Vermont Clean Water Initiative

2022 Performance Report

VERMONT CLEAN WATER INITIATIVE

VERMONT

AGENCY OF ADMINISTRATION
AGENCY OF AGRICULTURE, FOOD & MARKETS
AGENCY OF COMMERCE & COMMUNITY DEVELOPMENT
AGENCY OF NATURAL RESOURCES
AGENCY OF TRANSPORTATION

VERMONT CLEAN WATER INITIATIVE 2022 PERFORMANCE REPORT

Submitted on behalf of the Vermont Agency of Administration
January 13, 2023

Relevant Reporting Requirements:	Fulfilled by:
10 V.S.A. § 1389a (a) The Report shall summarize all investments, including their cost-effectiveness, made by the Clean Water Board and other State agencies for clean water restoration over the prior fiscal year	Chapter 2
10 V.S.A. § 1389a (b)(1) Documentation of progress or shortcomings in meeting established indicators for clean water restoration	Chapter 3 & 4
10 V.S.A. § 1389a (b)(2) A summary of additional funding sources pursued by the Board, including whether those funding sources were attained; if it was not attained, why it was not attained; and where the money was allocated from the Fund	Report of the Working Group on Water Quality funding under Act 73[1]
10 V.S.A. § 1389a (b)(3) A summary of water quality problems or concerns in each watershed basin of the State, a list of water quality projects identified as necessary in each basin of the State, and how identified projects have been prioritized for implementation	Refer to Tactical Basin Plans explained in Chapter 1
10 V.S.A. § 1389a (b)(4-5) A summary of any changes to applicable federal law or policy related to the State's water quality improvement efforts, including any changes to requirements to implement total maximum daily load plans in the State; a summary of available federal funding related to or for water quality improvement efforts in the State	2022 Federal Funding Related to Water Quality Improvement Efforts in Vermont[2]
10 V.S.A. § 1389a (b)(6) Beginning January 2023, a summary of the administration of the grant programs established under sections 925-928 of this title [Act 76 of 2019], including whether these grant programs are adequately funding implementation of the Clean Water Initiative	Chapter 1
10 V.S.A. § 1264 (k)(1-3) Report on installation of stormwater treatment practices through operational stormwater permits, including: (1) permitted new development is achieving at least a 70 percent average phosphorus load reduction; (2) estimated total phosphorus load reduction from new development, redevelopment, and retrofit of impervious surface permitted; and (3) number and percentage of projects that implemented Tier 1, 2, or 3 stormwater treatment practices	Appendix C
10 V.S.A. § 1386(e) A summary of activities and measures of progress of water quality ecosystem restoration programs	Chapter 2
Lake Champlain TMDL Progress Report Chapter 3 (1) estimated phosphorus reductions from clean water projects in the Lake Champlain basin; (2) monitored phosphorus loading to Lake Champlain (3) estimated total phosphorous load reductions by lake segment watershed; and (3) Appendix A-B: status of priority actions from Tactical Basin Plan Implementation Table for basins 2 & 4 and 3	Chapter 3 and Appendix A & B

[1] Report of the Working Group on Water Quality funding under 2017 Act 73, available at: https://anr.vermont.gov/sites/anr/files/specialtopics/Act73WorkingGroup/2017-11-15-FINAL-act-73-water-quality-funding-report.pdf.

[2] 2022 Report on Federal Funding Related to Water Quality Improvement Efforts in Vermont, available at: https://dec.vermont.gov/sites/dec/files/wsm/erp/docs/2022_Vermont_Federal_Clean_Water_Funding_Report_09-01-22.pdf.

ACKNOWLEDGEMENTS

This report was prepared by the Vermont Agency of Natural Resources Department of Environmental Conservation (DEC) Clean Water Initiative Program on behalf of the Vermont Secretary of Administration with assistance from partner agencies. The Clean Water Initiative Program coordinates with staff of the Vermont Agency of Administration; Vermont Agency of Agriculture, Food and Markets; Vermont Agency of Commerce and Community Development; Vermont Agency of Transportation; Vermont Fish and Wildlife Department; Vermont Department of Forests, Parks and Recreation; DEC's Water Investment Division; DEC's Watershed Management Division; Vermont Housing and Conservation Board; U.S. Department of Agriculture Natural Resources Conservation Service; and Lake Champlain Basin Program to complete this report. Vermont Agency of Digital Services supported data management and database development.

Report available electronically at: dec.vermont.gov/water-investment/cwi/reports

VERMONT CLEAN WATER INITIATIVE - cleanwater.vermont.gov

VERMONT CLEAN WATER INITIATIVE AGENCIES

Agency of Administration - aoa.vermont.gov
Agency of Agriculture, Food and Markets - agriculture.vermont.gov
Agency of Commerce and Community Development - accd.vermont.gov
Agency of Natural Resources - anr.vermont.gov
Agency of Transportation - vtrans.vermont.gov

VERMONT CLEAN WATER INITIATIVE AFFILIATE ENTITY

Vermont Housing and Conservation Board - vhcb.org

Cover Photo Image Descriptions (clockwise from top left): Camp Wihakowi Dam Removal in Northfield, VT / Funded by DEC in partnership with Friends of the Winooski River; Culvert Installation in Camel's Hump State Park / Funded by Lake Champlain Basin Program; Woodchip Barnyard Replacement / Funded by Agency of Agriculture, Food and Markets (AAFM) Water Quality Grants to Partners and Farmers Program; Constructed Wetland in Shelburne, VT / Funded by the Clean Water Fund; Manure Injection in Addison County / Funded by AAFM Water Quality Grants to Partners and Farmers Program.

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Vermont Clean Water Initiative 2022 Performance Report Executive Summary

Vermont's lakes, rivers, wetlands, and reservoirs are important environmental and economic resources for residents and visitors. The State of Vermont funds clean water projects to reduce pollution entering waters from the landscape to protect and restore water quality. Excess sediment and nutrients (such as phosphorus) entering waterways can lead to harmful algal blooms and nuisance aquatic plant growth. **Clean water projects** are regulatory or non-regulatory practices or protections that target water pollution, including excess nutrients and sediment, across land use sectors. Clean water projects can provide many co-benefits for the environment and local communities, such as increasing flood resilience, improving habitat function and biodiversity, supporting carbon sequestration, improving soil health, supporting workforce development, and providing local economic stimulus. The Vermont *Clean Water Initiative 2022 Performance Report* (referred to hereafter as Report) summarizes efforts of state government, along with federal and local partners, to improve water quality across Vermont from State Fiscal Year (SFY) 2016 to 2022 (July 1, 2015 – June 30, 2022).

Vermont's Clean Water Funding and Investments

Vermont's clean water funding helps municipalities, farmers, landowners, and nonprofit organizations implement projects that reduce nutrient and sediment pollution from all land use sectors. Funds from state programs complement and leverage other funding sources to support clean water efforts statewide**.** Collectively, state funding programs, federal funding programs, and regulatory programs drive clean water efforts in Vermont. See Report Chapter 1 to learn more about clean water funding.

The State of Vermont invested nearly $337 million in clean water projects through grants, contracts, and loans from SFY 2016 to 2022. Reaching Vermont's water quality goals requires investments across all land use sectors. Annual clean water investments have increased more than five-fold statewide since SFY 2016, but funding awarded to projects varies from year-to-year based on project readiness and capacity.

See Report Chapter 2 for more information.

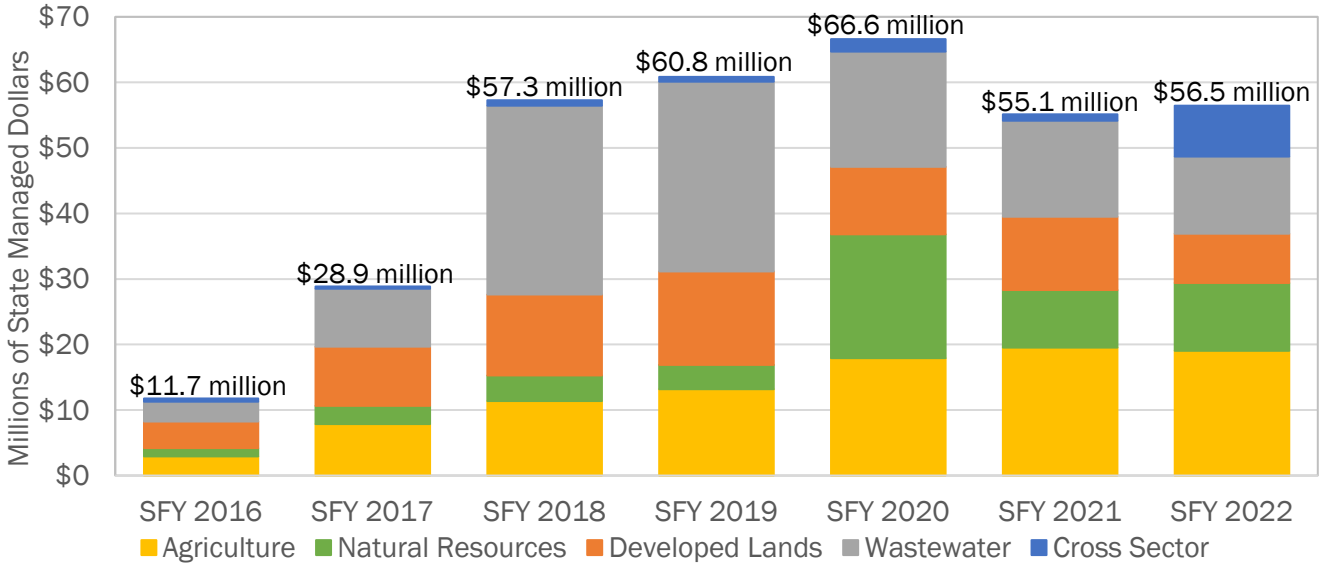


Figure ES-1. Vermont's clean water investments by land use sector, SFY 2016 - 2022

Clean Water Project Outputs

Clean water projects target nutrient and sediment pollution statewide across land use sectors to improve Vermont's water quality. The following highlights some of the results of state and federally funded and regulatory projects completed from SFY 2016 to 2022.

See Report Chapter 2 for more information and results on the impact of state funding.

Land Use	Clean Water Project Objectives	Cumulative Project Outputs SFY 2016-2022 by Land Use Sector
	Addresses runoff and soil erosion from farm production areas and farm fields.	• Over **335,000** acres of agricultural conservation practices implemented on fields and pastures • Over **4,500** structural practices installed in barnyards/production areas
	Restores functions of "natural infrastructure" – river channels, floodplains, lakeshores, and wetlands	• Over **470** riparian acres (adjacent to rivers, lakes, and wetlands) actively restored through buffer planting and floodplain and lakeshore restoration • Over **2,600** riparian acres passively restored through river corridor and wetland easements
	Addresses stormwater runoff form developed lands, such as parking lots, sidewalks, rooftops, and roads	• Over **340** municipal road miles improved through drainage and erosion control best practices • Over **1,000** acres of existing impervious/hard surfaces treated by stormwater practices
	Decreases nutrients (phosphorus and nitrogen) through enhanced wastewater treatment and addresses aging infrastructure	• **21** wastewater treatment facility upgrades and refurbishments completed • **6** combined overflow abatements completed[3]

Total Maximum Daily Load (TMDL) Progress

The 2022 Performance Report summarizes the state's progress in implementing the Lake Champlain and Lake Memphremagog phosphorus Total Maximum Daily Loads (TMDLs). TMDLs identify water pollution (e.g., phosphorus) reductions required to restore water quality. The figures below show the estimated total phosphorus load reduction (metric tons per year) achieved by clean water project implementation thus far, and the projected annual increase in estimated total phosphorus load reduction necessary to meet the Lake Champlain TMDL (Figure ES-2) and Lake Memphremagog TMDL (Figure ES-3) within the 20-year timeframe of the plans. Estimates include the results of projects implemented through state and federal funding programs and regulatory programs.

See Report Chapters 3 and 4 for more information.

[3] Combined sewer overflows (CSOs) may require multiple abatement projects in order to achieve water quality standards or eliminate any potential discharge from the CSOs.

TMDL Progress Projections

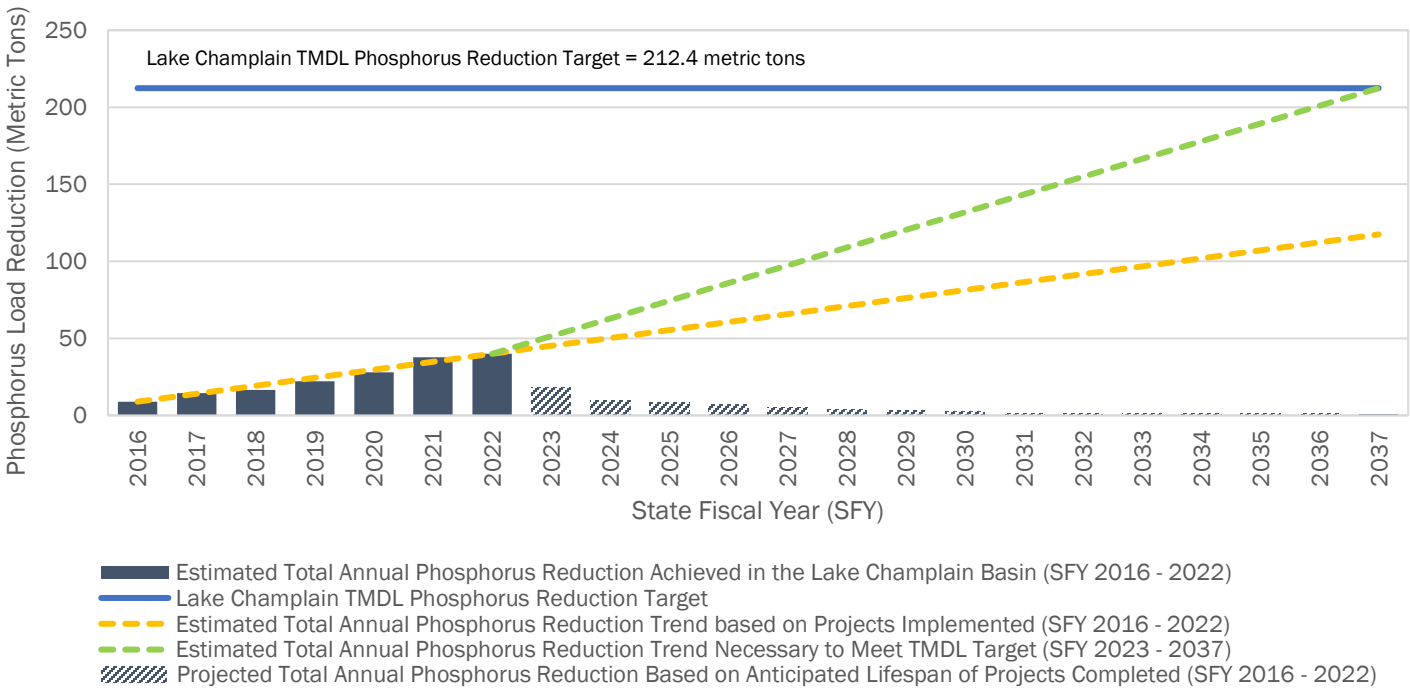


Figure ES-2. Estimated total annual phosphorus load reductions achieved to date and projected phosphorus reduction trend necessary to meet the Lake Champlain TMDL phosphorus reduction target by SFY 2037.

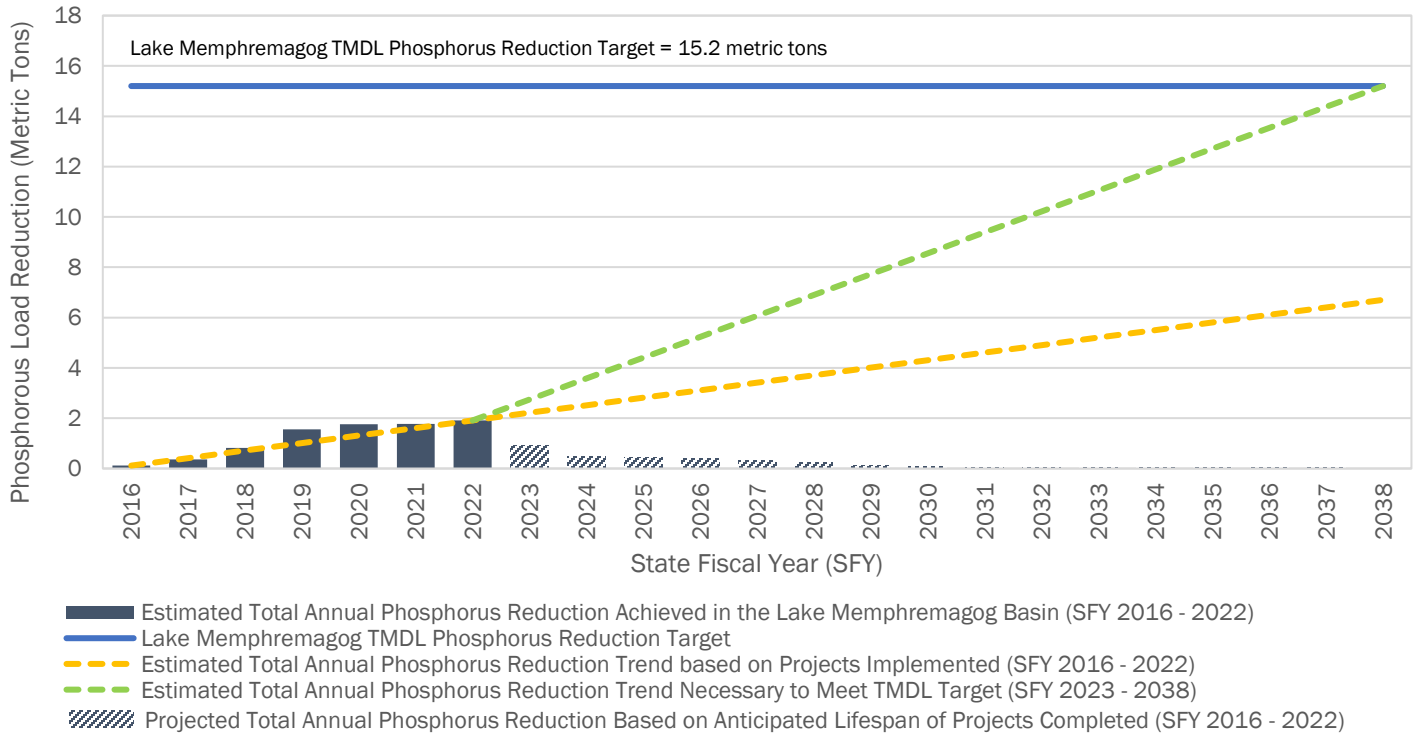


Figure ES-3. Estimated total annual phosphorus load reductions achieved to date and projected phosphorus reduction trend necessary to meet the Lake Memphremagog TMDL phosphorus reduction target by SFY 2038.

The TMDLs for both the Lake Champlain and Lake Memphremagog basins necessitate a year-over-year increase in achieved total estimated phosphorus load reduction in order to meet the established targets. The green dashed line in Figure ES-2 and Figure ES-3 shows a path forward to meet the TMDL targets. This path will depend on many factors including expansion of existing programs, growth in collective capacity, and implementation of new phosphorus estimation methods that more comprehensively capture the impact of clean water projects. Continued effort, investment, and coordination are critical to the state reaching the water quality goals outlined in the TMDLs. In addition, maintaining existing clean water projects to ensure performance through or beyond their anticipated design life will be an important component of realizing total phosphorus load reduction targets.

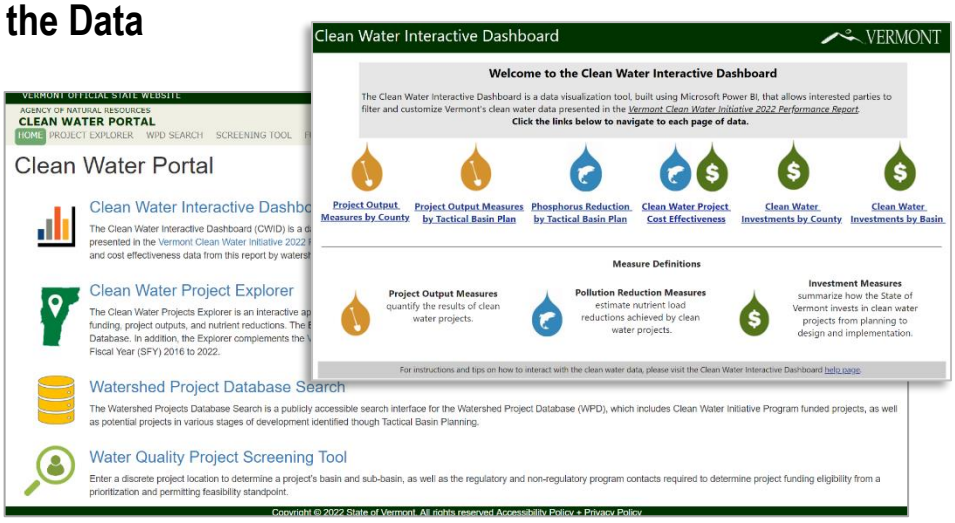
The estimated total phosphorus load reductions presented in this Report represent modeled estimates of clean water project performance. While these estimates are useful in assessing incremental progress towards the TMDL targets, ultimately the achievement of the state's water quality goals will be measured based on water quality monitoring. External variables, particularly changing temperature and precipitation patterns resulting from climate change, can have a substantial impact on measured nutrient concentrations and may affect the ultimate achievement of water quality goals in Vermont. This underscores the importance of continued assessment of water quality progress through monitoring data and consideration for external variables that may be impacting measured outcomes.

Looking Ahead to Cleaner Water

The State of Vermont is moving beyond the "ramping up" period of clean water programs and TMDL implementation in the Lake Champlain and Lake Memphremagog basins. An influx in federal funding being directed towards clean water programs in Vermont is expected to support broader investments resulting in expansion of clean water project impacts. In addition, the state has transitioned to a decentralized structure for many clean water funding programs. By empowering and investing in capacity of local and regional partners to administer funding, greater mobilization of funds and reduction of bottlenecks will allow for increased progress towards clean water goals on the ground. Through expanded methods for estimating phosphorus reductions achieved by clean water projects, the state will have an improved understanding of the progress made towards reaching clean water targets, and what more is needed to ensure these goals are met.

Learn More and Explore the Data

Explore investment, results, and estimated total phosphorus data behind the *Vermont Clean Water Initiative 2022 Performance Report* in the online Clean Water Interactive Dashboard via the Clean Water Portal at: https://anrweb.vt.gov/DEC/cleanWaterDashboard/.



Chapter 1: Introduction

Vermont's lakes, rivers, wetlands, and reservoirs are important environmental and economic resources for residents and visitors. Vermont's waterways provide safe drinking water and recreational opportunities for thousands of people and support local economies by fostering tourism and influencing property values. High-quality streams, lakes, and wetlands also support wildlife habitat and increase flood resiliency for local communities. Maintaining, protecting, and restoring water quality is a priority for Vermont. The State of Vermont and its local and federal partners are committed to restoring impacted waters and protecting high-quality waters. This report summarizes the efforts of state government and its partners to improve water quality across Vermont over the past seven state fiscal years.

Clean Water Restoration

Vermont's waters are generally high quality, but some waters suffer from excess pollution leading to unhealthy ecosystems which can negatively impact human health and economic activity.[4] In Vermont, most water quality problems are caused by excess sediment and nutrients (e.g., phosphorus and nitrogen) from nonpoint source pollution. Nonpoint source pollution transports sediment and nutrients from the landscape to waterways by rainfall and snowmelt (e.g., runoff from agricultural fields, roads, and parking lots). Nonpoint source pollution is more difficult to manage than point source pollution, which enters waterways from an easily identified and confined place (e.g., discharge from a wastewater treatment facility).

Figure 1. Cyanobacteria bloom in Lake Champlain caused by excess phosphorus runoff. © Lake Champlain Committee

Excess phosphorus loading can lead to cyanobacteria blooms in Vermont's lakes (Figure 1). Cyanobacteria, also known as blue-green algae, are a natural component of surface waters and provide important ecological services, such as photosynthesis and the transfer of nitrogen from the atmosphere to the aquatic environment through nitrogen fixation. However, high concentrations of cyanobacteria can produce potent toxins that may be harmful to people and animals and can cause undesirable environmental impacts. The Vermont Department of Health, Vermont Department of Environmental Conservation (DEC), and partners monitor blooms around the state and suspend water-based recreational activities, if needed, to protect the public from the health impacts of cyanobacteria blooms.

[4] Gourevitch, J., Koliba, C., Rizzo, D., Zia, A., Ricketts, T., "Quantifying the social benefits and costs of reducing phosphorus pollution under climate change", Journal of Environmental Management, Volume 293, 2021, 112838, Available: https://www.sciencedirect.com/science/article/pii/S0301479721009002.

