east, terminating at the western boundary of the Black River. The site is contaminated above drinking water standards for several coal tar related volatile organic compounds. The Class IV area is approximately 14.5 acres in size.

The findings for these reclassifications are based on the considerations outlined in Section 12-403 of the Vermont Groundwater Protection Rule and Strategy, effective February 1, 2005. A copy of the rule is available online at www.vermontdrinkingwater.org or by contacting the Department of Environmental Conservation, Drinking Water and Groundwater Protection Division, One National Life Drive, Main 2, Montpelier, VT 05603-3521or at 1-800-823-6500 in-state or 802-828-1535.

D3. State Regulations

Groundwater Protection Rule & Strategy:
Revisions to the above rule have been examined during the biennial period and are expected to be noticed for public comment in the near future. The rule articulates the State's groundwater policy which is to protect its groundwater resources to maintain high quality drinking water. It shall manage its groundwater resources to minimize the risks of groundwater quality deterioration by limiting human activities that present unreasonable risks to the use classifications of groundwater in the vicinities of such activities. The state's groundwater policy shall be balanced with the need to maintain and promote a healthy and prosperous agricultural community. This policy is further reinforced by legislation that states that groundwater in Vermont is a public trust resource. Efforts continue to incorporate the groundwater trust doctrine in the Groundwater Protection Rule & Strategy. State statute, 10 V.S.A. Chapter 48 establishes four classes of groundwater in the state:

- Class I. Suitable for public water supply. Character uniformly excellent. No exposure to activities which pose a risk to its current or potential use as a public water supply.
- Class II. Suitable for public water supply. Character uniformly excellent but exposed to activities which may pose a risk to its current or potential use as a public water supply.
- Class III. Suitable as a source of water for individual domestic water supply, irrigation, agricultural use and general industrial and commercial use. Waters not classified as Class I, II, or IV are by default Class III groundwater, unless reclassified by the Secretary.
- Class IV. Not suitable as a source of potable water but suitable for some agricultural, industrial and commercial use.

D4. Underground Injection Control Program

During the period January 1, 2014 through December 31, 2015, the UIC Program finalized, approved and then implemented an amended UIC Rule which became effective on October 29, 2014. The amended Rule provides a targeted approach to better address those sites that pose a moderate to high risk to groundwater while eliminating redundant permit requirements on low risk activities that previously bottle necked the program. 2015 efforts focused on a review of the existing permit database. The number of active UIC permits decreased significantly from approximately 70 to seven active UIC permits. Three Notices of Violation were issued for monitoring and reporting violations that resulted in enforcement action.

Based on a review of the existing floor drain registration database, 680 floor drains associated with high risk activities identified in the amended Rule were reviewed and targeted for closure.   Approximately 370 wells were subsequently eliminated through recent closure activities or record updates. Outreach to sites involving moderate risk activities and high risk well closure efforts are ongoing.

D5. Information & Public Education

Each reclassification of groundwater and each delineation of public drinking water source protection areas (SPA) includes a public notice. The town, residents or property owners in these areas, and officials of the water system are contacted. An opportunity for a hearing regarding the area is also provided. The outcome of both processes includes the identification of the groundwater resources along with the development of a rapport with concerned citizens at the town level. Groundwater planning at the local level can be better applied through such efforts. Such processes will go a long way towards educating the public and protecting the resource. Class II and IV Groundwater Areas as well as SPAs are posted on ANR's GIS website.

The DW&GPD annually sponsors Drinking Water Week at different locations throughout the State. The event provides a number of exhibits that explains the importance of drinking water and its protection. Attendance often includes students, the general public, interested parties, and members of the legislature.

The VDH toll-free phone line and its website have assisted well owners in better understanding the quality of their water. Also, when there is a confirmed exceedance of a water quality standard, whether naturally occurring or due to nearby land activities, there is technical assistance outlining treatment options so as to minimize a family's risk of exposure. VDH has also been present at Home Shows and realtor meetings regarding water quality sampling and testing. Similarly, the DW&GWPD's well driller's database is available on ANR's GIS website providing geographic and geological information to the public.