Clean water restoration plans known as Total Maximum Daily Loads (TMDLs) identify pollutant reductions required for an impaired waterbody to meet the State of Vermont's water quality standards. TMDLs set up long term pollutant reduction targets to mitigate both nonpoint source and point source pollution. Most of the State of Vermont is covered by three large-scale TMDLs that require nutrient loading reductions, as shown in Figure 2. Lake Champlain and Lake Memphremagog TMDLs target phosphorus pollution to address cyanobacteria blooms and other excess algae and aquatic plant growth. The five-state Long Island Sound TMDL targets nitrogen pollution, which causes low dissolved oxygen and dead zones in the Sound. The State of Vermont also has numerous small-scale nutrient TMDLs across the state. Implementation of large-scale and small-scale TMDLs together supports local and regional water quality restoration.

The State of Vermont uses the **Tactical Basin Planning** process to identify and prioritize clean water projects that will provide the greatest return on investment through achievement of water quality restoration goals. Tactical Basin Plans identify and prioritize clean water projects across multiple sectors (i.e., stormwater, rivers, roads, and wastewater treatment) based on scientific monitoring data and assessment results. Each Tactical Basin Plan contains a prioritized list of projects and strategies necessary to achieve clean water goals.[5]

Clean water projects, described in Figure 3 and throughout this report, refer to regulatory or non-regulatory practices or protections that target nutrient and sediment pollution across various land use sectors.[6] Clean water projects also provide many co-benefits for the environment and local communities, such as increasing flood resilience, improving habitat function and biodiversity, supporting carbon sequestration, improving soil health, supporting workforce development, and providing local economic stimulus.

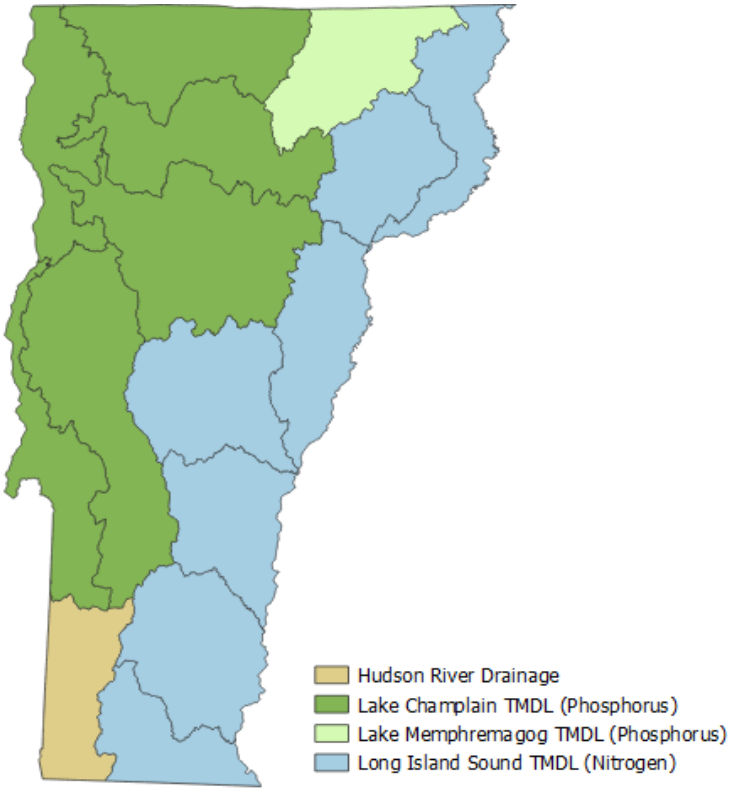


Figure 2. Vermont's large-scale TMDLs that require nutrient pollutant reductions. Tactical planning basins also shown.

[5] To learn more about the Tactical Basin Planning process and view Basin Plans for each of Vermont's 15 tactical planning basins, visit the Watershed Planning Program page of Vermont DEC's website: https://dec.vermont.gov/water-investment/watershed-planning/basin-planning-process

[6] Clean water project may be defined differently or more narrowly in other contexts, such as in relation to Act 76 of 2019.

Figure 3. Clean water project land use sectors, objectives, examples, and additional benefits.

Vermont's Clean Water Funding

The State of Vermont is committed to improving and maintaining water quality through financial and technical assistance and regulation. Vermont's clean water funding helps municipalities, farmers, landowners, and nonprofit organizations implement projects that will reduce nutrient and sediment pollution from all sectors. Funds from state programs complement and leverage other funding sources to support clean water efforts statewide. Collectively, state funding programs, federal funding programs, and regulatory programs drive clean water efforts in Vermont. All three program categories work together effectively to achieve water quality goals, as illustrated in Figure 4. For example, state funds leverage federal funds, and some funding programs support the cost of regulatory compliance.

Figure 4. Program categories within the scope of Vermont's clean water tracking and reporting.

FEDERAL CLEAN WATER FUNDING

United States Department of Agriculture Natural Resources Conservation Service (UDSA-NRCS) and the Lake Champlain Basin Program (LCBP) provide significant federal funding to clean water projects in Vermont. The results of USDA-NRCS- and LCBP-funded clean water projects are included in this report to show TMDL progress, but federal funding amounts are not included as they are reported elsewhere, and the focus of this report is how state funds are being spent.

The Vermont Clean Water Board and Budget Process

The Clean Water Board was created by Vermont Statute 10 V.S.A. § 1389, and is responsible for planning, coordinating, and financing the remediation, improvement, and protection of the quality of state waters. Composed of representatives from five state agencies and four members of the public, the Board recommends to the Governor an annual Clean Water Budget that is made up of Clean Water Fund, Capital Bill, and American Rescue Plan Act dollars.[7] Once the budget is recommended and approved by the Legislature, the funds are awarded out to multiple state agencies and affiliates that work to address water quality challenges across the different land use sectors.

The Clean Water Budget funds complement and leverage other funding sources to support clean water efforts statewide. The following table summarizes clean water funding programs managed by the State of Vermont included in this report.

Table 1. State of Vermont funding programs reported by state agencies and affiliates.

Agency/Affiliate	Clean Water Funding Programs
Agency of Administration (AoA)	Stormwater Utility Incentive Payments
Agency of Agriculture, Food and Markets (AAFM)	Best Management Practice (BMP) Program Capital Equipment Assistance Program (CEAP) Clean Water Fund Grants and Contracts Clean Water Fund Operational Funds Conservation Reserve Enhancement Program (CREP) Farm Agronomic Practice (FAP) Program Grassed Waterway and Filter Strip (GWFS) Program Pasture Surface Water Fencing (PSWF) Program Water Quality (WQ) Grants Vermont Phosphorus Innovation Challenge (VPIC) Vermont Pay for Performance (VPFP) Program
Agency of Commerce and Community Development (ACCD)	Better Connections Planning Grant Downtown Transportation Fund Vermont Center for Geographic Information (VCGI)
Agency of Natural Resources (ANR)	Clean Water Initiative Program Grants and Contracts Clean Water State Revolving Fund (CWSRF) Loans CWSRF Land Conservation Interim Financing Program Department of Forests Parks and Recreation Fish and Wildlife Department Watershed Grants Municipal Pollution Control Grants
Agency of Transportation (VTrans)	Better Roads Program Municipal Highway Stormwater Mitigation Program Transportation Alternatives Program (TAP)
Vermont Housing and Conservation Board (VHCB)	Conservation Grants Farmland Protection Grants Water Quality Grants
Multi-Agency Programs	American Rescue Plan Act (ARPA) Programs Municipal Roads Grants-in-Aid Program

[7] To learn more, visit the Clean Water Board webpage: https://dec.vermont.gov/water-investment/cwi/board

Act 76 of 2019: Vermont's Clean Water Service Delivery Act

Act 76 of 2019 established a water quality project delivery framework to support Vermont's clean water goals and secured a new long-term funding source for the Clean Water Fund. Act 76 established regional organizations called Clean Water Service Providers (CWSPs) for each tactical planning basin in the Lake Champlain and Lake Memphremagog basins. CWSPs are responsible for partnering with Basin Water Quality Councils to identify, fund, implement, operate, and maintain non-regulatory clean water projects to meet non-regulatory phosphorus reduction targets.

The Act also established four new grant programs to target both non-regulatory and regulatory sources of pollution. The grant programs created under Act 76 are set to start in State Fiscal Year (SFY) 2023 and thus funding associated with these programs will be reported beginning in next year's SFY 2023 report. Data are being collected on the funding and outcomes of these grant programs and DEC will analyze the adequacy of funding levels once sufficient data are collected and reviewed.

The American Rescue Plan Act

The American Rescue Plan Act (ARPA) is part of the federal COVID-19 response to address economic impacts due to the pandemic. The State of Vermont will receive $1.026 billion in ARPA funds to invest in broadband infrastructure, clean water, climate action, housing, and economic development to be encumbered by December 31, 2024 and expended by the end of calendar year 2026. The State Fiscal Year 2022 budget (July 1, 2021–June 30, 2022) allocated nearly $640 million of the ARPA funds to programs and initiatives, including $65 million for climate action and $100 million for clean water initiatives. The Agency of Natural Resources will distribute ARPA funds to support water and wastewater infrastructure programs.[8] A subset the ARPA funding was appropriated to the Clean Water Board and will be distributed (SFY 2022 - SFY 2024) to support several existing clean water programs across multiple state agencies.[9]

[8] Visit the ANR ARPA webpage for more information on types of water and wastewater infrastructure programs: https://anr.vermont.gov/special-topics/arpa-vermont

[9] View approved Clean Water Budget allocations for a full list of ARPA funding distributed by the Clean Water Board on the Clean Water Board's webpage: https://dec.vermont.gov/water-investment/cwi/board

Clean Water Regulatory Programs

Several state regulatory programs are in place to protect, maintain, and restore Vermont's lakes, rivers, and wetlands by establishing land use and management requirements that minimize discharges and runoff to surface waters and mitigate impacts to natural communities. Table 2 summarizes which regulatory programs are included in this report and what programs will be included in the future.

Table 2. Clean water regulatory program results included in this report and planned future additions.

Agency	Included in this Report	Planned Future Additions
Agency of Natural Resources[10]	Operational Stormwater Permits regulating new or redeveloped impervious surface	Transportation Separate Storm Sewer (TS4) Permit
	Municipal Separate Storm Sewer (MS4) Permit	Operational Stormwater Permits regulating sites with more than three acres of existing, unpermitted impervious surface (i.e., "three-acre permit")
	Municipal Roads General Permit (MRGP)	
	Wastewater National Pollutant Discharge Elimination System (NPDES) Permits	
Agency of Agriculture, Food and Markets[11]	Required Agricultural Practices (RAPs) (Phosphorus reduction data on compliance at barnyards/production areas)	RAPs (Phosphorus reduction data on compliance on croplands and pastures)

Report Purpose and Scope

The purpose of the *Vermont Clean Water Initiative 2022 Performance Report* is to summarize the results of the State of Vermont's clean water investments, educational programs, and regulatory programs from State Fiscal Year (SFY) 2016 through 2022 (July 1, 2015–June 30, 2022). The report also summarizes how state funding programs, federal funding programs, and regulatory programs are contributing to progress towards achieving the Lake Champlain and Lake Memphremagog TMDLs.[12]

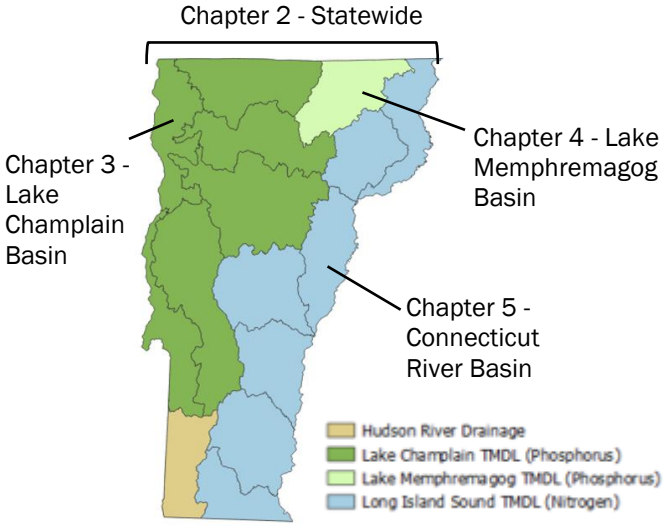


Figure 5. Geographic scope and focus of the Vermont Clean Water Initiative 2022 Performance Report chapters.

This report fulfills state statutory and federal reporting requirements, as outlined on Page 2. The *Vermont Clean Water Initiative 2022 Performance Report* is divided into chapters based on geographic region. The purpose of each geographically focused

[10] For more information on regulatory stormwater programs, visit: https://dec.vermont.gov/watershed/stormwater. For more information on wastewater permits, visit: https://dec.vermont.gov/watershed/wastewater.

[11] For more information on agricultural water quality regulations, visit: https://agriculture.vermont.gov/water-quality/regulations.

[12] The State of Vermont also has numerous small-scale nutrient TMDLs. For example, Lake Carmi in Franklin County also suffers from cyanobacteria blooms, thus the Phosphorus Total Maximum Daily Load for Lake Cami was established in 2009. Since Lake Carmi is located in the Lake Champlain basin, actions to reduce phosphorus pollution in Lake Carmi support both the implementation of the Lake Carmi TMDL and Lake Champlain TMDL. Implementation of large-scale and small-scale TMDLs can support both local and regional water quality priorities.

chapter is to report progress in each of Vermont's major nutrient TMDL watersheds. Figure 5 shows a map of the geographic regions with large-scale nutrient TMDLs and corresponding chapter numbers.[13]

Accountability Measures

Clean water investments and results are presented throughout the report using the following four accountability measures.

Investment measures show how Vermont invests in clean water projects from planning to design and implementation. *State investments* are defined as dollars obligated or awarded to clean water by State of Vermont agencies through grants and contracts or financed through loans. Investments reported include state and federal funding sources awarded to projects by state agencies, but exclude federal funds awarded to projects directly by federal agencies. Funds are assigned to state fiscal years according to grant or contract execution date. When a project is completed, funding is retroactively updated to reflect the final expended amount. State investments are summarized statewide in Chapter 2 and by large-scale watersheds in Chapters 3–5.

Education measures summarize outreach and technical assistance to support, identify, and develop clean water projects. The State of Vermont delivers clean water education through outreach (i.e., workshops, trainings, and public/stakeholder meetings) and technical assistance (i.e., targeted, one-on-one interactions). Hours of education provided are assigned to state fiscal years based on the date of the event. Education measures are summarized statewide in Chapter 2. Education efforts are widespread and can span multiple regions of the state and therefore are not reported in Chapters 3–5.

Project output measures quantify the results of clean water restoration projects. Output measures are standardized across all programs to summarize results of funding and regulatory efforts consistently. This report groups project output measures by land use sector. These results are assigned to a state fiscal year based on the completion date of the project and are only reported on once a project is complete. Project output measures achieved through state investments are summarized statewide in Chapter 2. To view project output measures by supported by other funding and regulatory efforts, and by individual basin, please visit the Clean Water Interactive Dashboard.

Pollutant reduction measures are estimated nutrient load reductions achieved by clean water projects. Pollution reduction estimates are modeled at the individual clean water project level. As measurement of pollutant reductions at the project level through water quality monitoring is not always technically feasible and would be cost-prohibitive at a statewide scale, pollution reduction estimates are instead based on the total pollutant load from the land being treated by a project and the average pollutant reduction efficiency of the project type. Annual pollutant reductions apply throughout the expected lifespan of a project, beginning on the date the project is completed.[14] Pollutant reductions reported herein represent the *delivered loads*, or the pollutant load reduction after accounting for estimated pollutant storage or deposition enroute to the receiving waterbody, rather than the *source load*, or the pollutant reduction from the landscape source which does not account for potential storage or deposition in the watershed.[15] Pollutant reduction measures are summarized statewide in Chapter 2 and by large-scale watershed in Chapter 3 and Chapter 4. At present, total phosphorus load reductions are tracked and reported for the Lake Champlain and Lake Memphremagog basins only.

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[13] Results in the Hudson River drainage basin are included in statewide results reported in Chapter 2 and can be viewed in the Clean Water Interactive Dashboard: https://anrweb.vt.gov/DEC/cleanWaterDashboard/

[14] Additional information on the methods used to estimate pollutant reductions can be found on the Clean Water Tracking and Accounting webpage: https://dec.vermont.gov/water-investment/cwi/projects/tracking-accounting.

[15] Previous publications of the *Vermont Clean Water Initiative Annual Performance Report* presented total phosphorus load reductions in the Lake Champlain basin in terms of source load. Beginning with the *Vermont Clean Water Initiative 2021 Performance Report*, reporting of total phosphorus load reduction was revised to be presented in terms of delivered load to increase the accuracy of progress compared to the TMDL.

Explore Clean Water Project Data with Online Tools

The State of Vermont coordinates across agencies to track clean water efforts in a centralized database known as the Clean Water Reporting Framework. The database is used to compile and summarize project data to produce this report. These data and many online tools are made available to the public through the Clean Water Portal.[16] The Portal's Clean Water Project Explorer allows interested parties to search for and learn details about individual state-funded clean water projects (Figure 6). The Explorer also contains potential projects identified through Tactical Basin Planning. The Portal's Clean Water Interactive Dashboard allows interested parties to examine investment data, project output measures, and pollutant reduction data from this report by watershed and county (Figure 7).

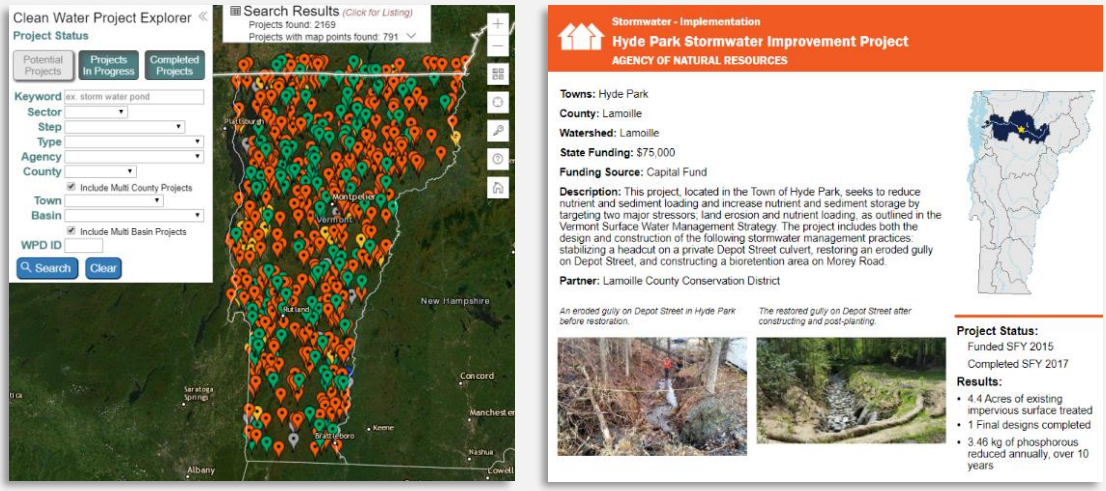

Figure 6. Sample Clean Water Projects Explorer search results (left) and individual project report (right).

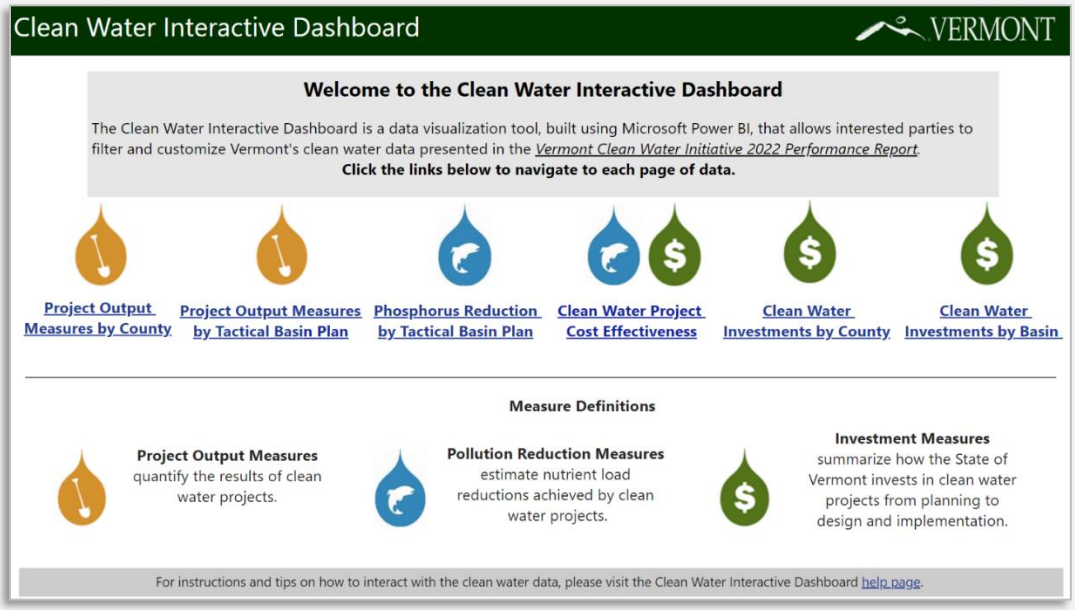

Figure 7. The Clean Water Interactive Dashboard homepage.

[16] The Project Explorer and Clean Water Interactive Dashboard can be accessed via the Clean Water Portal: https://anrweb.vt.gov/DEC/cleanWaterDashboard/.

Chapter 2: Statewide Clean Water Investments & Results

The State of Vermont's clean water investments are channeled through grant, loan, and assistance programs to strategically restore and safeguard the state's rivers, streams, lakes, ponds, and wetlands. These funds are used to help identify and prioritize projects, as well as to design and implement projects. This chapter summarizes state investments awarded to clean water projects by State of Vermont agencies through grants and contracts or financed through loans via state programs.

Vermont's Statewide Clean Water Investments

Click symbol to view description of accountability measures.

State Investments by Land Use Sector

Reaching Vermont's water quality goals requires investments across all land use sectors. The following figure summarizes state clean water investments by land use sector statewide over the past seven state fiscal years, from SFY 2016 to 2022.

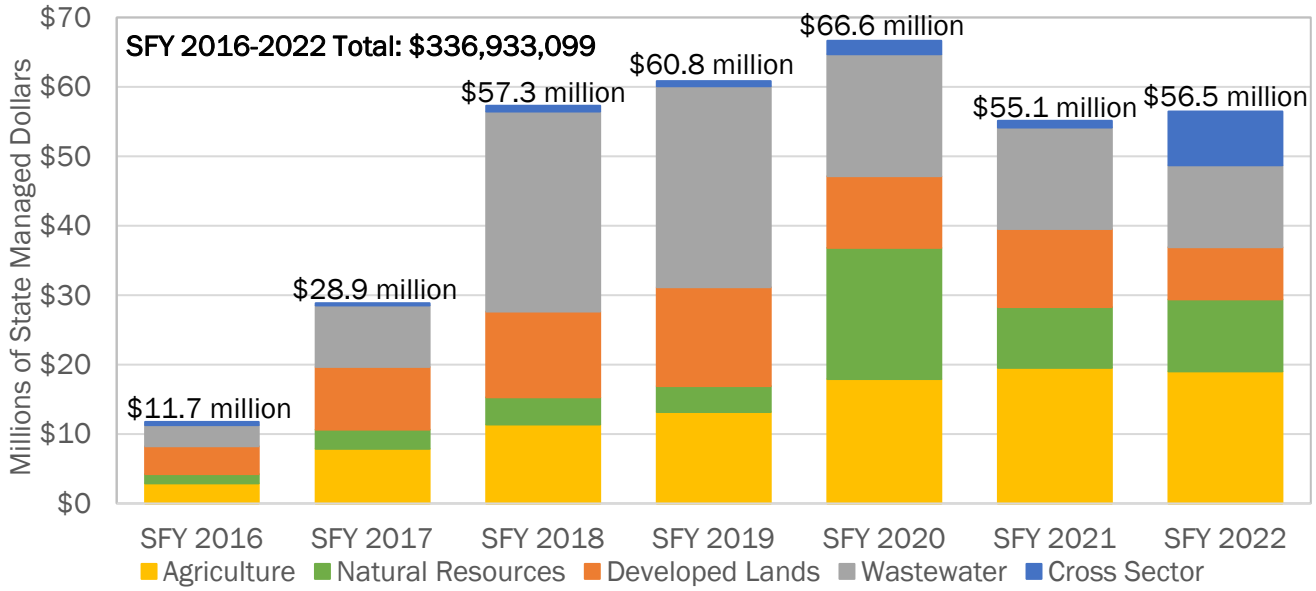

Figure 8. Total dollars awarded by State of Vermont agencies to clean water projects statewide by land use sector, SFY 2016-2022.

EXPLANATION OF FIGURE

The State of Vermont has invested over $336 million in clean water projects statewide from SFY 2016 to 2022. Annual clean water investments have increased significantly since SFY 2016, but funding awarded to projects varies from year-to-year based on project readiness and the timing of awards. In SFY 2021, COVID-19's economic impacts affected Clean Water Fund revenue sources and capacity to administer and implement projects, which led to a slight reduction in appropriation and a temporary slowdown of funding programs. Clean water funding is well-distributed across all land use sectors. Statewide agricultural funding has increased steadily since SFY 2016, and there have been increases in natural resources funding in SFY 2020 and 2021 due to ANR's new Land Conservation Interim Financing Program. The cross-sector funding in SFY 2022 can be attributed to "start-up" funds provided to Clean Water Service Providers as well as several large "multi-sector block grants" awarded to partners to implement projects across multiple sectors. Once the block grants are completed, dollars will be reallocated to the appropriate sector based on the project type.

State Investments by Funding Source

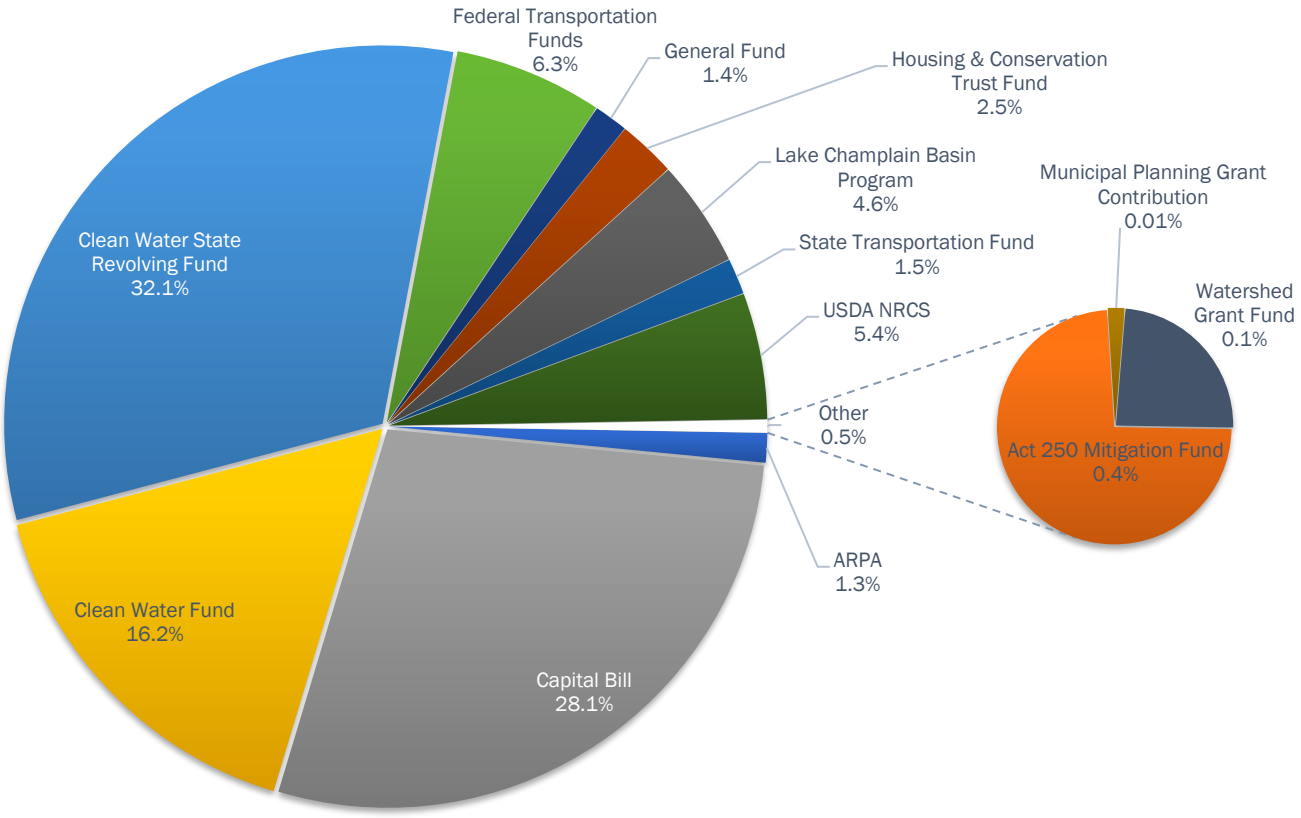

Figure 9. Proportion of dollars awarded to clean water projects through State of Vermont agencies by funding or financing source, SFY 2016–2022.[17]

EXPLANATION OF FIGURE

State agencies' clean water investments are supported by a variety of funding sources. This figure shows the percent of total dollars awarded by state agencies by funding source from SFY 2016 to 2022.

The annual Clean Water Budget is made up of Clean Water Fund and a portion of Capital Bill dollars, comprising about one third of the clean water funding. The Clean Water Board recommends the annual budget, which supports efforts to reduce pollution across all sectors, with representation from five state agency secretaries and four members of the public appointed by the Governor.

Several federal funding sources *administered by state agencies* are considered state investments, including Clean Water State Revolving Fund (CWSRF), Federal Transportation funds, U.S. Department of Agriculture Natural Resources Conservation Service (USDA-NRCS) funds, and Lake Champlain Basin Program funds. USDA-NRCS funds are funneled through the Agricultural Conservation Easement Program, the Vermont State Conservation Innovation Grant, and the USDA Regional Conservation Partnership Program. Direct investments by federal agencies or other organizations are beyond the scope of this report.

[17] Investments reported include state and federal dollars awarded to projects by state agencies, but exclude federal funds awarded directly by federal agencies and the Lake Champlain Basin Program as the focus of this report is state funding.

Leveraged Contributions by Land Use Sector

State-funded clean water projects leverage local and federal contributions to help cover project costs and to further clean water efforts in Vermont. Loans are considered leverage as they are ultimately paid back to the state. The following figure summarizes leveraged contributions from SFY 2016 to 2022 by land use sector.

Click symbol to view description of accountability measures.

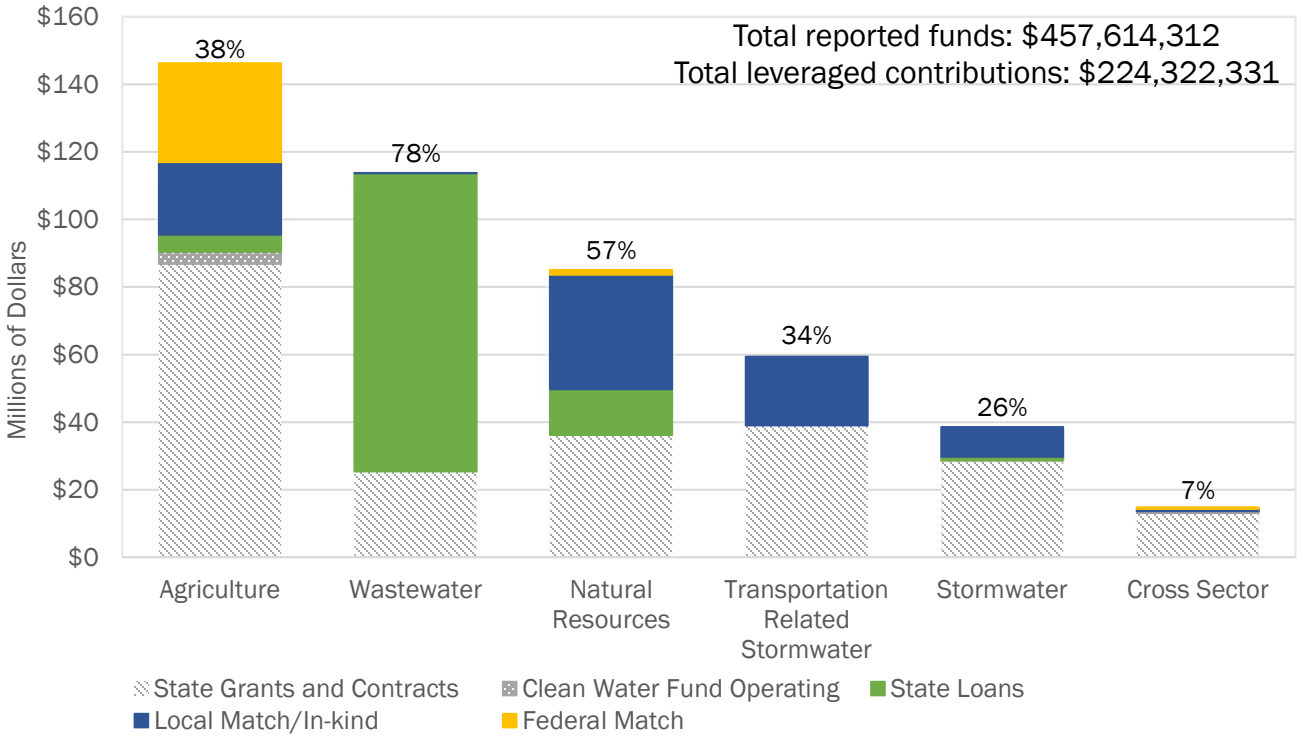

Figure 10. Leveraged contributions (i.e., local match/in-kind, federal match, and loans) reported through State of Vermont agencies in addition to state grants and contracts by land use sector, SFY 2016–2022. Percent represents the proportion of leveraged contributions out of the total reported funds within each sector.

EXPLANATION OF FIGURE

State-funded clean water projects leverage local and federal contributions to help cover project costs and to further clean water efforts. Leveraged contributions (i.e., local match/in-kind, federal match, and loans) since SFY 2016 total $224 million and represent 49 percent of total funds reported SFY 2016 through SFY 2022. Most reported wastewater funds are low-interest loans made to municipalities through the Clean Water State Revolving Fund that will ultimately be paid back to the state (except for some loan subsidies). Match contributions reported here only include local match/in-kind (e.g., private contributions, municipal funds, volunteer labor, etc.) and federal match reported through State of Vermont grants and contracts.

"Clean Water Fund Operating" refers to limited AAFM and ANR personnel funded through the Clean Water Fund to support implementation efforts and is not considered leveraged contribution. This report mainly focuses on passthrough funds administered by state agencies. This represents only a fraction of the substantial staffing costs associated with clean water work. State agency investments in personnel, operating, and monitoring activities are beyond the scope of this report. To further examine leveraged funds, visit the Clean Water Interactive Dashboard: https://anrweb.vt.gov/DEC/CleanWaterDashboard/.

State Investments by Project Step

Click symbol to view description of accountability measures.

Making wise investments in cost-effective clean water projects requires thorough project planning, analysis, design, and implementation. In addition, operation and maintenance of existing projects is important to sustaining project function and clean water outcomes. Investing in the project development process is key to ensuring state investments will yield the greatest water quality improvement per dollar, which includes de-prioritizing lower-value or non-viable projects early in development. The following figure summarizes the percentage of funding awarded to various steps of the clean water project development process during SFY 2016 to 2022.

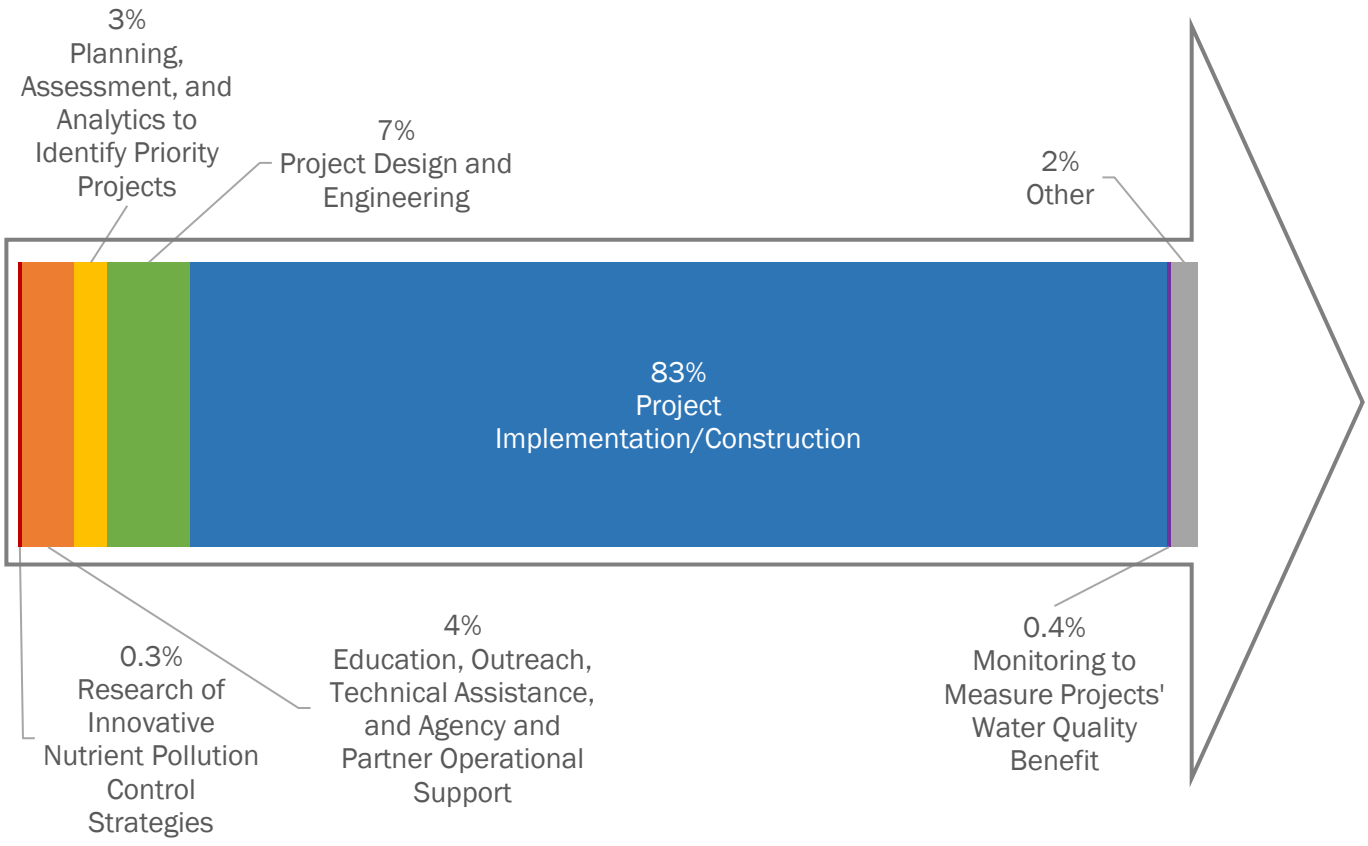

Figure 11. Percentage of dollars awarded by State of Vermont agencies to various steps of the clean water project development process, SFY 2016–2022.

EXPLANATION OF FIGURE

While the state invests in all project steps, over 80 percent of clean water investments are used to construct or implement clean water projects that reduce nutrient and sediment pollution. Approximately 10 percent of clean water investments are used in the planning, design, and engineering phases. The "other" category includes agreements that do not fit squarely into one project step, including multiple block grants issued to partners who will use the money to develop, design, and implement several projects. Once those projects are completed, those dollars may be reallocated to the appropriate step.

State Investments by Watershed

Click symbol to view description of accountability measures.

Each of Vermont's 15 tactical planning basins benefit from state investments in clean water projects. The following figure summarizes state clean water investments from SFY 2016 to 2022 by tactical planning basin.

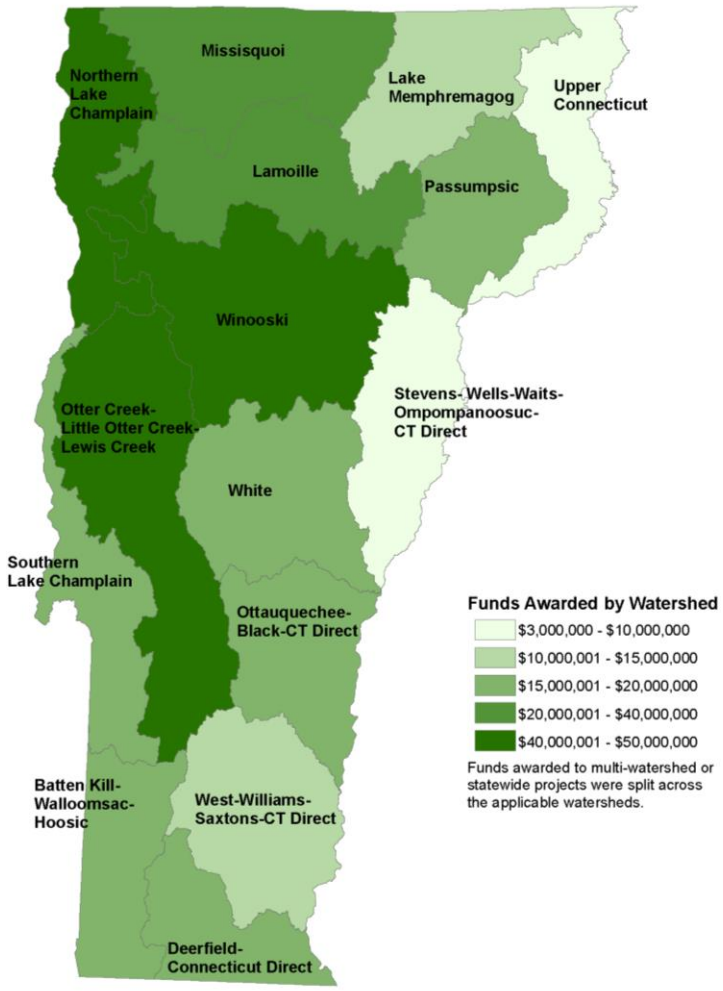

Figure 12. Map of total dollars awarded to clean water projects by State of Vermont agencies by tactical planning basin, SFY 2016–2022.

EXPLANATION OF FIGURE

The Northern Lake Champlain, Winooski River, and Otter Creek/Lewis Creek watersheds received the largest investments since SFY 2016, totaling over $50.3 million, $48.4 million, and $47.5 million, respectively. Investments in the Lake Champlain basin watersheds are high compared to other parts of the state due to the Accountability Framework required under the Lake Champlain TMDL. Significant investments in these basins are largely driven by municipal wastewater treatment and Combined Sewer Overflow (CSO) abatement requirements, as well as municipal stormwater treatment requirements for Vermont's most populous municipalities (i.e., Municipal Separate Storm Sewer System, or "MS4" communities). To further examine funding by watershed, visit the Clean Water Interactive Dashboard: https://anrweb.vt.gov/DEC/CleanWaterDashboard/.

Vermont's Statewide Education, Outreach, and Technical Assistance

Reducing nutrient and sediment pollution sources requires employing sound land management practices which can necessitate changes to our cities and towns, farms, and other natural spaces. Education and outreach related to clean water projects and programs is critical to achieve our water quality goals. The State of Vermont delivers clean water education through **outreach** (i.e., workshops, trainings, and public/stakeholder meetings) and **technical assistance** (i.e., targeted, one-on-one interactions). Clean water education, outreach, and technical assistance aim to:

- Increase public awareness and engagement in establishing and implementing clean water priorities;
- Increase landowner acceptance of new and changing policies and willingness to adopt best management practices;
- Support regulated entities in preparing to meet new regulatory requirements in the most cost-effective manner;
- Support clean water project proponents, including regulated entities, in planning and securing resources to implement clean water projects; and
- Increase adoption and effectiveness of best management practices to improve water quality.

Educational efforts support all land use sectors in planning and securing resources to implement clean water projects. The following section summarizes education, outreach, and technical assistance efforts by land use sectors with differing primary or target audiences.

Table 3. Primary or target audiences of State of Vermont clean water education, outreach, and technical assistance by land use sector.

Land Use Sector	Primary or Target Audiences
	Businesses, farmers, natural resources conservation districts, nongovernmental organizations (e.g., watershed groups), public
	Businesses, municipalities, natural resources conservation districts, nongovernmental organizations (e.g., watershed groups), public, regional planning commissions, residential landowners
	Municipalities, other governmental organizations, public, regional planning commissions, residential landowners
	Businesses, municipalities, public, residential landowners
	Loggers and foresters, natural resources conservation districts, nongovernmental organizations (e.g., watershed groups), other governmental organizations, public, regional planning commissions, residential landowners

Clean Water Outreach by Agency/Organization

Click symbol to view description of accountability measures.

State of Vermont agencies' provide support and funding to partner organizations to conduct outreach. The following figure summarizes the total hours of education provided by outreaching organizations from SFY 2016 to 2022.

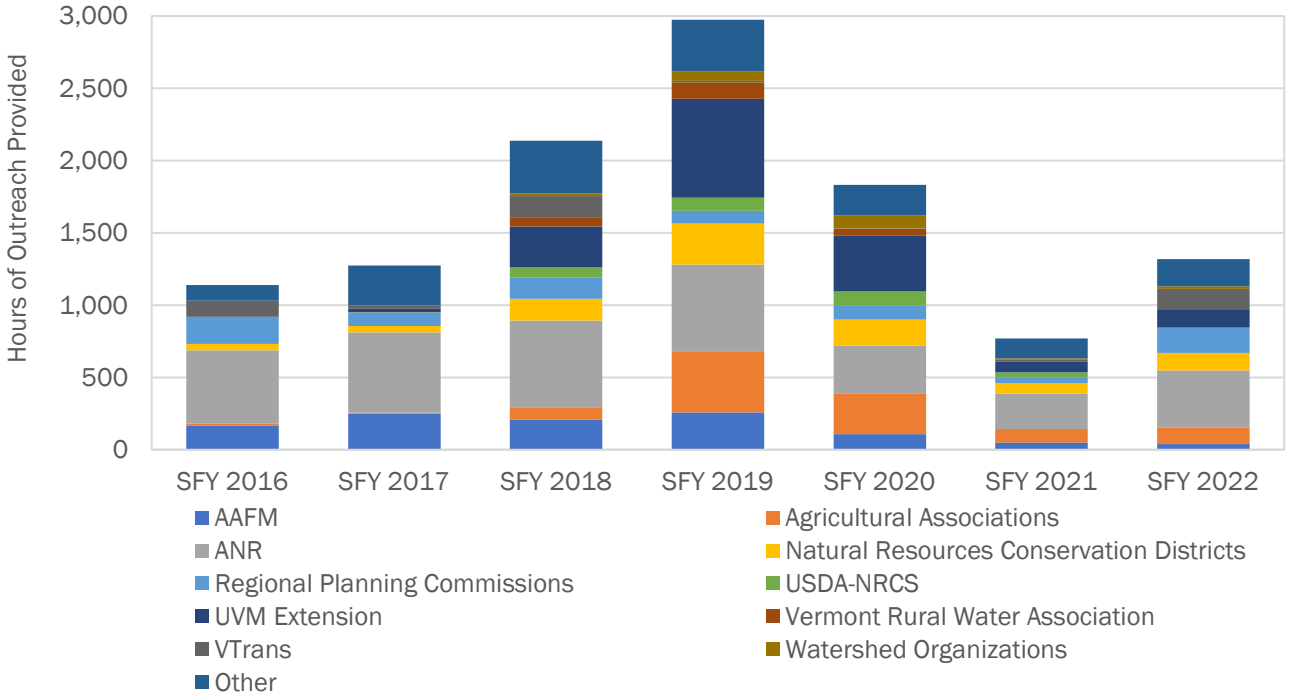

Figure 13. Total hours of education provided to participants of State of Vermont funded clean water outreach events (i.e., workshops, trainings, and public/stakeholder meetings) by outreach organization or organization category, SFY 2016–2022.[18]

EXPLANATION OF FIGURE

In total, 2,803 outreach events have been reported, reaching over 86,200 attendees, with over 324,000 hours of education received by attendees since SFY 2016. In SFY 2020, 2021, and 2022, there was a decrease in the overall number of outreach events reported compared to previous years. This is related to the COVID-19 pandemic limiting in-person outreach. Earlier outreach efforts were critical in the development of foundational programs to drive Vermont's clean water efforts, including the initial phases of implementing the Lake Champlain TMDL and the Vermont Clean Water Act (Act 64 of 2015). Note the entities responsible for reporting outreach efforts are ANR, AAFM, VTrans, and external partners conducting outreach under the scope of a state grant or contract agreement, however many events include multiple outreaching organizations. Outreach that is not directly supported by state funding may not be represented in this data. As a component of implementation of Act 76 of 2019, the state will be rolling out many new trainings for external partners which may result in an increase in the hours of outreach provided in future years.

[18] For presentation purpose, the figure above includes organizations that reported more than 0 hours of education between SFY 2016 and SFY 2022 grouped into the categories above. "Agricultural Associations" include both regional and statewide organizations connecting and supporting the agricultural sector. "Other" includes Eco AmeriCorps, Lake Champlain Basin Program, Lake Champlain Sea Grant, Vermont Housing and Conservation Board, Vermont League of Cities & Towns, and Federation of Vermont Lakes & Ponds.

Clean Water Outreach by Target Audience

Click symbol to view description of accountability measures.

State of Vermont outreach events reach a diverse range of audiences. The following figure summarizes the target audiences reached by State of Vermont funded clean water outreach efforts from SFY 2016 to 2022.