D6. Recommendation

Groundwater is fundamental to the ecosystem and as a drinking water resource. It recharges wetlands, streams, rivers, lakes, and ponds, which is critical to wildlife. This interconnection of water resources, however, has not had significant attention. Groundwater is also a source of drinking water for most of the State's population. While groundwater is addressed through the Safe Drinking Water Act, this Act's prime focus has been on monitoring, treatment, operation, and infrastructure needs of public water systems. Additional regulations that address groundwater are often in reaction to contamination. Yet, the quantity and quality of groundwater which define its use remain largely unknown. Characterizing the groundwater resources is progressing slowly relative to the continuing threats of contamination, the pressures and pace of economic development, and the importance of this resource due to ongoing fiscal restraints.

Part E. Public Participation

A "Solicitation for Water Quality Data & Information" press release was released on November 17, 2015 by Vermont Department of Environmental Conservation Watershed Management Division. The public was given until December 23, 2015 to provide any data and information for consideration for the 2016 305(b) integrated reporting process and 303(d) listing process. No data was received although a number of water quality monitoring reports from lay monitoring groups that have been generated in the last two years were used for the 305(b)/303(d) reporting and listing.

The draft 2016 Part A 303(d) List of Impaired Waters as well as an interim list showing the waters proposed for de-listing have been compiled and made available to the public for review and comment. At the same time, the 2016 draft Priority Waters Lists that contain: impaired waters that have a TMDL; impaired waters that don't need a TMDL; waters altered due to exotic species quantities; and waters altered due to flow regulation or modification, were also released for review. A list of all stressed river and stream segments was also produced for review.

Following receipt of public comments, a response summary will be developed that describes how the comments were addressed. Once approved, the Part 303(d) List will be posted on the Vermont ANR DEC Watershed Management Division website along with the other impaired and altered waters lists and along with the stressed waters list.

Appendix A:Vermont Department of Health Fish Consumption Advisory

HEALTH ALERT

The Vermont Department of Health recommends that people limit eating some fish caught in Vermont waters.

These advisories are based on tests of fish caught in Vermont waters and scientific information about the harmful effects of mercury and, in the case of large lake trout in Lake Champlain and all fish in the Hoosic River, PCBs (polychlorinated biphenyls).

You can mix and match fish (you catch or buy) with the same limits, but once you meet the lowest limit eat no more fish that month. Do not eat the monthly limit within a single week.

Store bought fresh and canned fish—including tuna—have mercury levels that are about the same as many Vermont-caught fish. Add in store bought fish when you decide how many fish meals to eat each month.