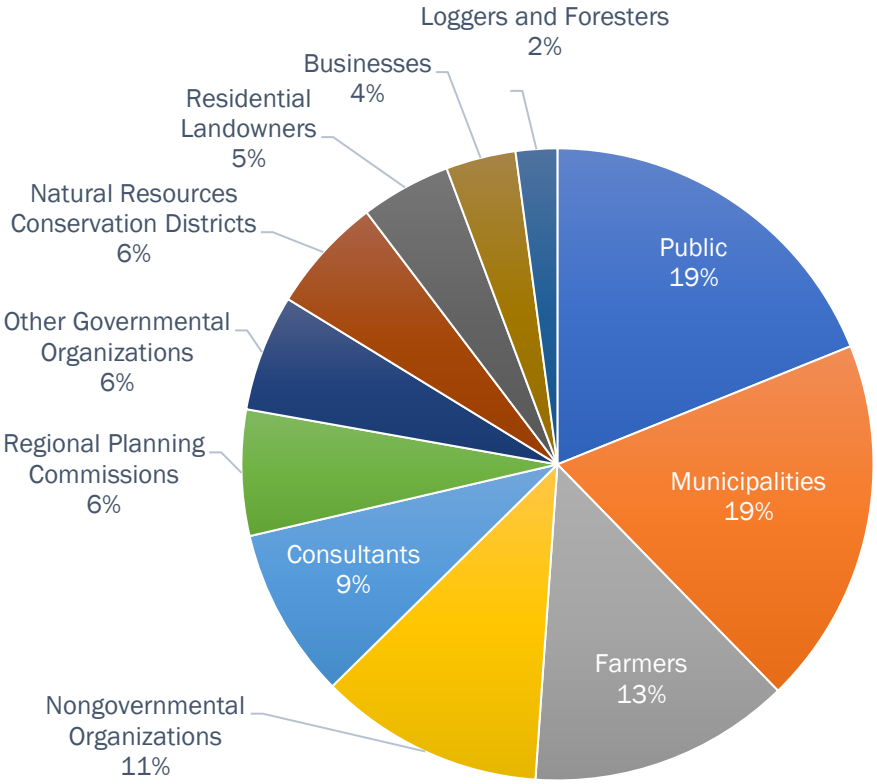

Figure 14. Target audiences reached through State of Vermont clean water outreach efforts (i.e., workshops, trainings, and public/stakeholder meetings), SFY 2016–2022.

EXPLANATION OF FIGURE

The state's outreach efforts target a wide range of different sector- and organization-based audiences. One of the state's water quality priorities is to support municipalities and farmers in addressing stormwater, wastewater, and agricultural sources of nutrient pollution, which is why these audiences represent a large proportion of the target audiences above. In addition, non-governmental organizations, such as watershed groups, regional planning commissions, and natural resources conservation districts, play an important role working with municipalities, farmers, and other landowners to secure funds to implement priority clean water projects. It is also important to keep the public engaged to broaden support of the state's clean water efforts and bolster landowner willingness to adopt and implement voluntary, non-regulatory clean water projects.

Technical Assistance by Land Use Sector

State of Vermont agencies and partners provide technical assistance, in addition to outreach, to regulated and non-regulated audiences who implement clean water projects. While not all technical assistance provided by state agencies can be tracked, the following table summarizes available data on technical assistance efforts by land use sector from SFY 2016 to 2022.

Table 4. State of Vermont technical assistance efforts by sector, SFY 2016–2022.

Measures	2016	2017	2018	2019	2020	2021	2022	Total
Agricultural Technical Assistance Measures								
Number of technical assistance visits conducted by AAFM and partners to support implementation of conservation practices	594	348	592	550	720	908	825	4,537
Number of farms provided technical assistance[19]	32	145	277	245	493	502	469	2,163
Number of water quality compliance farm visits conducted by AAFM to check compliance with Required Agricultural Practices (RAPs) and Medium Farm Operation (MFO) and Large Farm Operation (LFO) Rules	186	352	675	614	571	256	238	2,892
Developed Lands and Wastewater Technical Assistance Measures								
Approximate hours of technical assistance provided by DEC's Water Investment Division engineers on municipal stormwater and wastewater projects	--	5,300	6,400	5,200	3,620	6,232	6,170	32,922
Hours of water quality municipal technical assistance provided by VTrans staff	--	1,483	1,489	2,063	569	397	1,548	7,549
Natural Resources Technical Assistance Measures								
Number of logging operation site visits to provide Acceptable Management Practices (AMP) technical assistance[20]	11	12	17	19	24	16	--	99
Square miles of forest lands covered by Use Value Appraisal (UVA) site inspections[21]	296	330	305	350	112	190	--	1,583
Number of communities receiving Urban and Community Forestry Program technical assistance[22]	94	78	78	102	117	137	129	735

[19] Data collected for FY16–18 is not complete and only reflects farms provided technical assistance from partners.

[20] Data are reported by calendar year rather than state fiscal year. Given the timeline of this report, calendar year 2022 data are not yet available. FPR annual statewide summary reports are available at: https://fpr.vermont.gov/forest/managing-your-woodlands/acceptable-management-practices.

[21] Data are reported by calendar year rather than state fiscal year. Given the timeline of this report, calendar year 2022 data are not yet available.

[22] Data are reported by federal fiscal year (October 1–September 30) rather than state fiscal year.

EXPLANATION OF TABLE

In the agricultural sector, AAFM and partnering organizations have conducted over 4,500 technical assistance visits cumulatively from SFY 2016 to SFY 2022 to support implementation of agricultural conservation practices.

In the developed lands sector, DEC and VTrans staff provide technical assistance to prepare municipalities and other regulated entities to comply with water quality-related regulations. DEC Water Investment Division engineers provided over 32,900 hours of technical assistance on municipal stormwater and wastewater projects from SFY 2016 to 2022, while VTrans staff provided over 7,500 hours of water quality technical assistance to municipalities.

In the natural resources sector, projects are voluntary and not driven by regulation. Education targeting the public and landowners increases likelihood of natural resources restoration projects moving forward. Department of Forests, Parks and Recreation (FPR) staff conducted 99 site visits to provide technical assistance on Acceptable Management Practices at logging operations. The Vermont Urban and Community Forestry Program visited communities over 700 times to provide technical assistance from SFY 2016 to SFY 2022 related to planning and managing urban trees.

Since SFY 2020, some technical assistance efforts have been affected by the COVID-19 pandemic limiting or altering the opportunity for in-person trainings and meetings.

Figure 15. Students and staff from Lyndon Institute and the Village of Lyndonville, Vermont, wrap up a week of urban tree inventory by planting an oak tree on municipal property. With technical and financial assistance from the Vermont Urban and Community Forestry Program, Lyndon is regrowing its downtown tree canopy to provide resilient urban forests for the local community.

Statewide Results of Vermont's Clean Water Investments

Clean water projects target nutrient and sediment pollution across various land use sectors. The following section summarizes the results of state-funded and regulatory clean water projects completed statewide to improve the state's water quality. Some measures have been rounded to the nearest whole numbers for reporting purposes, but totals have been calculated using unrounded numbers.

Statewide Results of Agricultural Pollution Prevention Projects

Agricultural pollution prevention projects involve the installation or application of conservation practices that reduce sources of nutrient and sediment pollution from farm production areas and agricultural fields. The following table summarizes project outputs associated with state-funded agricultural pollution prevention projects.

Click symbol to view description of accountability measures.

Table 5. Outputs of state-funded agricultural pollution prevention projects implemented statewide, SFY 2016–2022.

Project Output Measures[23]	2016	2017	2018	2019	2020	2021	2022	Total
Acres of agricultural conservation practices implemented (excluding practice types listed below)[24]	5,434	3,362	8,126	14,032	25,615	29,435	20,389	106,395
Acres of agricultural forested and filter strip buffers installed	76	67	66	–	–	35	53	296
Acres of pasture with livestock excluded from surface water	258	117	97	47	34	62	111	726
Number of structural agricultural practices installed in barnyard/production areas, fields, and pastures	56	80	92	76	142	122	147	715
Acres of water quality protections within newly conserved agricultural lands	–	116	200	513	276	143	151	1,397
Acres of agricultural land treated through innovative equipment	–	1,452	4,992	13,512	27,565	32,880	15,808	96,210

Table continued on next page

[23] Agricultural project output measures can overlap with other project output measures if multiple practices were applied on the same field. For example, 10 acres of manure injection and 10 acres of cover crop applied on the same field will amount to 20 acres of agricultural conservation practices implemented in reported project outputs. Similarly, practices implemented on the same field over multiple years will be counted for each year implemented. For example, 10 acres of cover crop implemented on the same field in 2016, 2017, and 2018 will amount to 30 acres of agricultural conservation practices implemented in reported project outputs. The total agricultural project outputs column represents the total level of effort of state funding programs, rather than the number of distinct agricultural acres addressed.

[24] Acres of agricultural conservation practices includes aeration, conservation crop rotation, cover crop, crop to hay, grassed waterways, manure injection, conservation tillage, and rotational grazing.

Project Output Measures Supported by State Technical Assistance[25]	2016	2017	2018	2019	2020	2021	2022	Total
Acres of agricultural conservation practices implemented, including acres of agricultural filter strip buffer installed and acres of pasture with livestock excluded from surface water, supported by state-funded technical assistance	105	85	84	1,751	7,317	13,700	8,032	31,075
Agricultural Regulatory Measures	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Total**
Acres of production area inspected by AAFM for RAP compliance[26]	--	1,404	1,034	2,058	2,746	2,618	2,750	12,610

EXPLANATION OF TABLE

The number of agricultural pollution prevention projects implemented statewide has increased significantly since SFY 2016. AAFM's Farm Agronomic Practice (FAP) Program has funded over 106,000 acres of agricultural conservation practices (e.g., cover crops, conservation tillage, and manure injection) since SFY 2016. Equipment funded by the AAFM Capital Equipment Assistance Program, Vermont Housing and Conservation Board, and DEC has resulted in the implementation of over 96,000 acres of agricultural conservation practices since SFY 2017.

AAFM's Best Management Practice Program, Conservation Reserve Enhancement Program, Grassed Waterway and Filter Strip Program, and Pasture and Surface Water Fencing Program have funded over 700 structural field and production area practices since SFY 2016 to reduce runoff from fields and agricultural production areas. Structural practices can include waste storage facilities, roof runoff management, fence, and watering facilities.

While state funds are primarily used to provide direct financial assistance to farmers for the implementation of conservation practices, state funds also provide financial assistance to partners to deliver technical assistance to support farmers in implementing and reporting conservation practices. Technical assistance efforts of partners, such as University of Vermont Extension and Natural Resources Conservation Districts, funded through AAFM programs have resulted in an additional 30,000 acres of agricultural conservation practices implemented outside of direct conservation practice funding programs and over 1,200 acres of pasture with livestock excluded from surface water, among other practices.

[25] Agricultural conservation practices reported through technical assistance represent agricultural conservation practices implemented without direct financial assistance to farmers from state and federal programs. These practices are reported through technical assistance efforts which are funded by state programs.

[26] SFY 2016–2018 datasets are incomplete and do not fully account for all acres of production area inspected by AAFM for RAP compliance due to the initiation of this tracking mechanism.

Figure 16. Grassland Shallow Slot Manure Injection equipment is a very shallow manure injection method which causes a low level of soil disturbance. This application method significantly reduces surface phosphorus application and nutrient loss while increasing efficiency and crop production. This equipment purchase was funded through the Vermont Agency of Agriculture, Food and Markets Water Quality Grants to Partners and Farmers.

Figure 17. The Woodchip Barnyard Replacement project is a cost-effective solution to reduce water quality impacts from existing winter heavy-use areas and contains a drainage layer overlain by woodchips. The drainage system underneath collects and diverts the effluent to a collection system. The top layer of woodchips is replaced each year and can be composted and then field applied along with collected effluent. This project was funded by the Agency of Agriculture, Food and Markets through Water Quality Grants to Partners and Farmers.

Statewide Results of Natural Resources Restoration Projects

Click symbol to view description of accountability measures.

Natural resources restoration projects involve the restoration and protection of natural infrastructure functions that prevent and abate nutrient and sediment pollution. Natural infrastructure includes floodplains, river channels, lakeshores, wetlands, and forest lands. The following table summarizes project outputs associated with state-funded natural resources restoration projects. Project development measures reflect efforts in the identification, prioritization, and design of projects. Project output measures reflect the impact of project implementation/construction.

Table 6. Outputs of state-funded natural resources restoration projects implemented statewide, SFY 2016–2022.

Project Development Measures	2016	2017	2018	2019	2020	2021	2022	Total
Stream miles assessed by Stream Geomorphic Assessment, River Corridor Plan	113	29	72	9	–	59	–	282
Number of natural resources restoration projects identified[27]	125	17	136	316	36	52	–	682
Acres of river corridor scoped for easement	17	14	–	280	–	–	–	311
Number of preliminary (30%) designs completed	10	–	–	22	9	4	11	56
Number of final (100%) designs completed	9	6	24	5	8	10	2	64
Project Output Measures	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Total**
Acres of forested riparian buffer restored through buffer planting	85	32	63	58	13	52	23	327
Acres of floodplain restored	1	2	4	1	32	10	36	86
Acres of lakeshore restored	<1	–	9	1	<1	–	–	11
Stream miles reconnected for restoring rivers to the least erosive condition and regaining fish passage	32	100	124	157	45	39	11	508
Acres of wetland conserved and restored through easements	–	131	44	229	187	235	322	1,148
Acres of riparian corridor conserved and restored through easements	141	208	236	49	291	236	282	1,443
Acres of land conserved with natural resources protections	1,560	3,356	1,554	447	11,688	3,547	3,093	25,244
Miles of forest road drainage and erosion control improvements	–	<1	–	8	3	<1	4	17
Number of stream crossings improved	–	–	1	19	10	4	23	57
Square feet of gully erosion remediated	–	–	50,660	135	305	–	–	51,100

[27] Number of natural resources restoration projects identified includes projects resulting from River Corridor Plans, Stream Geomorphic Assessments, and Lake Watershed Action Plans, as well as projects identified for river corridor easement, riparian buffer planting, dam removal, and wetland restoration.

EXPLANATION OF TABLE

State funds supported over 300 acres of forested riparian (adjacent to waterways) buffer plantings from SFY 2016 to 2022, which capture sediment and pollutant runoff from the landscape and protect streambanks from erosion. State funds have also facilitated the restoration or conservation of over 1,100 wetland acres and 1,400 riparian corridor acres through conservation easements since SFY 2016, supporting water quality, flood resilience, and habitat functions. In addition, state funding and financing has assisted in conserving over 25,000 acres of lands, largely through VHCB conservation grants, as well as the Land Conservation Interim Financing Loan program. Interim financing provides access to capital to act on time-sensitive conservation opportunities and allows partners to secure funds to repay the loan over a five-year period.

From SFY 2016 to 2022, over 500 stream miles have been reconnected by the removal of dams and removal or upgrades of undersized culverts. In addition, there have been 78 acres of floodplain restored or reconnected since SFY 2020, as compared to only eight acres from SFY 2016 to 2019. Reconnecting streams by removing impediments and restoring access to a floodplain allows streams to regain a more natural state of equilibrium, which is the least erosive condition. This allows space for a stream to meander and for floodwaters to spread out and slow down across floodplains, thus removing nutrient and sediment pollution from the stream.

Natural resources restoration projects are voluntary, and results may vary year-to-year depending on landowner willingness to participate and other factors. This highlights the need to continue building partner capacity and outreach to increase participation.

Figure 18. Before (left) and after (right) removal of the Camp Wihakowi dam. Removal of this 100-foot-long concrete dam reconnected 26 stream miles of the Bull Run, a tributary to the Dog River in Northfield, Vermont. The removal was funded by the Department of Environmental Conservation in partnership with Friends of the Winooski River and completed October 2021.

Statewide Results of Developed Lands Projects

Click symbol to view description of accountability measures.

Developed lands projects mitigate erosion and treat polluted stormwater runoff containing nutrient (e.g., phosphorus and nitrogen) and sediment pollution from impervious surfaces. Stormwater treatment practices capture and treat flow from parking lots, sidewalks, and rooftops, while road improvement projects reduce erosion and mitigate pollutants from road-related sources. The following table summarizes project outputs associated with state-funded and regulatory developed lands projects. Project development measures reflect efforts in the identification, prioritization, and design of projects. Project output measures reflect the impact of project implementation/construction. Regulatory measures are reported through regulatory programs and are not tied to state funding programs. State and federal programs may provide funding to support projects designed to satisfy regulatory requirements.

Table 7. Outputs of stormwater treatment and road erosion remediation projects implemented statewide, reported through state funding programs or regulatory programs, SFY 2016–2022.

Project Development Measures	2016	2017	2018	2019	2020	2021	2022	Total
Number of projects identified through Stormwater Master Plans	52	120	141	128	197	115	109	862
Number of illicit/unauthorized discharges confirmed (to be addressed by the responsible municipality or landowner)	40	9	1	52	14	6	–	122
Number of preliminary (30%) designs completed	19	13	58	30	67	40	15	242
Number of final (100%) designs completed	9	20	13	20	36	8	4	110
Project Output Measures	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Total**
Acres of existing impervious surface treated by stormwater treatment practices	<1	87	34	135	198	12	41	507
Miles of municipal road drainage and erosion control improvements	1	13	62	88	49	54	76	343
Number of municipal road drainage and stream culverts replaced	–	101	110	234	175	183	95	898
Cubic yards of Class 4 road gully erosion remediated	–	–	260	33	–	5	–	299
Cubic yards of catch basin outlet erosion remediated	–	–	1	784	22	2	–	810
Acres stabilized through use of seeding/mulching equipment per year	–	–	19	98	248	166	40	571

Table continued on next page

Regulatory Measures	2016	2017	2018	2019	2020	2021	2022	Total
Acres of existing impervious surface treated by stormwater treatment practices under stormwater permits	7	34	97	153	90	36	92	509
Acres of new impervious surface treated by stormwater treatment practices under stormwater permits	–	–	249	237	142	111	110	850
Hydrologically connected municipal road miles inventoried[28]	11	814	1,655	1,463	1,169	737	91	5,938
Hydrologically connected municipal road miles identified as requiring water quality improvements	5	279	675	561	599	361	40	2,520

EXPLANATION OF TABLE

Stormwater Master Planning has resulted in the identification and prioritization of over 850 stormwater projects since SFY 2016. State-funded stormwater treatment practices have treated over 500 acres of existing impervious surfaces since SFY 2016; some projects were voluntary, and others were compelled by stormwater regulations.

From SFY 2016 to 2022, the Municipal Roads Grants-in-Aid Program and VTrans Better Roads Program have resulted in nearly 350 miles of municipal road drainage and erosion control improvements and replaced nearly 900 municipal road drainage and stream culverts to improve road runoff for water quality.

Operational stormwater permits require treatment of runoff from new development or redevelopment of a certain size and are not funded with state dollars. In addition, Municipal Separate Storm Sewer System (MS4) Permits require designated urbanized communities to manage stormwater discharges from those areas. MS4 communities can receive partial funding and/or loan financing for the implementation of MS4 projects that address existing untreated or under-treated impervious surface. Since SFY 2016, more than 800 acres of new, and 500 acres of existing impervious have been permitted and require treatment to the state standards. See Appendix C for more information on stormwater permit outputs.

To comply with the Municipal Roads General Permit (MRGP), municipalities were required to submit Road Erosion Inventories (REIs) by the end of 2020. The number of hydrologically connected (i.e., road segments adjacent to or intersecting surface waters) municipal road miles inventoried in each state fiscal year illustrates that permit compliance deadline, with the majority of road miles inventoried between SFY 2017–2021. REIs have covered almost 6,000 hydrologically connected municipal road miles, of which approximately 42 percent were identified as requiring water quality improvements. Vermont has approximately 6,500 miles of roads that fall under MRGP jurisdiction, indicating that inventories completed and submitted through the close of SFY 2022 represent about 92 percent of required inventories.

[28] Note that state funding programs supported the implementation of required Road Erosion Inventories (REIs). REI data come directly from the MRGP database.

Figure 19. This constructed wetland before (left) and after (below) was installed along a right of way in Shelburne, Vermont and provides stormwater treatment for approximately 39 acres of impervious surfaces including two sections of Shelburne Road. This stormwater treatment practice was completed in May of 2021.

Statewide Results of Wastewater Treatment Projects

Click symbol to view description of accountability measures.

Wastewater treatment projects decrease nutrients (e.g., phosphorus and nitrogen) and other pollutants from municipal wastewater systems through treatment upgrades, combined sewer overflow (CSO) abatement, and refurbishment of aging infrastructure. The following table summarizes project outputs associated with state-funded wastewater treatment projects. Project development measures reflect efforts in the identification, prioritization, and design of projects. Project output measures reflect the impact of project implementation/construction.

Table 8. Outputs of state-funded wastewater treatment projects implemented statewide, SFY 2016–2022.

Project Development Measures	2016	2017	2018	2019	2020	2021	2022	Total
Number of preliminary (30%) designs completed	1	4	4	7	7	7	6	36
Number of final (100%) designs completed	4	4	8	2	2	3	7	30
Number of municipal wastewater asset management plans completed	–	2	4	4	–	–	–	10
Project Output Measures	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**Total**
Number of combined sewer overflow abatements completed[29]	2	–	–	1	2	–	1	6
Number of sewer extensions completed	–	1	–	–	–	–	–	1
Number of wastewater collection systems refurbished	–	1	1	2	2	3	5	14
Number of wastewater treatment facilities refurbished	–	–	–	2	5	3	2	12
Number of wastewater treatment facility upgrades completed	1	4	1	–	–	3	–	9

EXPLANATION OF TABLE

Projects to refurbish or upgrade wastewater systems increased in SFY 2021 and 2022, approximately doubling the number of completed projects since SFY 2016. Municipal wastewater improvement projects are very large and take a long time to complete so results can vary widely year-to-year. Some projects improve treatment within facilities while others may extend sewer service area to address failed or failing septic systems in designated centers. State grants and low interest loans capitalized through the Vermont and U.S. Environmental Protection Agency (EPA) Clean Water State Revolving Fund (CWSRF) finance municipal wastewater improvements.

Figure 20. A wastewater disposal mound is a soil absorption system placed above the natural surface of the ground. The town of Addison installed a community wastewater disposal mound system to treat municipal waste in June 2019. The project was financed by the Clean Water State Revolving fund.

[29] Combined sewer overflows (CSOs) may require multiple abatement projects in order to achieve water quality standards or eliminate any potential discharge from the CSOs.

Estimated Total Phosphorus Load Reductions of State Investments

Click symbol to view description of accountability measures.

The State of Vermont estimates pollutant reductions associated with clean water projects to track progress towards achieving water quality goals. Currently, phosphorus reductions can only be estimated in the Lake Champlain and Lake Memphremagog basins.[30] Phosphorus reductions are summarized for Lake Champlain in Chapter 3 and for Lake Memphremagog in Chapter 4. The following figure summarizes the estimated phosphorus reductions associated with state-funded clean water projects, by land use sector, in both the Lake Champlain and Lake Memphremagog basins.[31]

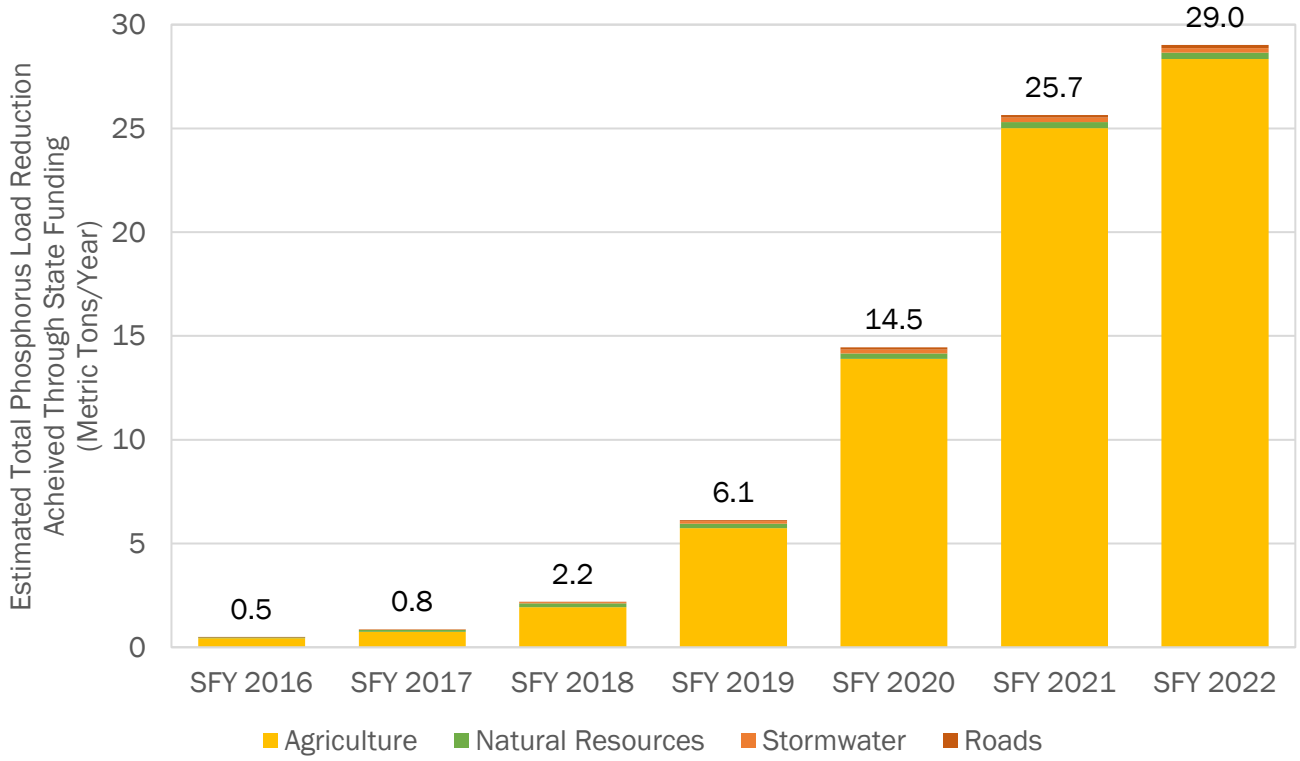

Figure 21. Annual estimated total phosphorus load reductions (metric tons per year) associated with state-funded clean water projects in the Lake Champlain and Lake Memphremagog basins by land use sector, SFY 2016–2022.[32]

[30] For more information on the methods used to estimate phosphorus reductions: https://dec.vermont.gov/water-investment/cwi/projects/tracking-accounting.

[31] Phosphorus reduction estimates are presented in delivered load. For more information, see the Accountability Measures section.

[32] Note that phosphorus reductions from state regulatory programs (e.g., production area compliance and operational stormwater permits) are not included here in order to illustrate the impact of state funding programs. However, note that some projects are installed with state funding to meet regulatory requirements (e.g., road improvements under the Municipal Roads General Permit) and these projects are included.

EXPLANATION OF FIGURE

State funding programs are estimated to have reduced approximately 29 metric tons of total phosphorus loading to Lake Champlain and Lake Memphremagog combined in SFY 2022. Over 96 percent of the estimated reductions reported at this time are in the agricultural sector. Since SFY 2016, 88 percent of all state-funded phosphorus reductions reported have been achieved through the implementation of agricultural practices that have a one-year lifespan (e.g., cover crop, conservation tillage, manure injection, etc.). If this level of effort is not maintained each year, the phosphorus reductions will not carry through to future years. Structural projects, such as stormwater treatment practices or forested riparian buffers, in contrast, have longer term lifespans (at least 10-20 years or more if properly maintained) and phosphorus reductions achieved by these projects will continue in future years.

Estimated phosphorus reductions are expected to increase in the coming years for at least the following reasons:

1. An influx in federal funding under ARPA and the Bipartisan Infrastructure Law, expansion of existing programs supported by increased Clean Water Fund revenue enacted under Act 76 of 2019, and investments to grow collective capacity are expected to result in an increase in project implementation across sectors.
2. The State has recently published methods for quantifying phosphorus reductions for agricultural, natural resource, and developed lands sector clean water practices. However, new methods were established for some practices, particularly in the natural resource sector, and cannot be fully implemented as data collection mechanisms are not yet in place. Collection of data required to estimate phosphorus reductions under these new methods will begin in the coming year.
3. Many state funding programs at DEC have shifted to block grant structures that rely on regional partners to manage and administer funding of individual projects. The transition to regional administration of clean water funding is anticipated to empower community partners, reduce bottlenecks, and increase the impact of clean water investments.

Cost Effectiveness of State Clean Water Investments

The previous section of this report summarizes the results of state-funded clean water projects completed from SFY 2016 to SFY 2022. Given the significant costs of restoring and protecting water quality, the state must spend its resources efficiently and effectively. The cost effectiveness of clean water projects is expressed as the state dollars per kilogram of estimated total phosphorus load reduction over the anticipated lifespan of the project.[33] If projects are maintained beyond their anticipated lifespan, cost effectiveness estimates would improve. Cost effectiveness can only be calculated for project types where estimated total phosphorus load reductions and cost data are available at the project level. Local and federal leveraged funds associated with state-funded projects are not included in the calculation of state-funded cost effectiveness. Refer to the Clean Water Interactive Dashboard for information on cost effectiveness including leveraged funds.[34] The figure below summarizes the cost effectiveness of state clean water investments in reducing phosphorus pollution by sector.

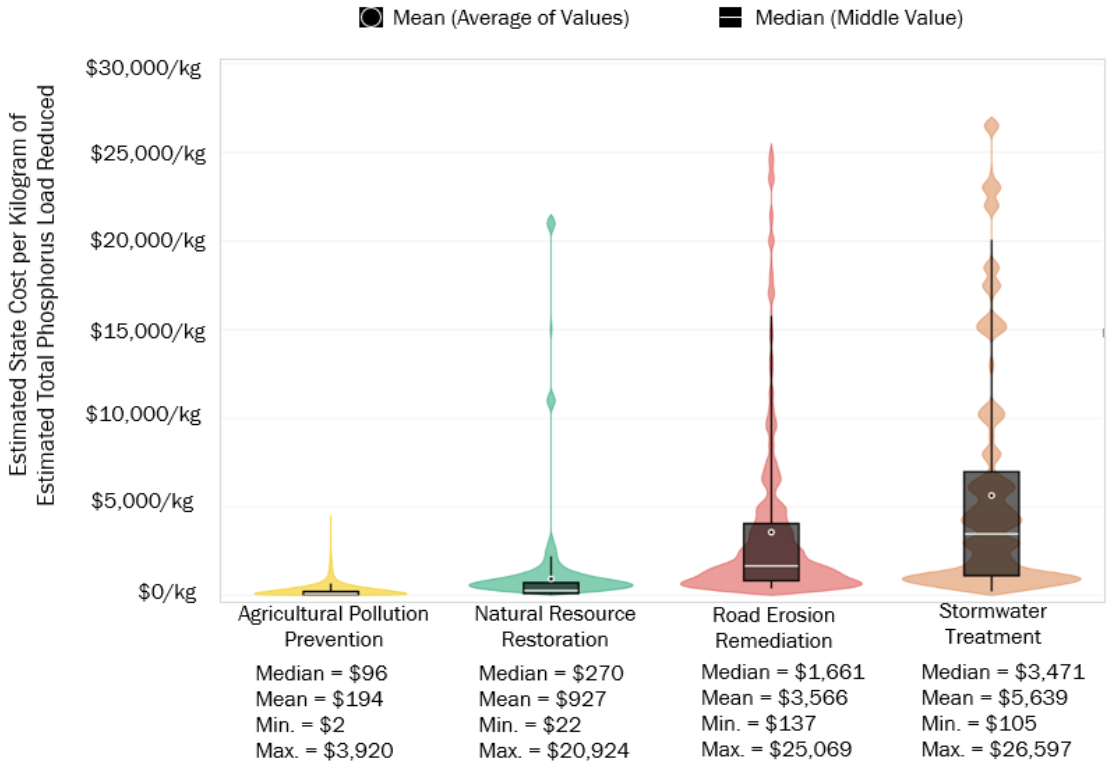

FIGURE GUIDE

The violin plots, pictured below, combine a box plot (see black rectangles/lines) and a density plot (see colored shapes).

A box plot shows the minimum, maximum, median, and average cost effectiveness values.

A density plot shows the relative number of projects falling into each range of cost effectiveness. Wider sections of the colored shapes represent more projects than thinner sections.

Figure 22. State investment per estimated kilogram of total phosphorus load reduced over the design life of each project type, based on clean water projects funded through State of Vermont agencies completed SFY 2016–2022 (excludes local and federal leveraged funds).[35]

[33] Phosphorus reduction estimates are presented in delivered load. For more information, see the Accountability Measures section.

[34] Access the Clean Water Interactive Dashboard here: https://anrweb.vt.gov/DEC/cleanWaterDashboard/.

[35] Note that 17 road and stormwater projects with cost effectiveness greater than $30,000/kg were removed from this analysis due to some project costs being associated with project components not related to phosphorus reductions (e.g., stream culvert upgrades). Agricultural pollution prevention cost effectiveness data does not include SFY 2022 due to a temporary change in data reporting.

EXPLANATION OF FIGURE

Achieving Vermont's water quality goals requires action across all land use sectors. The key is to target funds to the most cost-effective projects within each land use sector. The State of Vermont employs science-based assessments to identify and prioritize projects and incorporates those prioritized actions in Tactical Basin Plans. The figure above shows the variation and distribution of cost effectiveness across four sectors. The cost effectiveness calculation is *only* feasible for projects where cost data and estimated total phosphorus load reductions are available at the project level.

Agricultural pollution prevention practices (e.g., cover crops, conservation tillage, and agricultural riparian buffers) are generally the most cost-effective at reducing total phosphorus loading, costing a median of $96 of state investment per kilogram of estimated total phosphorus load reduced annually. However, agricultural field and pasture practices generally have a short lifespan, often one year, whereas practices in other sectors tend to have longer, 10 to 20-year, lifespans.

Natural resources restoration projects (currently only includes forested riparian buffers due to availability of phosphorus reduction estimates at project-level), are also generally cost-effective practices, costing a median of $270 of state investment per kilogram of estimated total phosphorus load reduced annually. Forested riparian buffers have a 10 to 20-year lifespan, which result in more sustained phosphorus reduction, as compared to most annual agricultural field and pasture projects. Note that riparian buffers on agricultural lands are included under agricultural pollution prevention practices, while buffers planted on all other land uses are considered natural resources restoration projects. The state will account for pollutant reductions in other natural resources projects, such as floodplain and streambank restoration, in future years.

Road erosion remediation projects have a high variability in cost effectiveness, ranging from approximately $137 to $25,069 of state investment per kilogram of estimated total phosphorus load reduced annually. Despite the large range, most road projects are clustered near the median of $1,661 of state investment per kilogram of estimated total phosphorus load reduced annually. The large range in the cost effectiveness of road practices may be a result of municipalities remediating the highest priority, most complex road segments (and therefore most expensive road segments) first to comply with the Municipal Roads General Permit (MRGP). Additionally, road project costs and complexity can vary based on what practices need to be installed to bring a road segment up to MRGP standards.

Stormwater treatment is most expensive per unit phosphorus load reduced compared to other project types shown in the figure, costing a median of $3,471 of state investment per kilogram of estimated total phosphorus load reduced annually. Stormwater practices are generally engineered structural practices that can incur high construction costs, but these practices have relatively long lifespans and can achieve phosphorus load reductions for 20 years or more, if properly maintained. Incorporating stormwater treatment into an already developed landscape is necessary but could be somewhat expensive due to inherent site constraints. This points to the importance of integrating stormwater mitigation as part of new development and redevelopment moving forward.

The following project types are not included in the cost effectiveness analysis:

- Wastewater treatment is not included, as reductions are not measured at the project level.
- Agricultural barnyard and production area management projects are not included, as estimated total phosphorus load reductions from agricultural barnyard and production area management are estimated based on compliance status for the whole production area and not at the individual project level.
- Capital Assistance Equipment Program-funded agricultural equipment is not included because state cost data are associated directly with equipment purchases rather than cost of implementing practices.
- Agricultural practices implemented without financial assistance from AAFM but tracked through state-funded technical assistance are also not included here because the cost data are associated with technical assistance activities rather than cost of implementing practices.

Chapter 3: Clean Water Investments and TMDL Progress in the Lake Champlain Basin

Lake Champlain TMDL

Lake Champlain is one of the largest lakes in North America and its watershed drains nearly half the land area of Vermont, as well as portions of northeastern New York and southern Québec. Phosphorus levels in some portions of Lake Champlain regularly exceed Vermont's water quality standards, which contributes to cyanobacteria blooms, low dissolved oxygen concentration, impaired aquatic life, and reduced recreational use. The Lake Champlain restoration plan, titled *Phosphorus Total Maximum Daily Loads for Vermont Segments of Lake Champlain* (i.e., Lake Champlain TMDL), identifies phosphorus load reductions that must be achieved in all 12 segments of Lake Champlain to meet State of Vermont water quality standards.[36] Total phosphorus loading to Lake Champlain from Vermont was modeled to be 631 metric tons per year during the TMDL baseline period of 2001 to 2010. The TMDL states total phosphorus loading to the lake must be reduced to 418 metric tons per year by the end of calendar year 2036 to achieve Vermont's water quality standards, a 212 metric ton reduction from the baseline.

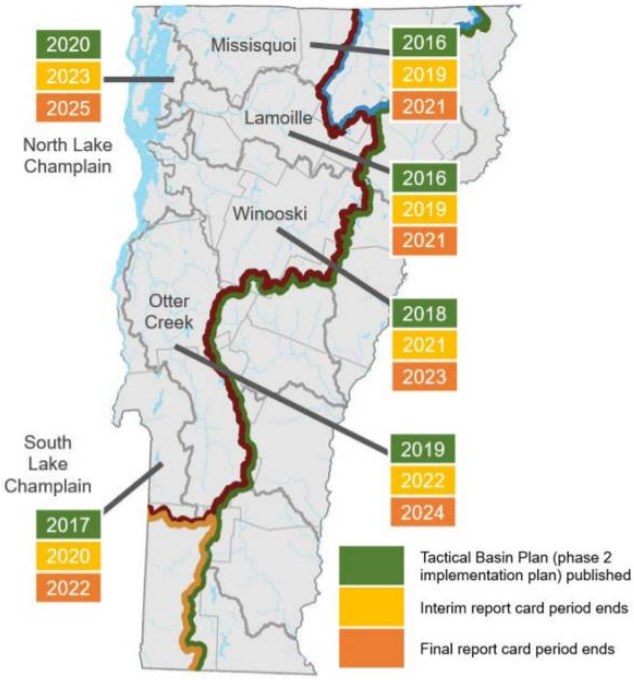

Figure 23. Lake Champlain TMDL Accountability Framework schedule by Tactical Basin Plan watershed.

The Lake Champlain TMDL contains an Accountability Framework intended to ensure adequate progress toward reducing phosphorus pollution to Lake Champlain. The Framework sets a schedule for U.S. Environmental Protection Agency (EPA) to issue report cards on the State of Vermont's progress throughout the 20-year implementation timeframe (2016-2036). Tactical Basin Plans are updated on a five-year rotating basis and include Implementation Tables with priority actions to implement the Lake Champlain TMDL. EPA issues interim report cards halfway through the five-year planning cycle and final report cards at the end of the five-year planning cycle based on progress reports produced by DEC (Figure 23).[37] EPA uses this chapter of the *Clean Water Initiative Annual Performance Report* and its appendices to help determine satisfactory progress for the Lake Champlain TMDL. The following progress reports for the 2022 reporting cycle are included in Appendices A and B respectively: South Lake Champlain (Basins 2 & 4) final progress report and Otter Creek (Basin 3) interim progress report.

[36] *Phosphorus Total Maximum Daily Loads for Vermont Segments of Lake Champlain* available at: https://dec.vermont.gov/watershed/restoring/champlain.

[37] Additional Lake Champlain TMDL Implementation Progress Report information available at: https://www.epa.gov/tmdl/tmdl-implementation-progress-reports-epa-report-cards-and-related-correspondence-between-epa.

The following section of the report summarizes the state, federal, and regulatory clean water efforts in the Lake Champlain basin that are contributing to Lake Champlain TMDL progress. This section also summarizes high-level information on the health of Lake Champlain, as originally reported in the Lake Champlain Basin Program's *2021 State of the Lake Report*. For more information on the variables that effect realized water quality conditions in Lake Champlain, see Chapter 6 of the *Clean Water Initiative 2021 Performance Report*.

Vermont's Clean Water Investments in the Lake Champlain Basin

Click symbol to view description of accountability measures.

Reaching Lake Champlain's water quality goals requires investments across all land use sectors. The following figure summarizes state investment plus direct Lake Champlain Basin Program investments in the Lake Champlain basin from SFY 2016 to 2022.

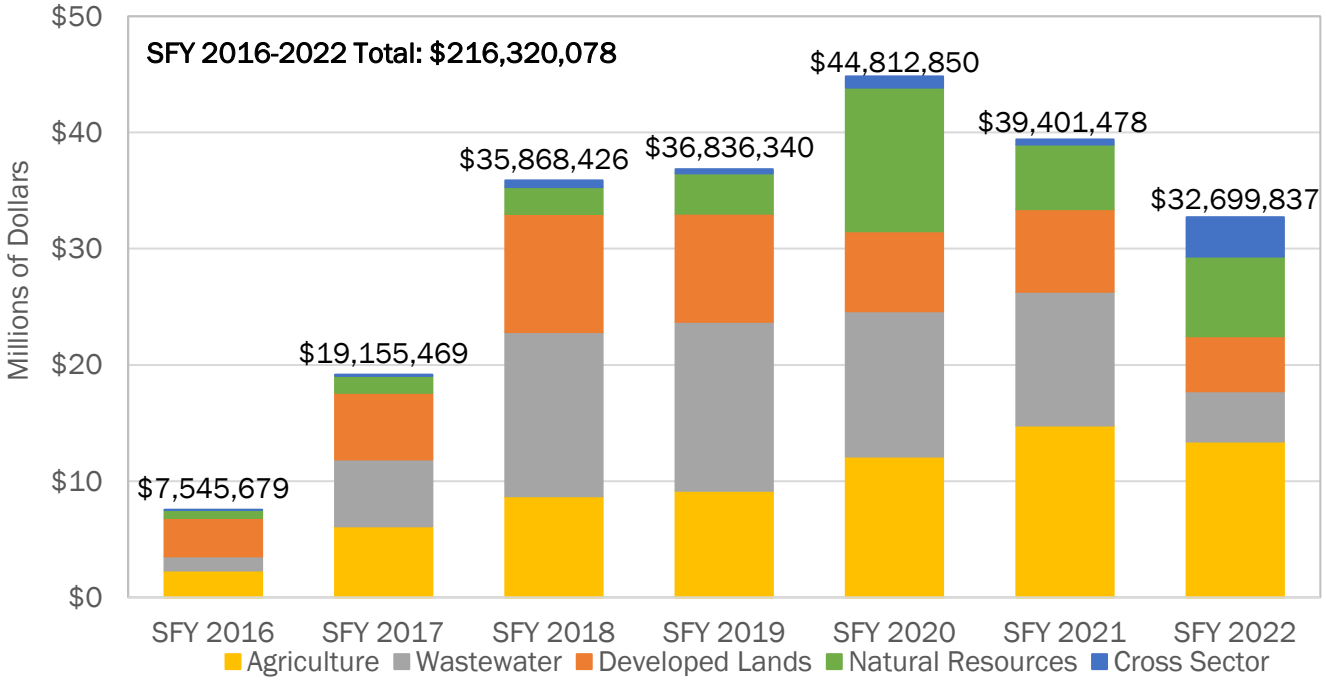

Figure 24. Total dollars awarded by State of Vermont agencies and Lake Champlain Basin Program to clean water projects in the Lake Champlain basin by land use sector, SFY 2016–2022. Note federal funding data from USDA NRCS are not included in this figure.

EXPLANATION OF FIGURE

The State of Vermont and Lake Champlain Basin Program have invested over $216 million in clean water projects in the Lake Champlain basin over the past 7 years. Funding is well distributed across land use sectors, with sectors averaging the following percentages of total funding: Agriculture = 31%, Natural Resources = 14%, Wastewater = 28%, Developed Lands = 25%, and Cross Sector = 2%.

Clean water funding awarded to projects varies from year-to-year based on project readiness and capacity to administer and implement projects. However, the COVID-19 pandemic's impact on the economy affected Clean Water Fund revenue sources in SFY 2021. This led to a slight reduction in appropriation and a temporary slowdown of funding programs. Funding and financing in the wastewater sector is variable from year-to-year as large infrastructure projects are contingent on demand from municipalities and projects tend to have substantially higher construction costs relative to other phases.

Click symbol to view description of accountability measures.

Estimated Total Phosphorus Load Reductions in Lake Champlain Basin

The State of Vermont estimates the pollutant load reductions associated with clean water projects to track progress towards achieving water quality goals. The following figure summarizes the estimated total phosphorus load reductions associated with state, federal, and regulatory projects in the Lake Champlain basin from SFY 2016 to 2022 by sector.[38]

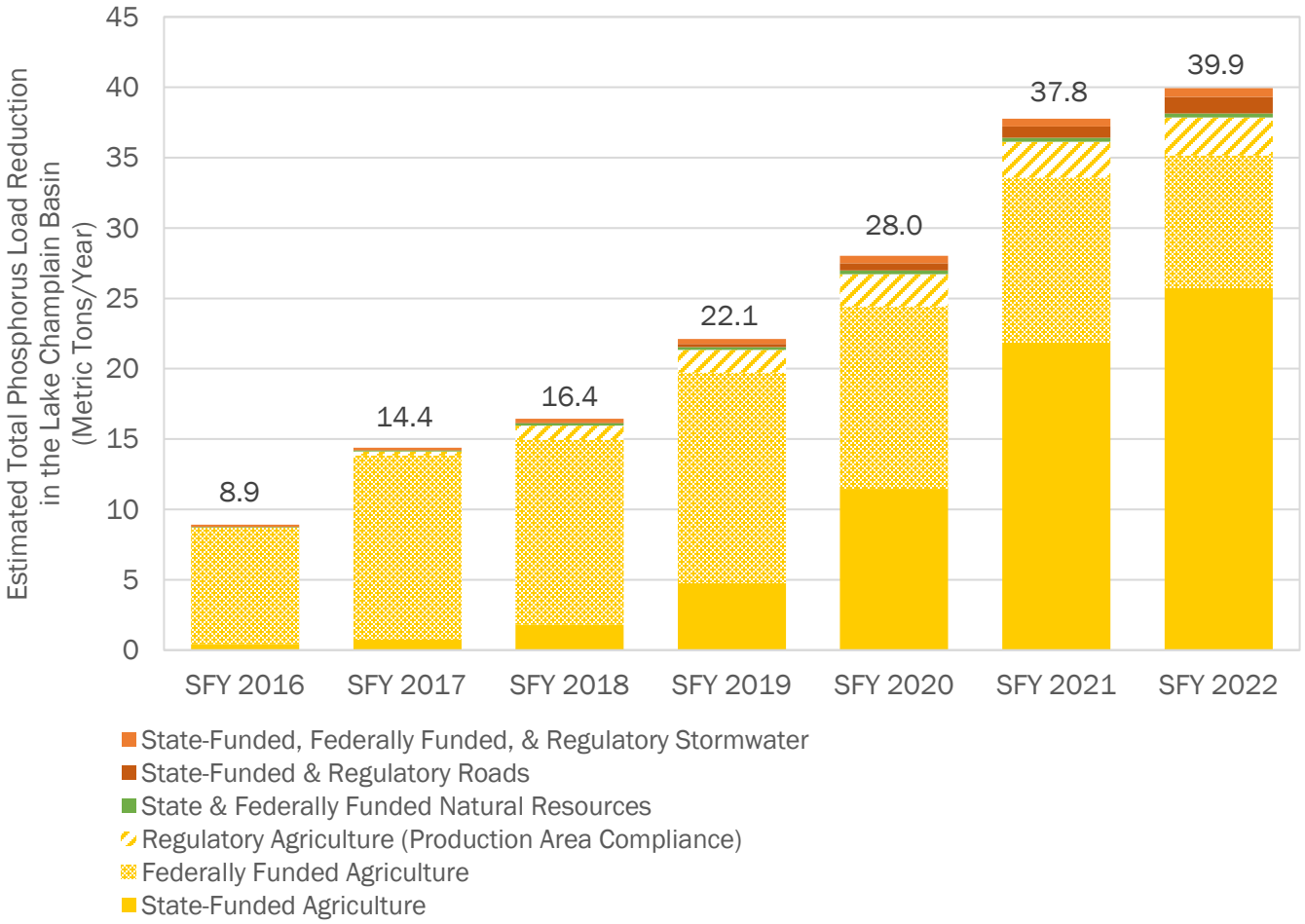

Figure 25. Annual estimated total phosphorus load reductions (metric tons per year) associated with state, federal, and regulatory clean water projects in the Lake Champlain basin in effect during SFY 2016–2022 by land use sector and program category.[39]

[38] Phosphorus reduction estimates are presented in delivered load. For more information, see the Accountability Measures section.

[39] Annual phosphorus load reductions are cumulative for all completed/operational projects based on start date and anticipated lifespan. Results of USDA-NRCS funded projects completed since SFY 2010 that are still in effect SFY 2016–2022 are included to represent progress since the Lake Champlain TMDL baseline period.

EXPLANATION OF FIGURE

State funding programs, federal funding programs, and regulatory programs in the Lake Champlain basin are estimated to have reduced approximately **39.9 metric tons** of phosphorus loading to Lake Champlain in SFY 2022. Seventy-six percent of total reductions resulted from state funding and regulatory programs in SFY 2022. Approximately 96 percent of all estimated phosphorus reductions since SFY 2016 are attributed to agricultural projects because

1. Agricultural conservation practices are highly cost-effective at reducing phosphorus loading;
2. Substantial federal funds leveraged through the USDA-NRCS layer on top of state funds to support this work; and
3. Methods are currently in place to estimate phosphorus load reductions associated with most types of agricultural conservation practices, while methods to estimate phosphorus reductions for many practices in other sectors are not yet fully implemented.

It is important to note that between 65–70 percent of estimated agricultural phosphorus reductions in the Lake Champlain basin each year were associated with practices with a one-year lifespan (e.g., cover crop and manure injection). If this level of effort is not maintained each year, the phosphorus reductions will not carry through to future years. In contrast, structural projects, such as stormwater treatment practices, forested riparian buffers, and livestock exclusion have longer term lifespans (10–20 years or more if properly maintained) and phosphorus reductions achieved by these projects will continue in future years. In addition to one-year lifespans, many agricultural practices that result in phosphorus reductions are dependent on land management decisions influenced by a variety of farm business factors, meaning sustained progress towards reaching phosphorus reduction targets in the agricultural sector is correlated with farmer willingness to implement conservation practices. Lastly, many conservation practices are not reported due to the implementation of practices outside of state or federal programs.