One fish meal = 8 ounces uncooked fish

For more information call
1-800-439-8550
healthvermont.gov

VERMONT DEPARTMENT OF HEALTH

	Women of childbearing age and children age 6 and under	Everyone else
GENERAL ADVISORY:		
Brown Bullhead Pumpkinseed	No more than 5 meals/month	No Restrictions
Walleye	0 Meals	No more than 1 meal/month
American Eel Chain Pickerel Lake Trout Smallmouth Bass	No more than 1 meal/month	No more than 3 meals/month
Largemouth Bass Northern Pike Yellow Perch (10 inches and larger)	No more than 2 meals/month	No more than 6 meals/month
Brook Trout Brown Trout Rainbow Trout White Perch Yellow Perch (smaller than 10 inches)	No more than 3-4 meals/month	No Restrictions
All Other Fish	No more than 2-3 meals/month	No more than 9 meals/month
SPECIAL ADVISORIES:		
Lake Carmi - Walleye	No more than 4 meals/month	No Restrictions
Lake Champlain Lake Trout (larger than 25 inches)	0 meals (includes all children under 15)	No more than 1 meal/month
Smallmouth Bass (19 inches and larger)	0 meals	No more than 1 meal/month
Yellow Perch (smaller than 10 inches)	No more than 5 meals/month	No Restrictions
Shelburne Pond Yellow Perch (smaller than 10 inches)	No more than 5 meals/month	No Restrictions
Hoosic River - All Fish	0 meals	0 meals
Deerfield Chain (Grout Pond, Somerset Reservoir, Harriman Reservoir, Sherman Reservoir, and Searsburg Reservoir)		
Brook Trout Brown Bullhead	No more than 5 meals/month	No Restrictions
Brown Trout (14 inches and smaller) Rainbow Smelt Rainbow Trout Rock Bass Yellow Perch	No more than 1 meal/month	No more than 3 meals/month
Brown Trout (larger than 14 inches) All Other Fish	0 meals	No more than 1 meal/month
15 Mile Falls Chain (Comerford Reservoir and Moore Reservoir)		
White Sucker	No more than 1 meal/month	No more than 3 meals/month
All Fish	0 meals	No more than 2 meals/month
15 Mile Falls Chain (McIndoes Reservoir)		
Yellow Perch	No more than 2 meals/month	No more than 6 meals/month
All Other Fish	No more than 1 meal/month	No more than 3 meals/month

v.May 2013

Appendix B: The remaining 68 CSO outfalls in Vermont, as of September 28, 2015

Table 1. A comprehensive listing of the remaining 68 CSO outfalls in Vermont, as of September 28, 2015.

MUNICIPALITY	NPDES ID#	S/N #	CSO #	RECEIVING WATER	LOCATION
Barton	VT0100641	008	007	Tributary to Barton River	Main Pump Station
Burlington Main	VT0100153	003	001	Wetland/Winooski River	Manhattan Drive at Park Street
		004	002	Wetland/Winooski River	Manhattan Drive at N Champlain Street
				Lake Champlain via Barge Canal	Manhole #3.25 at Pine Street and Lakeside Avenue
Burlington East/River	VT0100307			Winooski River	Colchester Avenue
Burlington North	VT0100226	002	001	Winooski River	Gazo Avenue
Enosburg Falls	VT0100102			Missisquoi River	Route 108 Bridge
Fair Haven	VT0100129			Castleton River	Adams Street Pump Station
				Castleton River	River Street Ejector Station
Hartford-WRJ	VT01001010	002	003	Connecticut River	Passumpsic Pump Station
		003	004	Connecticut River	Wilder Pump Station
		004	005	Connecticut River	Nutt Lane
		006	009	Connecticut River	Behind Municipal Building
		007	010	Connecticut River	Maple Street
Middlebury	VT0100188	002	001	Otter Creek	Pump Station #9
		003	002	Otter Creek	Pump Station #3
		011	010	Otter Creek	Pump Station #2
		013	012	Otter Creek	Pump Station #17
Montpelier	VT0100196	002	001	Winooski River	Taylor Bridge Abutment
		004	003	Winooski River	Bailey Avenue
		007	007	North Branch River	Near Railroad Bridge
		008	008	North Branch River	100 ft south of CSO #007
		009	009	North Branch River	Main Street near Baird Street
		014	023	Winooski River	Bailey Avenue Bridge
Newport City	VT0100200	002		Clyde River	Manhole A, Spring Street
		004		Clyde River	Manhole 16, Clyde Street
Newport City		005		Upper South Bay	Manhole 6, Clyde Street near Herrick Street