Note that estimated total phosphorus load reductions have changed compared to the *Vermont Clean Water Initiative 2021 Performance Report* due to improved clean water project tracking and accounting.

Lake Champlain TMDL Progress

Click symbol to view description of accountability measures.

Total phosphorus loading to Lake Champlain from Vermont was modeled to be 631 metric tons per year during the Lake Champlain TMDL baseline period of 2001 to 2010. The TMDL states total phosphorus loading to Lake Champlain must be reduced by 212 metric tons per year by the end of calendar year 2036 (SFY 2037) to achieve Vermont's water quality standards. The following figure summarizes the steady progress that has been made towards achieving the Lake Champlain TMDL since SFY 2016.[40]

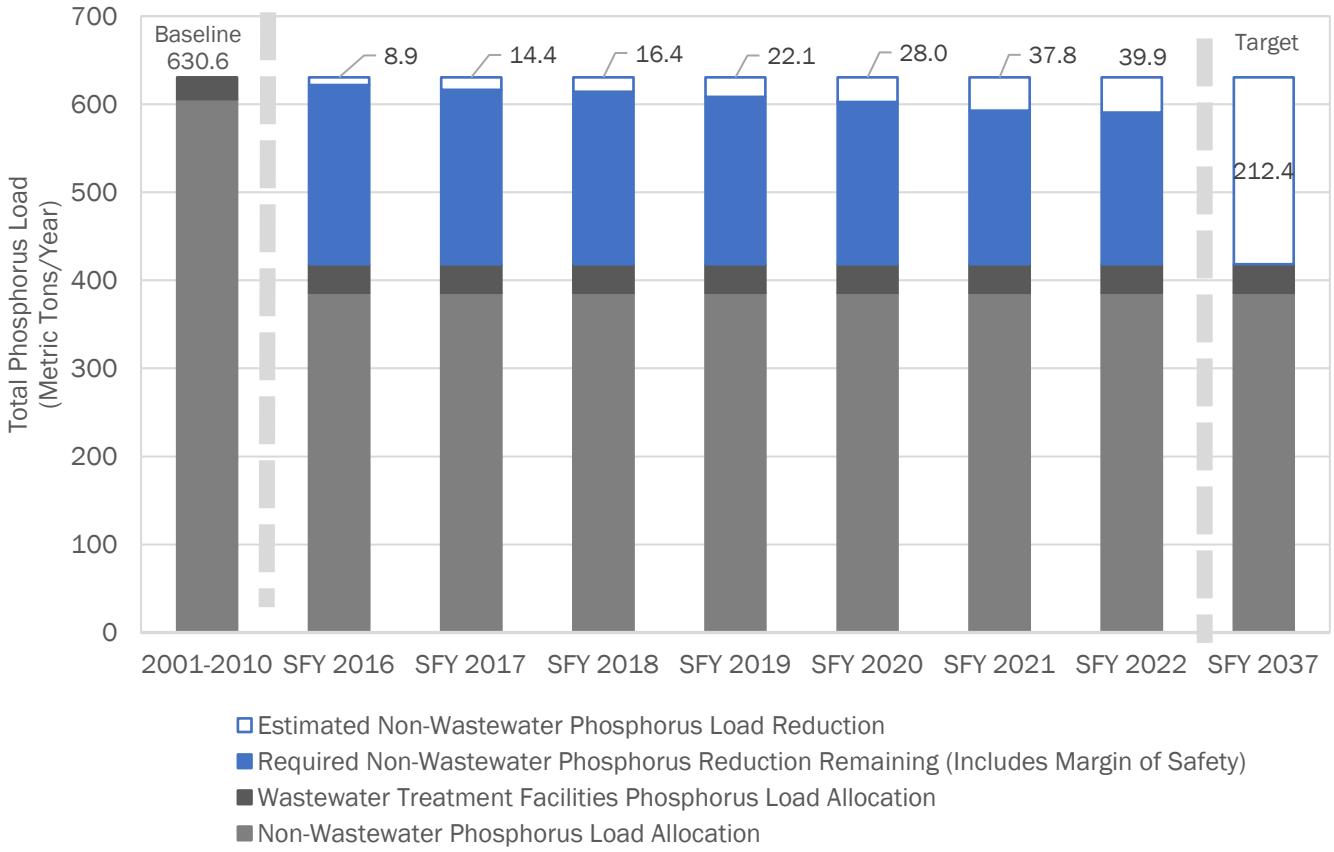

Figure 26. Estimated total phosphorus load reductions in effect during SFY 2016–2022 relative to the Lake Champlain TMDL total phosphorus baseline and target total phosphorus load in metric tons per year.

[40] Phosphorus reduction estimates are presented in delivered load. For more information, see the Accountability Measures section.

EXPLANATION OF FIGURE

The progress made toward reaching Lake Champlain's phosphorus reduction target has steadily increased year after year. State, federal, and regulatory clean water programs are estimated to have reduced 39.9 metric tons of phosphorus loading delivered to Lake Champlain in SFY 2022, which represents approximately **19 percent** of the required reduction. This result is expected to increase in the coming years for at least the following reasons:

1. An influx in federal funding under ARPA and the Bipartisan Infrastructure Law, increased Clean Water Fund revenue enacted under Act 76 of 2019, and growth in capacity will drive project implementation across sectors. For more information the Clean Water Budget, visit: https://dec.vermont.gov/water-investment/cwi/board
2. The State has recently published methods for quantifying phosphorus reductions for agricultural, natural resource, and developed lands sector clean water practices. However, new methods were established for some practices, particularly in the natural resource sector, and cannot be fully implemented as data collection mechanisms are not yet in place. Collection of data required to estimate phosphorus reductions under these new methods will begin in the coming year.
3. The State of Vermont has been building and expanding clean water regulatory, financial, and technical assistance programs since SFY 2016. Many regulatory programs are now in place that will drive phosphorus reductions from agriculture and developed lands, with meaningful progress expected in the coming years.

Lake Champlain TMDL Progress by Lake Segment Watershed

Click symbol to view description of accountability measures.

The Lake Champlain TMDL allocates total phosphorus load reduction targets by lake segment watershed, which differ from tactical planning basins. The following figure presents estimated total phosphorus load reductions in effect in SFY 2022 by lake segment watershed compared to the target reduction.[41]

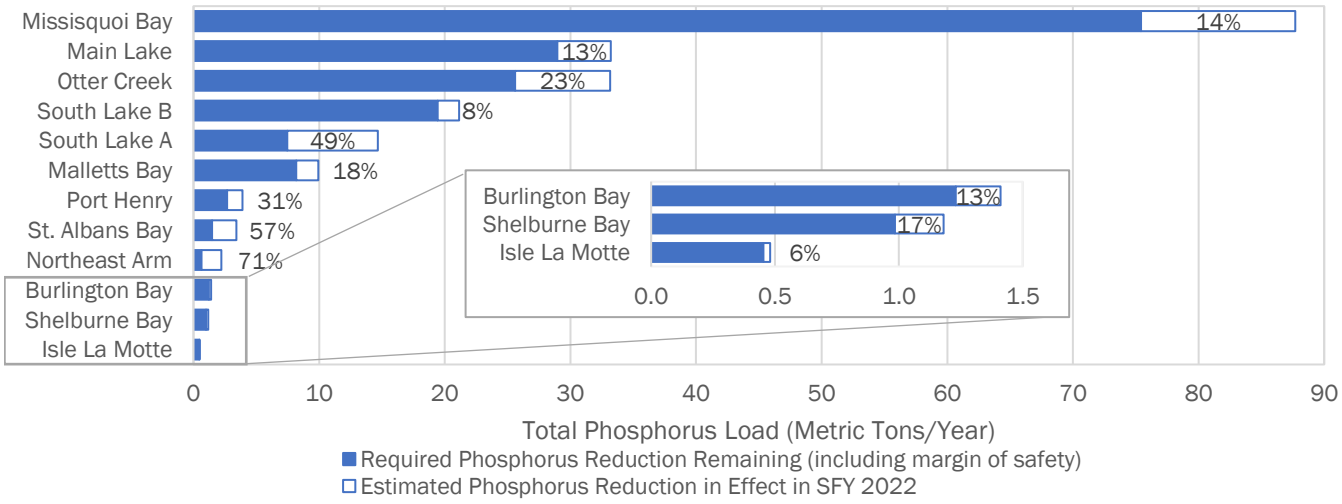

Figure 27. Estimated total phosphorus load reductions in effect during SFY 2022 by lake segment watershed compared to total phosphorus load reduction targets in metric tons per year. Percent represents the proportion of estimated total phosphorus load reductions achieved as of SFY 2022 compared to the lake segment target reduction.

[41] Phosphorus reduction estimates are presented in delivered load. For more information, see the Accountability Measures section.

EXPLANATION OF FIGURE

The level of progress varies by lake segment watershed for the following reasons:

1. Lake segment size and level of phosphorus reduction required varies: The TMDL allocated phosphorus loading capacity based on each lake segment's land use characteristics and the reduction required to meet Vermont water quality standards. The level of effort required and the magnitude of phosphorus loading ranges by lake segment. Tactical Basin Plans target efforts to watersheds with the greatest need for reduction.
2. Clean water projects are targeted in priority watersheds: Tactical Basin Plans inform where to prioritize efforts for reducing phosphorus loading to Lake Champlain. The level of progress in the Northeast Arm and St. Albans Bay lake segments is relatively high, as USDA-NRCS has targeted significant agricultural technical and financial assistance to these watersheds.
3. New phosphorus reduction methodology: The State has recently published methods for quantifying phosphorus reductions for agricultural, natural resource, and developed lands sector clean water practices. New methods were established for some practices, particularly in the natural resource sector, and have not yet been fully implemented as new data collection mechanisms are being established. Lake segments dominated by agricultural efforts show greater progress than lake segments targeting natural resources restoration because there are currently more comprehensive systems to quantify estimated reductions for agricultural projects compared to other sectors.

Monitored Total Phosphorus Load from Vermont Wastewater Treatment Facilities in the Lake Champlain Basin

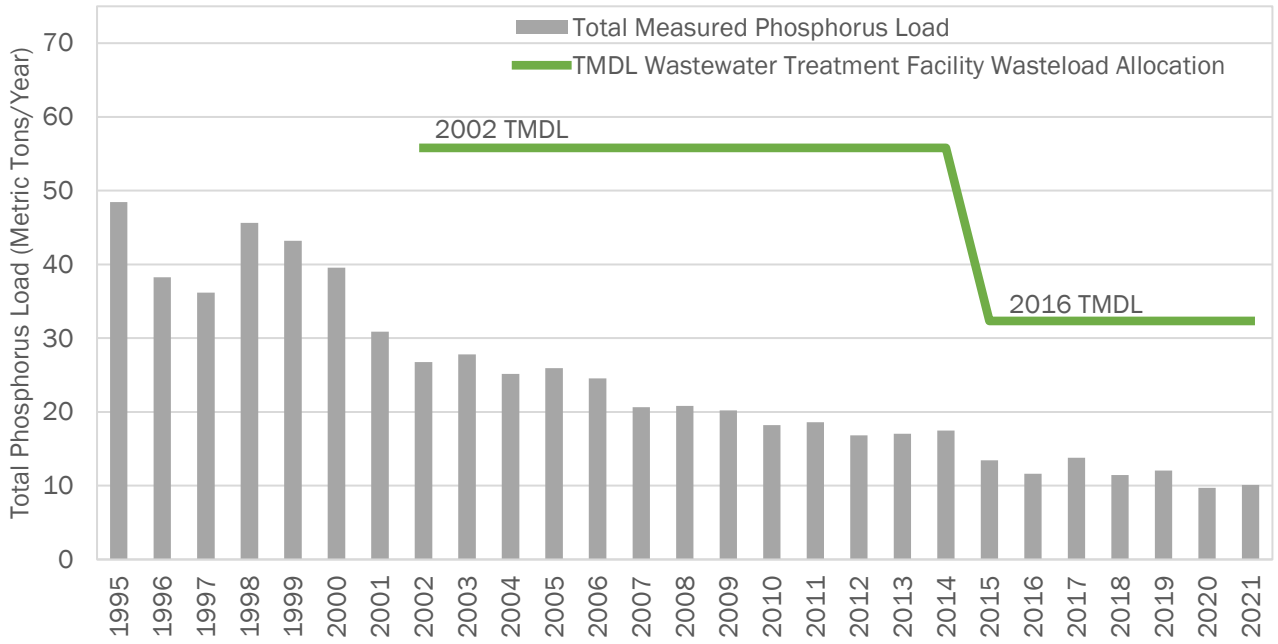

Figure 28. Measured total phosphorus load (metric tons per year) from Vermont wastewater treatment facilities draining to Lake Champlain and the Lake Champlain TMDL wastewater treatment facility wasteload allocation, calendar year 1995–2021.

EXPLANATION OF FIGURE

Total average annual phosphorus loading into Lake Champlain originating from Vermont wastewater treatment facilities was approximately 24.6 metric tons per year during the Lake Champlain TMDL baseline period of 2001–2010, representing approximately four percent of total phosphorus loading to Lake Champlain from Vermont sources. During the baseline period, measured total annual phosphorus loading from wastewater treatment facilities was well below the wasteload allocation (i.e., maximum permitted phosphorus limit) of 55.8 metric tons that was established under the 2002 Lake Champlain TMDL. The updated 2016 Lake Champlain TMDL for Vermont reduced the wastewater treatment facility wasteload allocation from 55.8 to 32.3 metric tons, which is intended to achieve the overall required phosphorus load allocation while allowing for some development and growth over the TMDL implementation timeframe. Discharge monitoring indicates Vermont wastewater treatment facilities in the Lake Champlain basin contributed approximately 10.1 metric tons of total phosphorus load to Lake Champlain in calendar year 2021, representing only 31 percent of the wasteload allocation under the current TMDL. These data demonstrate a consistent trend of measured total annual phosphorus load from Vermont wastewater treatment facilities, overall, well below the wasteload allocation.

Lake Champlain Water Quality

The State of Vermont can estimate progress towards achieving TMDLs by modeling estimated phosphorus reductions from clean water projects; however, measured water quality is the ultimate indicator of clean water progress in Lake Champlain. Coordinated by and in partnership with the Lake Champlain Basin Program (LCBP), the Vermont Department of Environmental Conservation and New York State Department of Environmental Conservation have been monitoring in-lake phosphorus concentrations in Lake Champlain since 1990. The objective of the Lake Champlain TMDL is to reduce phosphorus concentrations in Lake Champlain back to established limits, in compliance with Vermont water quality standards.

LCBP publishes the State of the Lake report approximately every three years to inform citizens and resource managers about the health of the lake. The *2021 State of the Lake Report* summarizes the status and trends of the following nine ecosystem indicators for Lake Champlain's five major lake segments, as shown in the figure below. Additional information and data on the health of Lake Champlain can be found in the full *2021 State of the Lake Report*.[42]

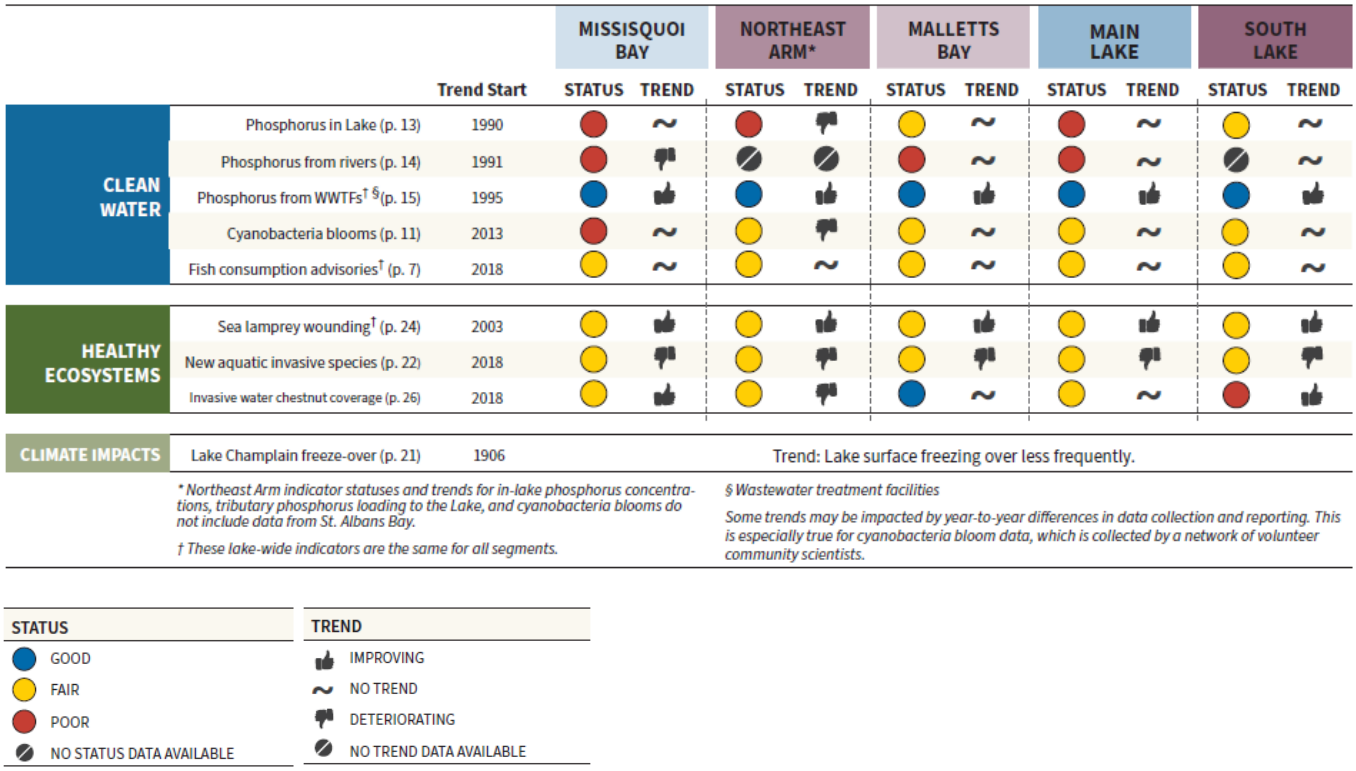

Figure 29. Ecosystem indicators by major Lake Champlain segment. Figure from *2021 State of the Lake* report.[43]

[42] The *2021 State of the Lake Report* can be accessed here: https://www.lcbp.org/wp-content/uploads/2016/03/SOL2021_full-document_for-web.pdf

[43] In the 2021 State of the Lake Report excerpt shown in Figure 29, the Northeast Arm includes the St. Albans Bay lake segment, Main Lake includes the Isle La Motte, Burlington Bay, Shelburne Bay, Otter Creek, and Port Henry lake segments, and South Lake is made up of both South Lake A and South Lake B lake segments.

EXPLANATION OF FIGURE

Since 2013, 95 percent of routine visual assessments on Lake Champlain during the recreational season reported conditions free of cyanobacteria blooms. Cyanobacteria conditions vary significantly among lake segments, and warm weather blooms continue to present a challenge to recreation and public health. Cyanotoxins are rarely detected in Lake Champlain, though it is best to avoid areas with active cyanobacteria blooms.

Many lake segments have in-lake phosphorus concentrations that are often near or below targeted limits, but phosphorus concentrations in Lake Champlain's shallow bays are often above these limits, resulting in harmful cyanobacteria blooms. Shallow bays are particularly susceptible to elevated phosphorus concentrations due to a combination of nutrient loading from tributaries and internal loading from legacy phosphorus in shallow lake-bed sediments.

- In the Malletts Bay and South Lake segments, in-lake phosphorus concentrations are considered fair, meaning phosphorus concentrations are near in-lake limits, and the trend since 1990 is stable.
- For the Missisquoi Bay and Main Lake segments, in-lake phosphorus concentrations exceed in-lake phosphorus limits, and the trend is stable.
- In the Northeast Arm, in-lake phosphorus concentrations exceed recommended limits and in-lake phosphorus concentrations have increased since 1990. Although the Northeast Arm is estimated to have achieved over 70 percent of its required total phosphorus load reduction based on clean water projects implemented, several variables can impact measured phosphorus concentrations.

Phosphorus load reductions are required to come from both point sources and nonpoint sources. Investments in wastewater treatment facilities since 1990 have driven significant reductions in phosphorus loading from point sources in Vermont, New York, and Québec. As shown above, phosphorus loading from wastewater treatment facilities (WWTFs) is meeting TMDL loading targets, and the trend continues to improve. Remaining phosphorus load reductions must come from the nonpoint source sectors (i.e., agriculture, developed lands, and natural resources) in order to meet the Lake Champlain TMDL. For more information on phosphorus loading from WWTFs in Lake Champlain, see the State of the Lake Report: https://sol.lcbp.org/table-of-contents/clean-water/nutrients/.

Lake Champlain tributary streamflow and water quality concentrations can be used to estimate total phosphorus loading to the lake. Phosphorus loading from rivers to Lake Champlain varies greatly from year-to-year, but average annual loading needs to be reduced to meet water quality goals. As shown above, phosphorus loading from rivers draining to the Missisquoi Bay, Malletts Bay, and Main Lake segments exceeds TMDLs limits, and the trend is stable.

Measured phosphorus loading to Lake Champlain is expected to decrease in the coming decades in response to clean water efforts. The Vermont Clean Water Act (Act 64) of 2015 and Clean Water Service Delivery Act (Act 76) of 2019 both established new regulatory, project delivery, and funding sources to accelerate clean water progress, but the implementation of these programs may not be fully realized for a decade or more. As the implementation of clean water projects increases, it is expected that decreased loading will first be measurable at a local level in smaller rivers and streams. While targets may be met at the local scale, it will take many years—possibly decades—before cumulative improvements are observable in larger tributaries and subsequently in Lake Champlain.

Chapter 4: Clean Water Investments and TMDL Progress in the Lake Memphremagog Basin

Lake Memphremagog TMDL

Figure 30. Map of tactical planning basin 17 (Lake Memphremagog) highlighted in green.

Lake Memphremagog is an international waterbody with the majority of its watershed area in Vermont and a small portion in Québec. The Vermont portion of the watershed covers most of Orleans County including the three major lake tributary rivers: the Black, Barton, and Clyde as well as the smaller Johns River (Figure 30). Land use within the Vermont portion of the watershed is largely forest or shrub with about 17 percent in agriculture, and five percent in developed lands.[44]

Phosphorus levels in the Vermont portion of Lake Memphremagog are higher than the water quality standard set for the lake. Elevated levels of phosphorus contribute to intermittent cyanobacteria blooms but also support excessive plant and algae growth that limits the quality of the lake for recreational use. The Lake Memphremagog TMDL was established in 2017 to specify the maximum amount of phosphorus that the waterbody can receive and still meet applicable water quality standards and establish targets for reducing phosphorus loading to the lake from its watershed. Total phosphorus loading to Lake Memphremagog from Vermont was modeled to be 52.7 metric tons per year during the TMDL baseline period of 2009 to 2012. The TMDL states total phosphorus loading to Lake Memphremagog must be reduced by 29 percent to 37.4 metric tons per year by 2037 to achieve Vermont's water quality standards.[45]

Tactical Basin Planning is integral to identifying priority projects to achieve water quality goals. The 2017 Lake Memphremagog, Tomifobia, and Coaticook Tactical Basin Plan (Basin 17) provides an assessment of the health of the basin and defines on-going and future strategies to address high-priority surface water stressors.[46] Work is currently underway to update the Lake Memphremagog, Tomifobia, and Coaticook Tactical Basin Plan, a draft of which is anticipated to be released for public comment in early 2023. The purpose of the plan is to identify actions necessary to meet or exceed state water quality standards, and to achieve sustained ecological health and human use of surface waters. The plan sets priorities for meeting phosphorus load reduction targets for the Lake Memphremagog watershed as outlined in the Lake Memphremagog TMDL. The following section of the report summarizes the state, federal, and regulatory clean water efforts in tactical planning basin 17, which includes all the Vermont land that drains to the St.

[44] The Lake Memphremagog TMDL can be accessed here: https://dec.vermont.gov/sites/dec/files/wsm/mapp/docs/Memph%20TMDL%20Final%20EPA%20approved.pdf.

[45] Table 10, Lake Memphremagog TMDL, page 25.

[46] The 2017 Lake Memphremagog, Tomifobia, and Coaticook Tactical Basin Plan can be accessed here: https://dec.vermont.gov/sites/dec/files/wsm/mapp/docs/Basin17_TBP_Signed.pdf.

Francis River. Most land in this basin flows to Lake Memphremagog, including the Black, Barton, and Clyde Rivers, but tactical planning basin 17 also includes the Tomifobia and Coaticook watersheds that do not drain to Lake Memphremagog.

Vermont's Clean Water Investments in the Lake Memphremagog Basin

Click symbol to view description of accountability measures.

Reaching Lake Memphremagog's water quality goals requires investments across all land use sectors. The following figure summarizes state clean water investments in the Lake Memphremagog basin from SFY 2016 to 2022. Federal funds awarded to projects directly by federal agencies are not included in this report as they are outside the scope of this report.