MUNICIPALITY	NPDES ID#	S/N #	CSO #	RECEIVING WATER	LOCATION
		006		Upper South Bay	Manhole 25, Clyde Street near W Main Street
		010		Lake Memphremagog	Manhole 49, near Bay View Street
		013		Tributary to Lake Memphremagog	Manhole 24, near Union Street
Northfield	VT0100242	002	004	Dog River	East Street (near Sanel Auto Parts)
Richford	VT0100790	002	1	Missisquoi River	Before Pump Station 2 (Playground)
		003	2	Missisquoi River	River Street Siphon Chamber
City of Rutland	VT0100871	002	001	Otter Creek	Calvery Cemetery
		003	002	East Creek	Homeplate
		005	005	East Creek	West Street Siphon
		009	009	East Creek	Third Base
St Albans City	VT0100323			Stevens Brook	Lower Welden Street and South Elm Street
St Johnsbury	VT0100579	006	006	Passumpsic River	Bay Street (south of CVPS)
		006A	006A	Passumpsic River	Bay Street (south of CVPS)
		007	007	Passumpsic River	River Road at Portland Street
		008	008	Passumpsic River	Bay Street (behind CVPS Garage)
		009	009	Passumpsic River	Bay Street
		010	010	Passumpsic River	St Marys Street (behind Chaloux)
		010A	010A	Passumpsic River	St Marys Street (end of street)
		011	011	Passumpsic River	Elm Street (ball field)
		020	020	Passumpsic River	Railroad Avenue (near pump station)
		021	021	Passumpsic River	Passumpsic Street at junction of Tremont Street
		023	023	Sleepers River	Fairbanks Village behind Middle School
		023	024	Sleepers River	Fairbanks Village behind Middle School
		026	026	Sleepers River	Western Avenue
		027	027	Sleepers River	Western Avenue
Springfield	VT0100374	002	003	Black River	Pump Station #1 (Clinton Street)
		004	005	Black River	Downstream of Bridge Street Siphon
		006	007	Black River	Behind Fire Station

MUNICIPALITY	NPDES ID#	S/N #	CSO #	RECEIVING WATER	LOCATION
		007	008	Black River	Clinton Street and Love Street
		008	009	Black River	Clinton Street at Land Rover
Springfield		010	011	Black River	Community Center Bridge
		011	012	Black River	Mineral Street
		012	013	Black River	Park Street Bridge
		016	018	Black River	Lewis Street and Pine Street
		017	020	Black River	Riverside Upstream Siphon
			024	Black River	Pump Station #6 (Midway)
		003	004	Black River	Behind L&L Building #1
		020	028	Black River	Bryant Building / North Lot
			100	Black River	Olive Street
Vergennes	VT0100404			Potash Brook	MacDonough Drive
				Otter Creek	Northland Job Corp Academy Pump Station
Woodstock	VT0100757			Kendron Brook	Kedron Brook Overflow (Manhole #3-9)

Appendix C: EPA and Vermont Long-term Vision for the 303(d) TMDL Program

EPA's 303(d) Vision

Background

In recent years, USEPA has been working with the states to develop a new long-term (2016-2022) "Vision" for the TMDL program that gets away from solely looking at the number of TMDLs completed, but instead encourages States to develop tailored strategies to implement their CWA 303(d) Program responsibilities in the context of their overall water quality goals and State priorities. It should be noted that it does not impose any binding legal requirements on EPA, the States, or other stakeholders, and it does not alter CWA 303(d) regulatory obligations to identify impaired or threatened waters and develop TMDLs for such waters.

The overall "Vision" identifies several concepts whereby a state can work to integrate its 303(d) Program into its overall water quality priorities. The six areas of focus include promoting:

- "Prioritization" of listed waters for action;
- "Assessments" of priority impaired waters;
- "Protection" of healthy watersheds to prevent impairment;
- "Alternative" plans to TMDLs that may be better suited to attain water quality in certain circumstances;
- "Engagement" with the public concerning priorities, and
- "Integration" with the TMDL program with other Clean Water Act program areas to achieve water quality goals.

However, it is up to the states to choose to incorporate any or all of these elements into their 303(d) water quality program. One aspect of the "Vision" that EPA is strongly encouraging is the "prioritization" component because newly proposed program measures use the long-term priorities as the baseline to measure program progress.

Vermont has been following the development of the 303(d) Vision process since its inception and welcomes the broadening of the vision of the 303(d) Program beyond simply counting TMDLs. In recent years, Vermont has developed its own unifying vision for addressing impaired waters as well as restoration and protection activities known as Vermont's Surface Water Management Strategy. This strategy, among others things, incorporates all six major elements the EPA Vision addresses in one way or another but several of these objectives are accomplished outside the context of the 303(d) Program. For example, the *engagement*, *integration* and *protection* goals are addressed in Vermont's Tactical Basin Planning process, outside the scope of 303(d) activities.

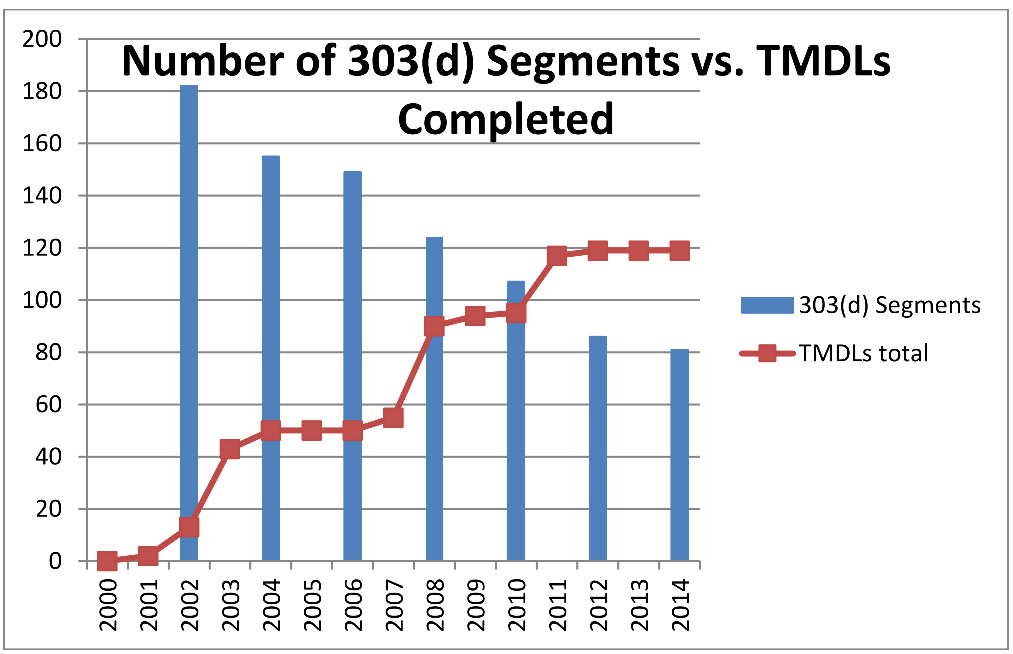
Vermont's 303(d) Program represents only one avenue through which the Vision objectives are addressed. The Tactical Basin Planning process and the resulting plans are intended to capture the Division's water quality priorities as well as align activities conducted by partners and stakeholders with those priorities

Prioritization

One aspect at the core of the Vision is the identification of 303(d) List priorities. These priorities transparently identify the area upon which the state expects to focus its development of TMDLs or other alternative watershed plans between 2016-2022. Guidance suggests prioritization of certain areas of the 303(d) List can occur in whatever way integrates best within the state's other water quality objectives. Examples include prioritization based on geographic location, pollutant type, or uses impaired. Vermont has developed a prioritization scheme that is detailed below.

Historical 303(d) List Composition and TMDL Development

The graphic below illustrates Vermont's continued success at shrinking the number of impaired segments in the 303(d) universe while concurrently showing a steady increase of TMDL development. To date, much of the TMDL development has come by developing methodologies for specific types of impairments and thereby applying those methods to categories of pollutants. This approach has allowed relatively large TMDL "batches" to be completed in the past. These batches have included the Northeast Regional Mercury TMDLs, Vermont's Urban Stormwater TMDLs, Acid Lakes TMDLs and the nonpoint source Bacteria TMDLs. Vermont is currently in the process of developing a TMDL methodology for nonpoint source phosphorus TMDLs where agricultural inputs are a primary source. While this batch TMDL approach has allowed for steady TMDL development in the past, the opportunities to continue this way have diminished. Looking to the future, there are limited large batches of impairment types with more than a handful of impaired segments, thus the rate of TMDL development will likely diminish especially since many of the remaining impairment types are not readily amenable to TMDL development. However, this should be seen as a positive situation since the number of impaired segments on the 303(d) List has decreased by over 55% since 2002, and the Vermont has increasingly developed alternative approaches to improve water quality. A further discussion of TMDL opportunities as well as alternatives is given below.