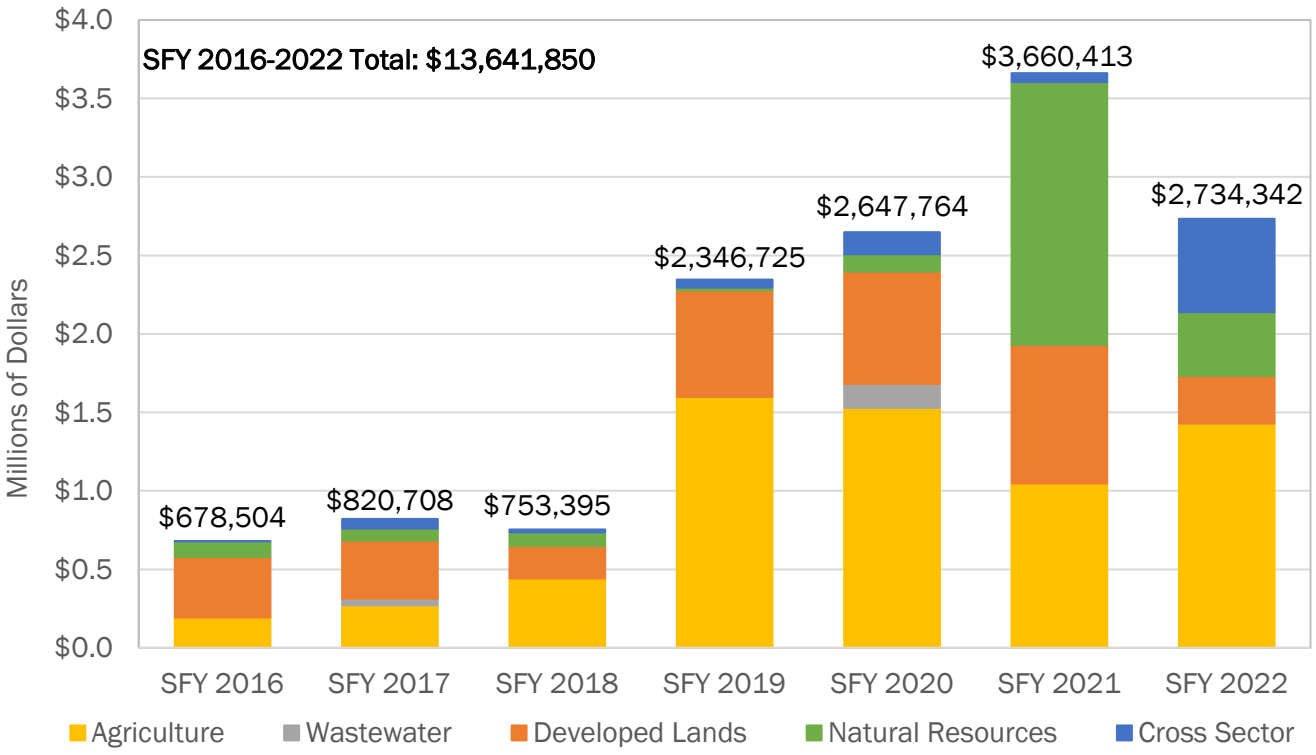

Figure 31. Total dollars awarded by State of Vermont agencies to clean water projects in the Lake Memphremagog basin by land use sector, SFY 2016–2022.

EXPLANATION OF FIGURE

The State of Vermont has invested over $13 million in the Lake Memphremagog watershed since SFY 2016. From SFY 2016 to 2020, the greatest investments in the Lake Memphremagog basin occurred in the developed lands and agriculture sectors. There was a large increase in natural resources funding in SFY 2021 due to the conservation of 129 acres of waterfront land at Bluffside Farm on Lake Memphremagog in Newport. This $1.4 million project was funded by a Clean Water State Revolving Fund Land Conservation Interim Financing Loan provided to Vermont Land Trust. This interim financing program provides partners with upfront access to capital to act on time-sensitive conservation opportunities and affords partners time to secure funds to repay the loan over the course of five years. In SFY 2022, there was an increase in cross-sector funding partially attributed to startup funding allocated to the Clean Water Service Provider in the Memphremagog Watershed and multi-sector block grants.

Estimated Total Phosphorus Load Reductions in Lake Memphremagog Basin

The State of Vermont estimates the pollutant load reductions associated with clean water projects to track progress towards achieving water quality goals. The following figure summarizes the estimated total phosphorus load reductions associated with state, federal, and regulatory clean water projects in the Lake Memphremagog basin from SFY 2016 to 2022 by sector.[47]

Click symbol to view description of accountability measures.

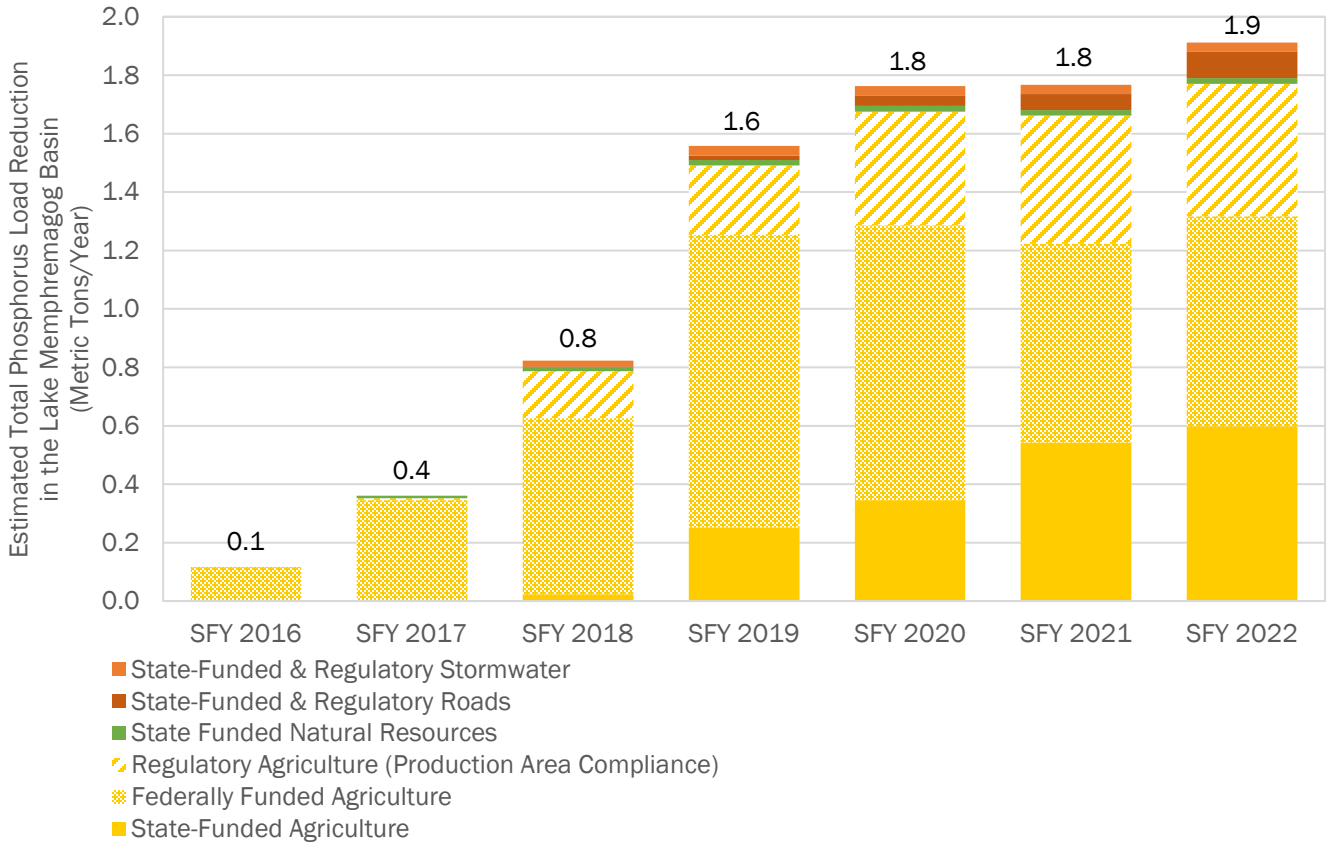

Figure 32. Annual estimated total phosphorus load reductions (metric tons per year) associated with state, federal, and regulatory clean water projects in the Lake Memphremagog basin in effect during SFY 2016–2022 by land use sector and program category.[48]

[47] Phosphorus reduction estimates are presented in delivered load. For more information, see the Accountability Measures section.

[48] Annual phosphorus load reductions are cumulative for all completed/operational projects based on start date and anticipated lifespan. Results of USDA-NRCS funded projects completed since SFY 2010 that are still in effect SFY 2016–2022 are included.

EXPLANATION OF FIGURE

Estimated phosphorus reductions achieved by state funding programs, federal funding programs, and regulatory programs in the Lake Memphremagog basin have increased nearly twenty-fold from SFY 2016 to 2022. Since SFY 2017, there has been a steady incremental increase each year in the estimated phosphorus reductions achieved through natural resource, stormwater, and road projects. There was a large increase in agricultural phosphorus reductions from SFY 2018 to 2019 due to an increase in the cover crop and crop to hay practices funded by USDA-NRCS and AAFM. Approximately 93 percent of estimated phosphorus reductions achieved in SFY 2022 are associated with agricultural projects for three reasons:

1. Agricultural conservation practices are highly cost-effective in treatment of phosphorus (note these are mostly annual practices and need to be reimplemented each year to maintain the reductions shown);
2. Substantial federal funds leveraged through the USDA-NRCS layer on top of state funds to support this work; and
3. Methods are currently in place to estimate phosphorus load reductions associated with most types of agricultural conservation practices, while methods to estimate phosphorus reductions for some practices in other land use sectors still need to be implemented.

The temporary slowdown in year over year change in phosphorus reduction beginning in SFY 2020 was due, in part, to reduced conservation practice implementation by farmers during the COVID-19 pandemic. Between SFY 2020 and SFY 2021, the total phosphorus reduction achieved through agricultural practices remained nearly the same, though a larger proportion of the reduction was achieved through state-funded and regulatory practices in SFY 2021 as compared to SFY 2020. Annual variability in individual funding programs may have many causes but highlights the importance of maintaining a diverse range of funding opportunities to support clean water projects. The variability of implementation across years also underscores the importance of investing in program and partner capacity to broaden the reach and impact of clean water project implementation.

It is important to note that 60 percent of the agricultural reductions in the Lake Memphremagog basin in SFY 2022 were associated with annual practices with a one-year lifespan (e.g., cover crop and manure injection). If this level of effort is not maintained each year, the phosphorus reductions will not carry through to future years. Structural projects, such as stormwater treatment practices or forested riparian buffers, in contrast, have longer term lifespans (10–20 years or more if properly maintained) and phosphorus reductions achieved by these projects will continue in future years.

Note estimated total phosphorus load reductions have changed compared to the *Vermont Clean Water Initiative 2021 Performance Report* due to improved clean water project tracking and accounting.

Lake Memphremagog TMDL Progress

Click symbol to view description of accountability measures.

The Lake Memphremagog TMDL states total phosphorus loading to Lake Memphremagog must be reduced from 52.7 metric tons per year to 37.4 metric tons per year by the end of calendar year 2037 (SFY 2038) to achieve Vermont's water quality standards. The following figure summarizes progress towards achieving the Lake Memphremagog TMDL.[49]

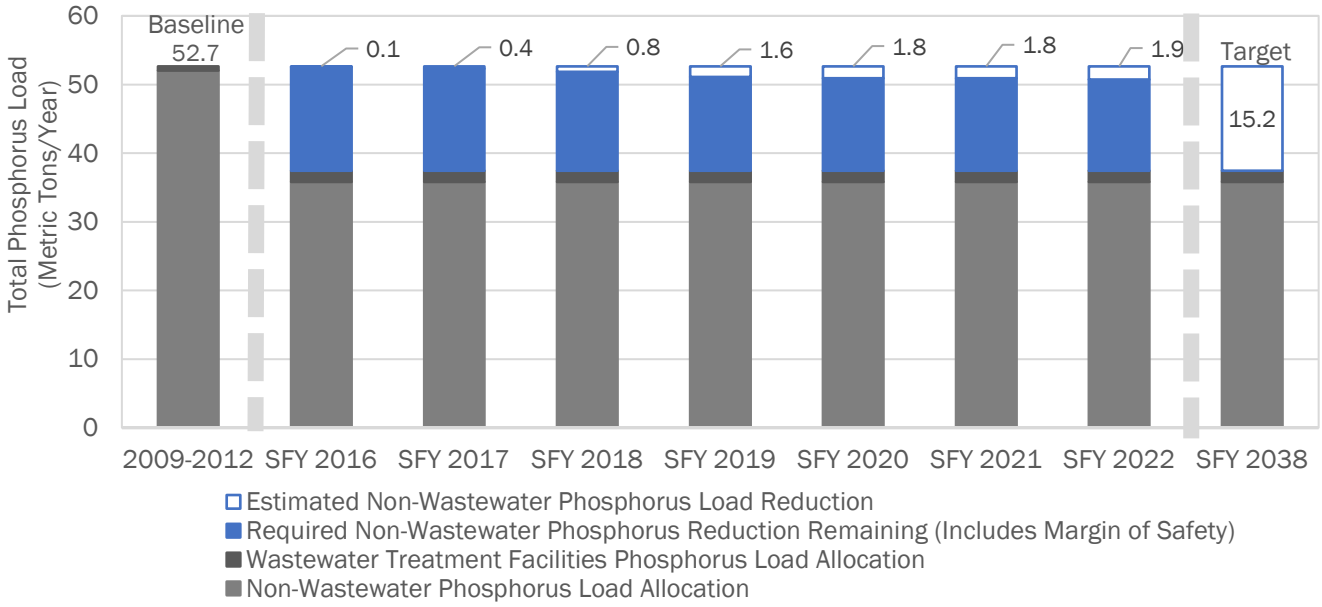

Figure 33. Estimated total phosphorus load reductions in effect during SFY 2016–2022 in the context of the Lake Memphremagog TMDL total phosphorus baseline and target total phosphorus load in metric tons per year.

EXPLANATION OF FIGURE

State, federal, and regulatory clean water programs are estimated to have reduced 1.9 metric tons of phosphorus loading to Lake Memphremagog in SFY 2022, which represents approximately **13 percent** of the required reduction. Phosphorus reductions are expected to increase in the coming years for at least the following reasons:

1. An influx in federal funding under ARPA and the Bipartisan Infrastructure Law, as well as increased Clean Water Fund revenue enacted under Act 76 of 2019, will drive non-regulatory project implementation across sectors.
2. The State of Vermont has been "ramping up" clean water regulatory, financial, and technical assistance programs since SFY 2016. Many regulatory programs are now in place that will drive phosphorus reductions from agriculture and developed lands, with meaningful progress expected in the coming years.
3. The State of Vermont is expanding its ability to quantify phosphorus reductions for all project types; however, some gaps still exist. Methods have been established to estimate phosphorus reductions for additional practices, particularly in the natural resources sector, and those methods will be implemented in the coming years and reflected in future versions of the *Performance Report*.

[49] Phosphorus reduction estimates are presented in delivered load. For more information, see the Accountability Measures section.

Monitored Total Phosphorus Load from Vermont Wastewater Treatment Facilities in the Lake Memphremagog Basin

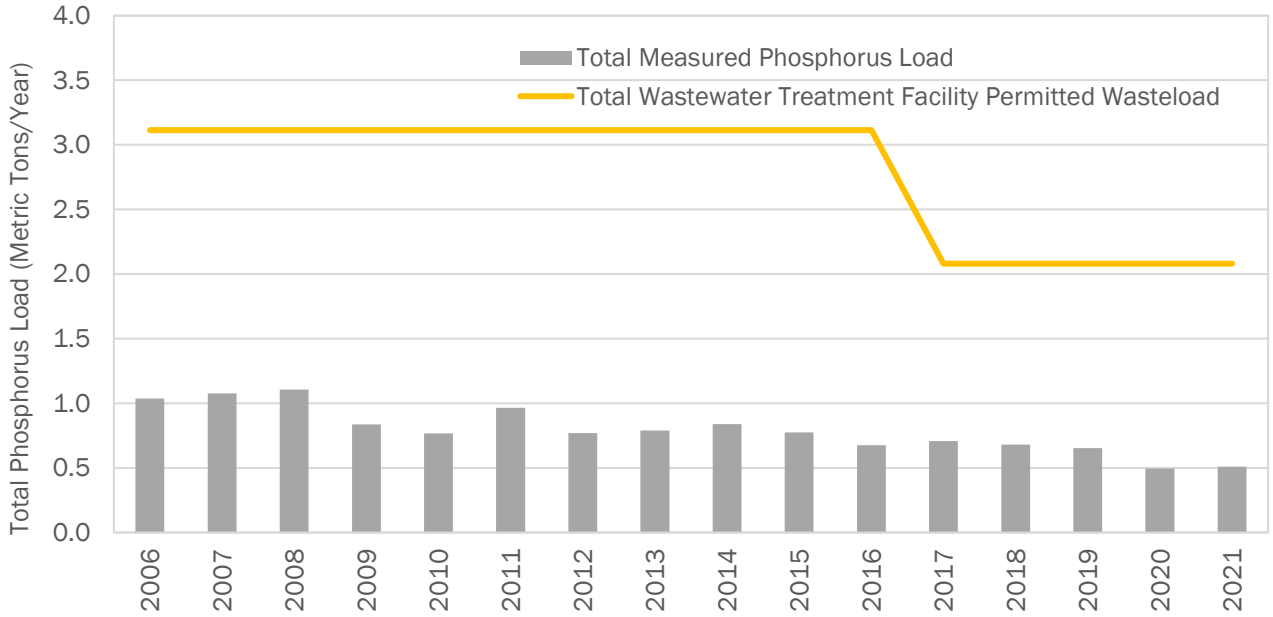

Figure 34. Measured total phosphorus load (metric tons per year) from Vermont wastewater treatment facilities draining to Lake Memphremagog and the Lake Memphremagog TMDL wastewater treatment facility permitted wasteload, calendar year 2006–2021

EXPLANATION OF FIGURE

Total average annual phosphorus loading into Lake Memphremagog originating from Vermont wastewater treatment facilities was approximately 3.1 metric tons per year during the Lake Memphremagog TMDL baseline period of 2009–2012, representing approximately four percent of total phosphorus loading to Lake Memphremagog from Vermont sources. During the baseline period, measured total annual phosphorus loading from wastewater treatment facilities was well below the permitted phosphorus limit of 3.1 metric tons. The 2017 Lake Memphremagog TMDL for Vermont reduced the wastewater treatment facility permitted wasteload 2.08 metric tons, which is intended to achieve the overall required phosphorus load allocation while allowing for some development and growth over the TMDL implementation timeframe. Discharge monitoring indicates Vermont wastewater treatment facilities in the Lake Memphremagog basin contributed approximately 0.51 metric tons of total phosphorus load to Lake Memphremagog in calendar year 2021, representing only 24 percent of the permitted wasteload under the current TMDL. These data demonstrate a consistent trend of measured total annual phosphorus load from Vermont wastewater treatment facilities, overall, well below the wasteload allocation.

Lake Memphremagog Water Quality

The State of Vermont estimates the phosphorus reductions associated with clean water projects in the Lake Memphremagog basin to show incremental progress towards achieving the Lake Memphremagog TMDL. The estimated phosphorus reductions presented in this report, however, do not represent measured load reductions to Lake Memphremagog. Lake Memphremagog tributary streamflow and water quality concentrations can be used to estimate total phosphorus loading to the lake. Vermont DEC has collected tributary data to support the estimation of tributary loading since 2005, with an increase in the number of samples collected in 2021 and 2022 as compared to previous years. DEC is working to compile and analyze this data to support the calculation of annual loading rates and trends and anticipates including this information in future versions of the *Performance Report*.

Although phosphorus reduction estimates can be used to monitor progress towards achieving TMDLs, measured water quality is the ultimate indicator of clean water progress in Lake Memphremagog. Officials from Vermont and the Province of Québec have monitored Lake Memphremagog's in-lake phosphorus concentrations since 1985 and 1999, respectively. Phosphorus concentration targets for South Bay and the Vermont portions of Lake Memphremagog were established in 1991 at 14 µg/L and 25 ug/L, respectively.

The State of Vermont publishes trends on Lake Memphremagog and South Bay water quality as part of the Vermont Inland Lake Scorecard. The following figure summarizes measured water quality trends in Lake Memphremagog since 1984. Although the Lake Memphremagog TMDL covers both South Bay and Lake Memphremagog, only Lake Memphremagog data are presented here for brevity. Water quality scorecards for both Lake Memphremagog and South Bay can be accessed on the Vermont Integrated Watershed Information System.[50]

[50] Water quality scorecards are available at: https://anrweb.vt.gov/DEC/IWIS/ReportViewer2.aspx?Report=LakesScorecardLinksTable&ViewParms=True

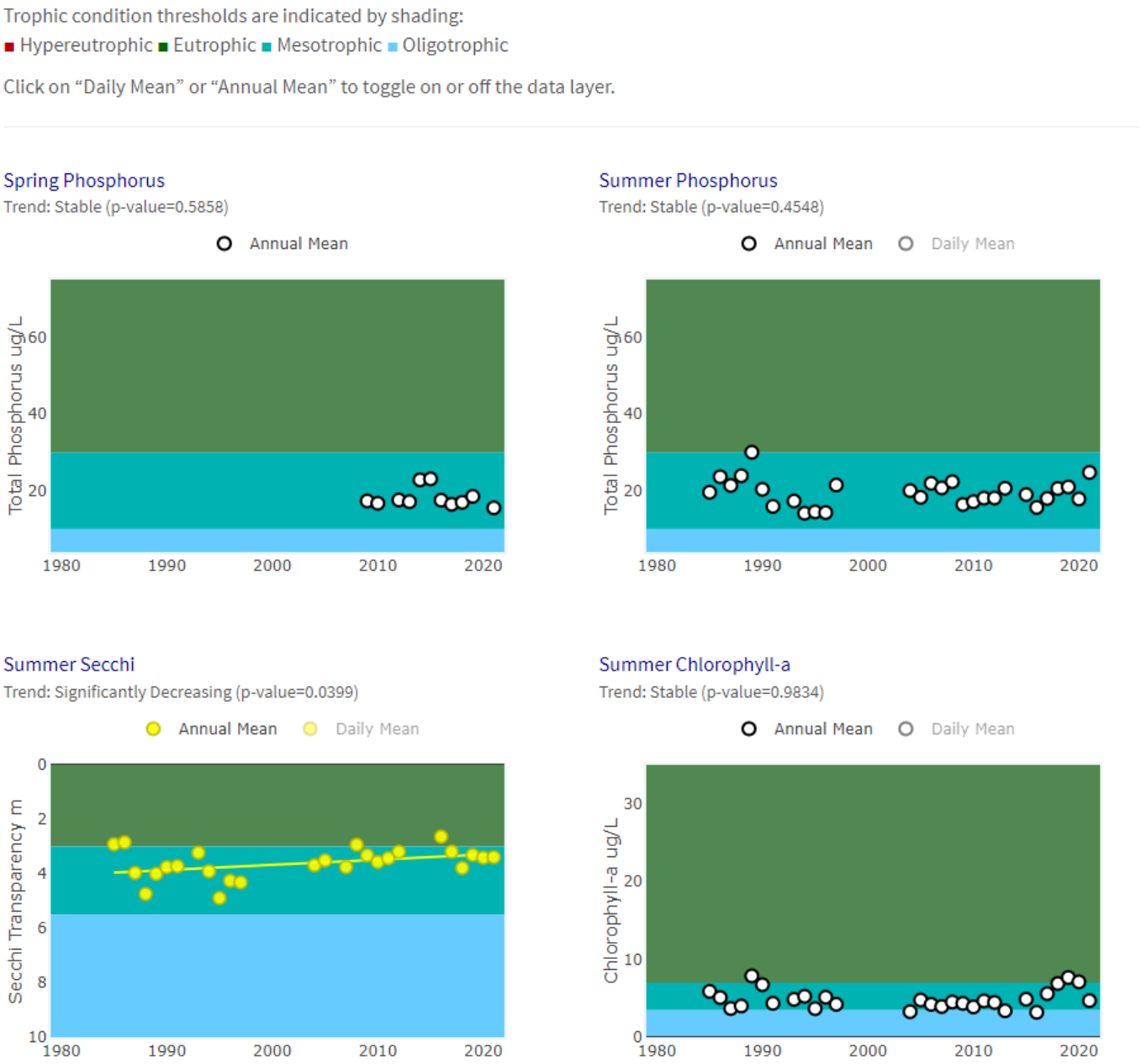

Figure 35. Water quality scorecard for Lake Memphremagog illustrating trends in spring total phosphorus (TP), summer TP, summer water clarity (Secchi depth), and summer algal biomass (chlorophyll *a*), calendar year 1984–2021.[51]

[51] Blue, light green, and dark green bands represent oligotrophic (low nutrients), mesotrophic (moderate nutrients), and eutrophic (high nutrients) conditions, respectively. Data from VT DEC Lakes and Ponds Program.