Considerations for Prioritization

Vermont sees several ways by which it will address planning activities regarding the priority waters under the Vision framework – some involve TMDLs and others TMDL alternative approaches.

Below is a summary of planning approaches envisioned and how they relate to the Vision process.

TMDLs
There are still several opportunities for which development of TMDLs is still an appropriate approach to addressing 303(d) impaired waters:

- Lake Memphremagog, phosphorus – (1)
- Nonpoint Source Agricultural Area TMDLs – (11)
- Moon Brook, thermal pollution
- A few other nonpoint impairments may be applicable for TMDLs

TMDL Alternatives designed to meet WQS
Historically in Vermont, this category applies to waters whereby 4b alternatives to TMDLs have proven to be a better approach to more quickly attain water quality standards. Currently on the 2014 List, there are 12 impaired segments in Category 4b (Vermont's Part B) and there are opportunities to develop alternative plans for several more segments. Additionally, there may be other established planning scenarios that could also qualify as Vision planning efforts.

- High elevation stormwater Water Quality Remediation Plans (4) – submitted as 4b alternatives (4)
- Dam operation plans/licenses (1) – 401 Certification (e.g. Waterbury Reservoir)
- Discharge permit reissuance (e.g. Halnon Brook, Tributary to Hubbardton River, Tributary to Stevens Branch)
- Detailed and comprehensive nonpoint source remediation planning as part of Tactical Basin Planning – In instances of smaller scale impairments with a limited number of contributing sources, the Implementation Tables contained in the Tactical Basin Plans may provide enough specificity and assurance that standards will be met to qualify as an alternative to a TMDL, particularly in those areas subject to wasteload allocations contained in the Lake Champlain TMDL, or addressable through the new regulatory authorities of the VT Clean Water Act. These may qualify for reporting credit under WQ-27.

Alternative plans outside the scope of the 303(d) Vision
Sometimes alternatives outside the scope of the 303(d) Vision are considered the best approach for many reasons. These alternatives often take precedence because other programs and regulations are better positioned to bring about water quality improvements. However, these plans may not rise to the standard set forth under the Vision whereby the plans must have attainment of water quality standards as their final goal. These types of plans often take an adaptive management approach to finding complete solutions where implementation activities are followed by monitoring to determine ultimate success.

- CSO Long-term control plans (10)
- Landfills – closure/monitoring plans
- Contaminated sites cleanup
- Mine/Superfund site cleanup plans

Historically, there are several examples where these types of planning activities have resulted in resolving impairments.

Impairments for continued monitoring and tracking

Some impairments identified on the 2014 303(d) List are problems for which localized watershed planning activities will provide little benefit. Two prominent listed categories are identified below:

- PBCs in fish tissue (11) – consumption restrictions have been posted for certain fish species in certain areas due to high PCB contamination (11). The vast majority of PCB contamination sites have been cleaned up but bioaccumulated PCBs remain in the food chain. As this isn't a watershed loading problem, loading control activities are inappropriate but conditions will continue to be tracked.
- Acid stream impairments caused by acid deposition (8) – sources of the acid deposition are primarily from outside the local watershed so planning activity to reduce inputs is better suited on the national level. VTDEC continues monitoring the status of these streams.

Reporting Measures WQ-27 & WQ-28

Two reporting measures are being introduced to the 303(d) Program as a means to expand flexibility beyond the previous reporting metric of simply counting how many TMDLs a state has completed.

Measure WQ-27

Measure WQ-27 builds off the prioritization scheme and the language reads:

> *Extent of priority areas identified by each State that are addressed by EPA-approved TMDLs or alternative restoration approaches for impaired waters that will achieve water quality standards. These areas may also include protection approaches for unimpaired waters to maintain water quality standards.*

The motivation for EPA to focus this measure on "priority" areas is to allow states to communicate a specific impairment type on which it intends to spend much of its resources to benefit overall water quality goals. The measure also allows "credit" for TMDL alternatives whereby the ultimate goal is to meet water quality standards. Quantification of the measure will be in the catchment area rather than a simple "check" for each TMDL completed, i.e. larger TMDLs count for more credit. Also, EPA will allow for annual changes to the priority universe to allow for flexibility and unforeseen circumstances.

Measure WQ-28

Measure WQ-28 language reads:

> *State-wide extent of activities leading to completed TMDLs or alternative restoration approaches for impaired waters, or protection approaches for unimpaired waters.*

This measure expands the accounting of TMDLs and alternative plans outside the scope of the priority areas to a state-wide extent. This measure will also track actions that are part of the process that lead to a completed TMDL, alternative restoration approach, or protection plan, and include:

> *Planning actions for* TMDLs, alternative restoration approaches, or protection plans*:* Planning actions include: review of existing information, data evaluation, and data collection.
>
> *Developing actions for* TMDLs, alternative restoration approaches, or protection plans*:* Developing actions include: data analysis, model development, draft of plan, proposal of a TMDL for public comment, and public outreach.

2014 *Priority* 303(d) Listed Waters

Waters in the table below represent Vermont's priorities for TMDL or alternative planning activities consistent with the 2016-2022 Vision and include 27 out of the 81 total listed waters (33%). These waters will provide the baseline for WQ-27 reporting requirements beginning in 2016.

Waterbody ID	ADB code(s)	Name	Pollutant	Use Impaired	Problem
VT02-02	01	HUBBARDTON RIVER, TRIB #7, BELOW WWTF DISCHARGE	E. COLI, NUTRIENTS, TEMPERATURE	ALS, CR, 2CR	BENSON WWTF, AG RUNOFF POSSIBLE SOURCES; MONITORING & ASSESSMENT REQUIRED
VT03-07	02	LITTLE OTTER CREEK, RM 15.4 TO RM 16.4	NUTRIENTS, SEDIMENT	ALS	AGRICULTURAL RUNOFF
VT03-12	02	HALNON BROOK, TRIBUTARY #1	NUTRIENTS	ALS	ELEVATED NUTRIENTS AFFECT AQUATIC BIOTA
VT05-01	02	ROCK RIVER, UPSTREAM FROM QUE/VT BORDER (APPROX 13 MILES)	NUTRIENTS, SEDIMENT	ALS	AGRICULTURAL RUNOFF; NUTRIENT ENRICHMENT
VT05-01	03	SAXE BROOK (TRIB TO ROCK RIVER) FROM MOUTH UPSTREAM 1 MILE	NUTRIENTS	ALS	AGRICULTURAL RUNOFF
VT05-07	03	JEWETT BROOK (3.5 MILES)	NUTRIENTS, SEDIMENT, E. COLI	ALS	AGRICULTURAL RUNOFF
VT05-07	05	STEVENS BROOK, MOUTH UPSTREAM 6.5 MILES	NUTRIENTS, SEDIMENT, E. COLI	ALS, CR	AGRICULTURAL RUNOFF; MORPHOLOGICAL INSTABILITY, ST ALBANS CSO
VT05-07	04	MILL RIVER, FROM ST. ALBANS BAY TO 1.8 MILES UPSTREAM	NUTRIENTS, SEDIMENT	ALS	AGRICULTURAL RUNOFF, STREAMBANK EROSION
VT05-07	01	RUGG BROOK, FROM MOUTH TO APPROX 3.1 MILES UPSTREAM	NUTRIENTS, SEDIMENT, E. COLI	ALS, CR, AES	AGRICULTURAL RUNOFF
VT06-04	01	BERRY BK, MOUTH UP TO AND INCLUDING NO. TRIB (APPROX. 1 MI)	SEDIMENT, NUTRIENTS	ALS, AES	AGRICULTURAL RUNOFF, AQUATIC HABITAT IMPACTS
VT06-04	04	TROUT BROOK, UPSTREAM FROM MOUTH FOR 2.3 MILES	NUTRIENTS	ALS	AGRICULTURAL RUNOFF

VT06-04	02	GODIN BROOK	NUTRIENTS, SEDIMENT	ALS, AES	AGRICULTURAL RUNOFF, AQUATIC HABITAT IMPACTS
VT06-04	03	SAMSONVILLE BROOK	NUTRIENTS, SEDIMENT	ALS, AES	AGRICULTURAL RUNOFF, AQUATIC HABITAT IMPACTS
VT06-05	02	WANZER BROOK (MOUTH TO RM 4.0)	NUTRIENTS, SEDIMENT	ALS	AGRICULTURAL RUNOFF
VT06-08	03	MUD CREEK, FROM VT/QUE BORDER UP TO RM 6.5 (APPROX. 3.2 MILES)	NUTRIENTS, SEDIMENT	ALS, AES	AGRICULTURAL RUNOFF; NUTRIENT ENRICHMENT
VT06-08	04	COBURN BROOK (MOUTH TO RM 0.2)	NUTRIENTS	ALS	AGRICULTURAL ACTIVITY AND RUNOFF
VT08-11L02	02	WATERBURY RESERVOIR (Waterbury)	SEDIMENT	ALS, AES	SEDIMENTATION, TURBIDITY
VT10-06	01	ROARING BROOK, RM 3.5 TO RM 4.2	STORMWATER	AES, ALS	STORMWATER RUNOFF, LAND DEVELOPMENT; EROSION
VT10-06	02	E. BRANCH ROARING BROOK, RM 0.1 TO RM 0.6	STORMWATER, IRON	AES, ALS	STORMWATER RUNOFF, LAND DEVELOPMENT, EROSION
VT12-05	01	NO. BRANCH DEERFIELD RIVER, TANNERY BRK RD TO 0.2 MI ABOVE SNOW LAKE	STORMWATER	AES, ALS	STORMWATER RUNOFF, LAND DEVELOPMENT & CONSTRUCTION RELATED EROSION
VT12-05	03	IRON STREAM, TRIB TO JACKS BROOK (0.3 MILE)	IRON	ALS	LAND DEVELOPMENT, SOURCE(S) NEED FURTHER ASSESSMENT
VT13-13	01	CROSBY BROOK, MOUTH TO RM 0.7	SEDIMENT	ALS	HABITAT ALTERATIONS DUE TO SEDIMENTATION, CHANNELIZATION AND BUFFER LOSS
VT13-16	01	NEWTON BROOK, MOUTH TO RM 2.0	SEDIMENT	ALS	AGRICULTURAL ACTIVITY
VT14-02	04	LORDS BROOK, HEADWATER TRIBUTARY #2 AND TRIB 2-TRIB 1	METALS	ALS	ABANDONED MINE DRAINAGE BELOW "SOUTH CUT" AND "SOUTH MINE"
VT14-05	02	TABOR BRANCH TRIBUTARY #6, MOUTH TO RM 0.1	UNDEFINED	ALS	AGRICULTURAL RUNOFF

VT17-01L01	01, 02	LAKE MEMPHREMAGOG (Newport)	PHOSPHORUS	AES, CR	EXCESSIVE ALGAE GROWTH, NUTRIENT ENRICHMENT
VT17-02	01	STEARNS BROOK TRIBUTARY (HOLLAND)	NUTRIENTS	ALS	AGRICULTURAL RUNOFF