EXPLANATION OF FIGURE

Average annual spring and summer total phosphorus concentrations in Lake Memphremagog have been relatively stable since data collection began in 2008 and 1984, respectively. Average annual summer water clarity (Secchi depth) shows a statistically significant decreasing trend, which may be an indication of water quality deterioration and evidence of internal (from lake-bottom sediment) nutrient loading. Average summer algal biomass (chlorophyll *a*) does not show a statistically significant trend, although there have been recent increases in algal biomass since 2016. Algae are the base of the aquatic food chain, and higher algal biomass (chlorophyll *a*) is generally associated with greater nutrients in the lake. However, summer total phosphorus has been relatively stable since 2003, suggesting the recent increase in algal biomass (chlorophyll *a*) may be due to other factors such as lake temperatures or natural variability.

Although the Vermont Inland Lake Scorecard data do not suggest significant trends in phosphorus and chlorophyll water quality variables, the Québec monitoring program has indicated reductions in phosphorus in several lake segments. For more information on nutrient loading to Lake Memphremagog and water quality sampling results in both Québec and Vermont through 2018, please see the International Joint Commission's Nutrient Loading and Impacts in Lake Champlain, Missisquoi Bay, and Lake Memphremagog report: https://www.ijc.org/sites/default/files/2020-04/Government%20Package%20English.pdf.

Chapter 5: Connecticut River Basin Clean Water Investments and Results

Long Island Sound TMDL

The Connecticut River is New England's longest river running through four states: Vermont, New Hampshire, Massachusetts, and Connecticut. Seven tactical planning basins in the eastern half of the State of Vermont drain to the Connecticut River, which eventually drains to the Long Island Sound. The Long Island Sound is a large estuary that drains a total watershed of over 16,000 square miles, including the Connecticut River as well as areas of Rhode Island and New York according to the Long Island Sound TMDL (Figure 36).[52]

Figure 36. Map of the Long Island Sound watershed. Figure from New England Interstate Water Pollution Control Commission.

The Long Island Sound is impaired due to nitrogen, which can cause algal blooms and hypoxia (i.e., low dissolved oxygen concentrations) leading to "dead zones" that threaten marine life. To address the excess nitrogen and resulting hypoxia, the EPA approved *A Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound* in 2001 to define the nitrogen reductions necessary to meet water quality standards in the Sound.

Clean water efforts in the Vermont drainages to the Connecticut River are contributing to water quality progress for Long Island Sound. The following section of the report summarizes the state, federal, and regulatory clean water efforts in the Connecticut River basin. There are no current methods in place to estimate total nitrogen load reductions to the Connecticut River, but these will be established in the coming years.

[52] A Total Maximum Daily Load Analysis to Achieve Water Quality Standards for Dissolved Oxygen in Long Island Sound can be accessed here: http://longislandsoundstudy.net/wp-content/uploads/2010/03/Tmdl.pdf http://longislandsoundstudy.net/wp-content/uploads/2010/03/Tmdl.pdf.

Vermont's Clean Water Investments in the Connecticut River Basin

Click symbol to view description of accountability measures.

Reaching the Connecticut River basin's water quality goals requires investments across all land use sectors. The following figure summarizes state clean water investments in the Connecticut River basin from SFY 2016 to 2022. Federal funds awarded to projects directly by federal agencies are not included in this report as they are reported on elsewhere.

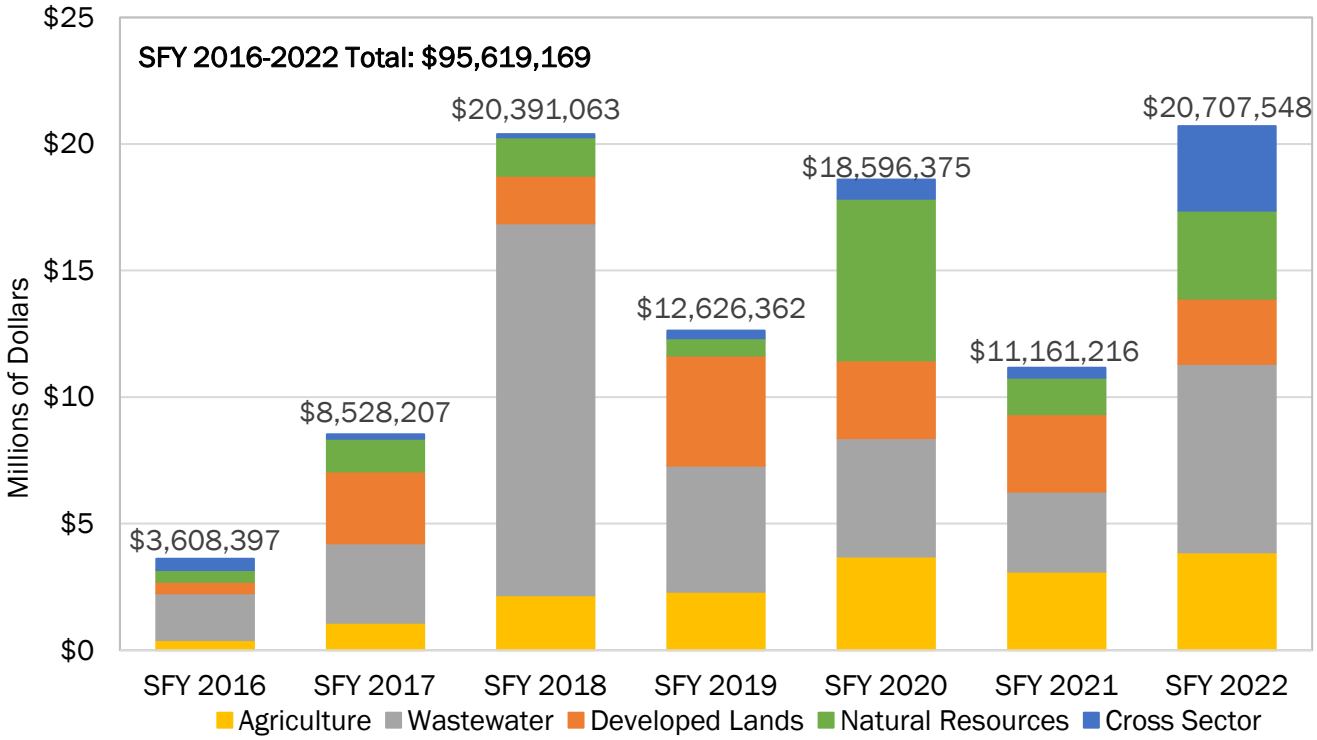

Figure 37. Total dollars awarded by State of Vermont agencies to clean water projects in the Connecticut River basin by land use sector, SFY 2016–2022.

EXPLANATION OF FIGURE

The State of Vermont has invested over $95 million in clean water projects in the Connecticut River watershed since SFY 2016. Clean water funding in the Connecticut River basin varies from year-to-year based on project readiness and grant award dates. In SFY 2018, the Clean Water State Revolving Fund (CWSRF) and Capital Bill funding provided significant investments to wastewater refurbishment and combined sewer overflow (CSO) abatement projects in the Connecticut River watershed. Two of the largest CWSRF projects in SFY 2018 included the Dover Wastewater Treatment Facility refurbishment, costing $4.4 million and the Saint Johnsbury Pleasant Street and Gilman Road CSO Project, costing $5.1 million. The large increase in natural resources funding in SFY 2020 was due to the $4 million conservation of Rolston property located in the towns of Chittenden, Mendon, and Killington funded by a CWSRF Land Conservation Interim Financing Loan. This interim financing program provides partners with upfront access to capital to act on time-sensitive conservation opportunities and affords partners time to secure funds to repay the loan over the course of five years.

Future Total Nitrogen Load Reduction Tracking

Nitrogen reduction estimates cannot be reported for the Connecticut River basin, as the State of Vermont does not yet have baseline nitrogen loading estimates or nitrogen reduction efficiencies for clean water projects in the Connecticut River basin. EPA-supported efforts are underway to develop consistent methods for all five states in the Long Island Sound basin to employ in estimating nitrogen reductions for clean water projects. Vermont's Clean Water Service Delivery Act, Act 76 of 2019, requires setting a schedule to publish methods for other (i.e., non-phosphorus) impairments by November 1, 2023 (10 V.S.A. § 923).

Chapter 6: Conclusion

Excess nutrient loading to Vermont's waters leads to local and regional water quality issues, including unsightly and potentially harmful cyanobacteria blooms in Lake Champlain and Lake Memphremagog, and low dissolved oxygen and dead zones in the Long Island Sound. Most of the phosphorus loading to Vermont's waters is from nonpoint sources, such as agricultural and stormwater runoff, transported across the landscape to waterways by rainfall and snowmelt. Due to the dispersed nature of nonpoint source pollution, many variables can affect the amount of pollution delivered to a waterbody any given year. The State of Vermont estimates the nonpoint source nutrient reductions associated with clean water projects, but these estimates may differ from realized environmental conditions. For more information on the variables that affect measured water quality conditions, including climate change, land use change, and cyanobacteria ecology, as well as information on where to access measured water quality monitoring data for Vermont's waters, please refer to Chapter 6 of the *Vermont Clean Water Initiative 2021 Performance Report*.

Modeled vs. Measured

The phosphorus reduction estimates presented in this report in comparison to the Lake Champlain and Lake Memphremagog TMDL reduction targets are *modeled* estimates of phosphorus reductions. The state has established accounting methods to estimate the pollutant reduction associated with implementation of various types of clean water projects to determine progress towards meeting the largescale TMDLs.[53] These methods will be refined and expanded in the future as new information becomes available to increase the accuracy of tracking the State's progress towards reaching pollution reduction targets set by the TMDLs.

The State also collects data on *measured* phosphorus concentrations across multiple monitoring locations. Many factors can affect the results of measured in-lake phosphorus concentrations. The recency and intensity of precipitation can influence measured concentrations of phosphorus as a result of nutrients flushing off the landscape and into waterbodies. In addition, legacy phosphorus bound in lakebed sediments presents a potentially substantial source of internal phosphorus loading in larger lakes. While much of the clean water investments to date have targeted reductions in phosphorus reaching Vermont waterbodies through external loading originating from the landscape, addressing internal sources of loading from legacy phosphorus concentrations contained in lake sediments may also be needed in some areas to achieve desired water quality outcomes and reduce the occurrence of cyanobacteria blooms. For example, shallow enclosed bays with high instance of thermal stratification may continue to exhibit cyanobacteria blooms primarily resulting from internal loading of legacy phosphorus despite widespread investments at the watershed scale to mitigate and reduce external sources of phosphorus loading.

As a result of the variables that impact measured water quality, it is expected that there may be substantial lag time between the implementation of projects and the realization of measurable improvements in water quality. This highlights the importance of sustained efforts to continue managing nutrient and sediment pollution to ensure long term health of Vermont's waters.

[53] Vermont Department of Environmental Conservation standard operating procedures for tracking and accounting for phosphorous reductions can be accessed here: https://dec.vermont.gov/water-investment/cwi/projects/tracking-accounting#SOP

Looking Ahead to Cleaner Water

The TMDL for both the Lake Champlain and Lake Memphremagog basins necessitate a year-over-year increase in achieved phosphorus reduction in order to meet the established targets. The figures below show estimated total annual phosphorus reductions achieved to date, as well as the projected path of phosphorus load reduction progress required to meet the TMDL reduction targets within the 20-year timeframe of the TMDLs.[54]

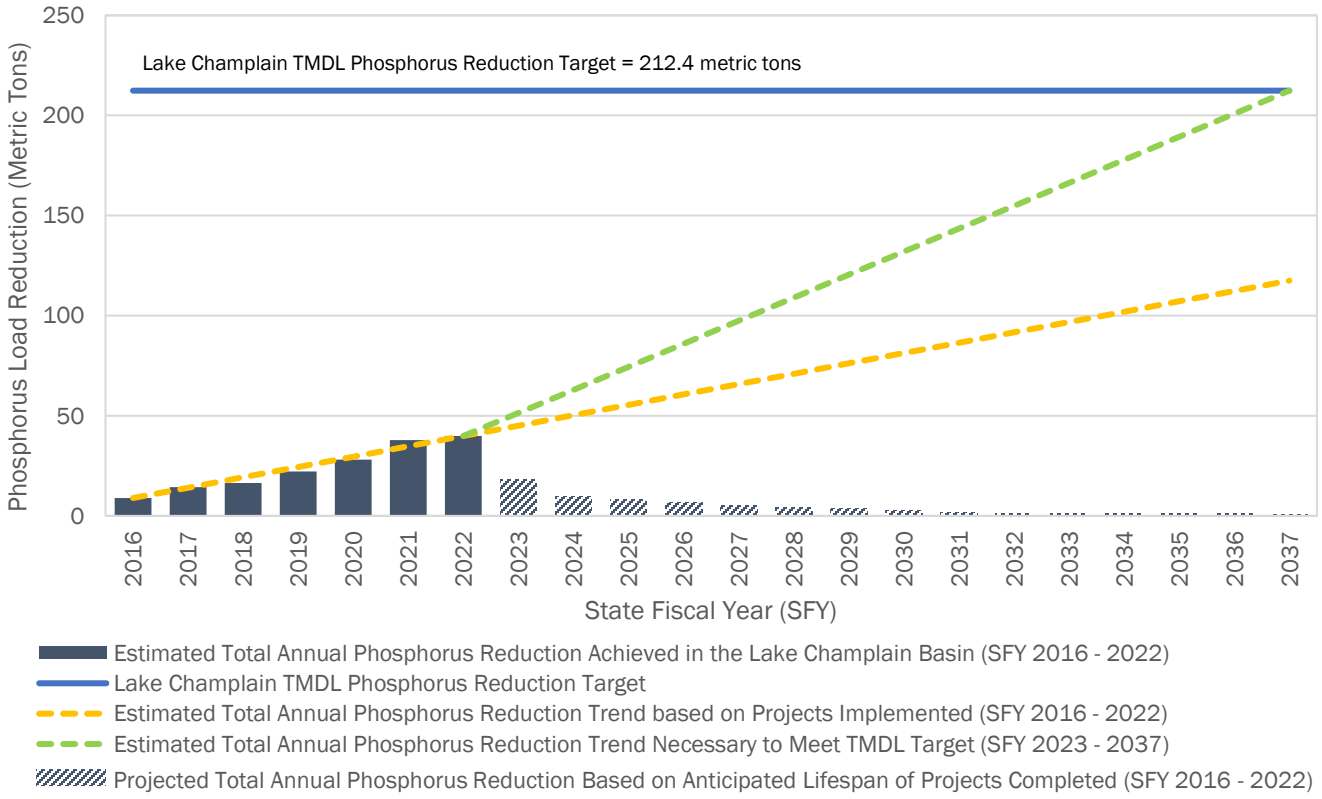

Figure 38. Estimated total annual phosphorus load reductions achieved to date and projected phosphorus reduction trend necessary to meet the Lake Champlain TMDL phosphorus reduction target by SFY 2037.

EXPLANATION OF FIGURE

Between SFY 2016 and 2022, estimated total annual phosphorus load reductions achieved through clean water project implementation in the Lake Champlain basin has resulted in an average annual increase in phosphorus reduction of 5.2 metric tons per year. In order to meet the TMDL target phosphorus reduction of 212.4 metric tons by the end of the 20-year TMDL period, estimated annual phosphorus reductions between SFY 2023 – 2037 needs to increase to an annual average change of 11.5 metric tons reduced per year.

[54] Phosphorus reduction estimates are presented in delivered load. For more information, see the Accountability Measures section.

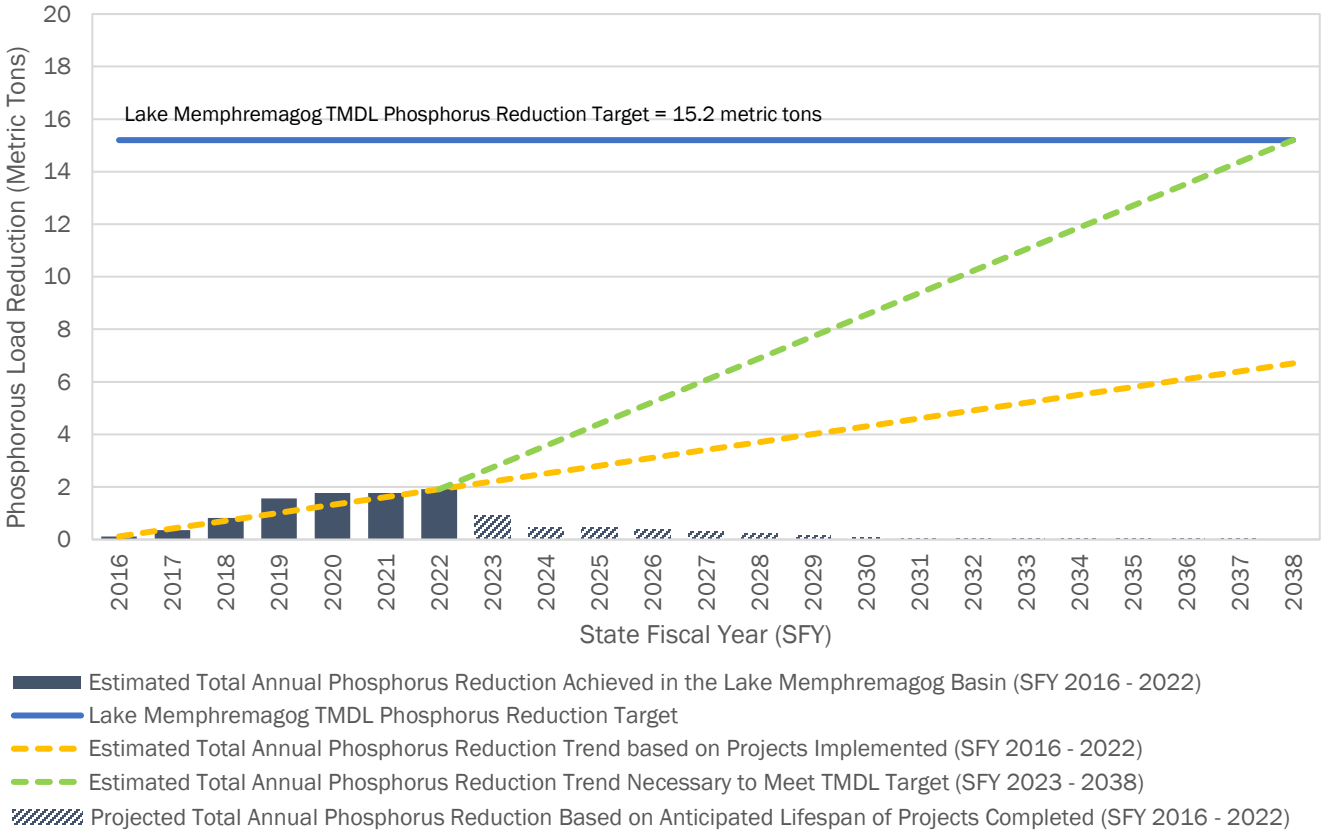

Figure 39. Estimated total annual phosphorus load reductions achieved to date and projected phosphorus reduction trend necessary to meet the Lake Memphremagog TMDL phosphorus reduction target by SFY 2038.

EXPLANATION OF FIGURE

Between SFY 2016 and 2022, estimated total annual phosphorus load reductions achieved through clean water project implementation in the Lake Memphremagog basin has resulted in an average annual increase in phosphorus reduction of 0.3 metric tons per year. In order to meet the TMDL target phosphorus reduction of 15.2 metric tons by the end of the 20-year TMDL period, estimated annual phosphorus reductions between SFY 2023 – 2038 needs to increase to an annual average change of 0.8 metric tons reduced per year.

Continued effort, investment, and coordination is critical to the state reaching the water quality goals outlined in the TMDLs. In addition, expansion of maintenance efforts to sustain the functional life of implemented projects will be key to building on past work and contributing to future progress towards the TMDL target reductions. Estimated phosphorus reductions in the Lake Champlain and Lake Memphremagog basins are expected to increase in the coming years for at least the following reasons:

- State funding programs at DEC have shifted to block grant structures that rely on regional partners to manage and administer funding of individual projects. The transition to regional administration of clean water funding is anticipated to empower community partners, reduce bottlenecks, and increase the impact of clean water investments.

- Vermont has received an influx in federal funding under ARPA and the Bipartisan Infrastructure Law, as well as increased Clean Water Fund revenue enacted under Act 76 of 2019. Program expansion supported by this funding will drive clean water project implementation across sectors, which is anticipated to be reflected in increases in estimated annual phosphorus reductions in the coming years.

- The State of Vermont has been expanding clean water regulatory, financial, and technical assistance programs since SFY 2016. Many regulatory programs are now in place that will drive phosphorus reductions from agriculture and developed lands, with meaningful progress expected in the coming years.

- The State has recently published methods for quantifying phosphorus reductions for clean water practices in the agricultural, natural resource, and developed lands sectors. New methods were established for some practices, particularly in the natural resource sector, which have not been fully implemented as data collection mechanisms are not yet in place. Collection of data required to estimate phosphorus reductions under these new methods will begin in the coming year.

As the State of Vermont moves beyond the "ramping up" period of TMDL implementation in the Lake Champlain and Lake Memphremagog basins, new funding streams and revised structures of funding administration will enable the state to realize even more impactful clean water outcomes and results. By empowering local and regional partners to administer funding through Act 76, greater mobilization of funds and reduction of bottlenecks will allow for more progress towards clean water goals on the ground. Through expanded methods for estimating phosphorus reductions achieved by clean water projects, the state will have an improved understanding of the progress made towards reaching clean water targets, and what more is needed to ensure these goals are met.

Appendix A. South Lake Champlain (Basins 2 & 4) TMDL Implementation 2022 Progress Report

The Accountability Framework of the 2016 *Phosphorus Total Maximum Daily Loads (TMDL) for Vermont Segments of Lake Champlain* ensures TMDL implementation moves forward at a steady rate. A major driver of the Accountability Framework is the Vermont Department of Environmental Conservation's (DEC) development of basin-specific Tactical Basin Plans (TBP). TBPs are developed on a five-year rotating basis and include Implementation Tables that identify priority actions needed to implement the TMDL. It is through review of the Implementation Tables, and the progress made in accomplishing the tasks, that U.S. Environmental Protection Agency (EPA) tracks implementation progress in each basin. To facilitate EPA's evaluation of progress, DEC describes the status of each strategy midway through (2.5 years) and at the conclusion of the five-year planning cycle in interim and final report cards, respectively.

Appendix A is the final report card for the South Lake Champlain Basin, updating the 2020 interim report card.[55] The five-year reporting period began in January 2018 coincident with the publication of the 2017 South Lake Champlain TBP and goes through June 30, 2022.[56] Data in this report aligns with this five-year period and the SFY 2017–SFY 2022 granting period of the Clean Water Reporting Framework.

The following sections describe progress towards completing phosphorus reduction strategies excerpted from the 2017 South Lake Champlain TBP Implementation Table. Each strategy is organized by one of five major sectors – agriculture, developed lands, natural resources, forestry, and wastewater. Progress described for each strategy includes status (defined in Table A-1) as well as an explanation of actions taken. The explanation describes how the Agency supported the strategy and resulting outcomes that together show that meaningful results were achieved. Information provided includes performance measures for Agency-supported assistance that were collected as part of the Accountability Framework. These performance measures provide a quantitative measure of implementation to accompany the description of collaborative effort.

Estimations of total phosphorus loading reductions to the lake are not presented in this report. Instead, estimated total phosphorus load reductions are presented in Chapter 3 of the *Vermont Clean Water Initiative 2022 Performance Report* to allow comparison to the TMDL phosphorus allocations.

Basins 2 & 4 Update

The 2017 TBP strategies were evaluated and their associated actions were assigned a status condition using the rationale described in Table A-1. To address strategies identified as ongoing in the 2022 South Lake

[55] Page 117 of the Vermont Clean Water Initiative 2020 Performance Report.

[56] The 2017 South Lake Champlain Tactical Basin Plan available at: https://dec.vermont.gov/sites/dec/files/wsm/mapp/docs/mp_TacticalBasinPlan_Basin02-04_SouthLakeChamplain_FINAL_2017-12-31.pdf

Champlain Tactical Basin Plan, a status of complete, continued, or discontinued has been assigned to previously ongoing projects. Of the 59 strategies identified to date, 27 have been completed, 30 are in progress, and 2 are discontinued (Figure A-1).

Table A-1. Status conditions assigned to strategies and actions in the TBP Implementation Table (Table A-2).

Strategy Status for Final Report Card	Description	Example(s)
Complete	A discrete action identified in a strategy with a clear end point that has been implemented. A strategy identified as ongoing in the 2019 interim report card that has been pursued and implemented throughout the TBP's 5-year period.	Provided 3 trainings to partners to evaluate 5 properties for Lake Wise assessments. The Municipal General Permit was implemented and all or most towns are on schedule to meet permit requirements. Five priority projects were implemented that were identified in River Corridor Plans.
In Progress	A discrete action identified in a strategy with a clear end point that is being implemented either as described, or, where needed, with revisions as described in the subsequent plan.	Stormwater master plan was funded and is being implemented but is not yet complete. An updated strategy to support water quality goals was identified during the planning process to focus on monitoring to meet water quality goals.
Continued	A discrete or programmatic strategy that was not initiated or formally pursued due to lack of interest, funding, or capacity gaps.	Strategy was carried over to the watershed projects database to be implemented when there is interest and capacity. Strategy is still a high priority and carried over to the next basin plan.
Discontinued	A discrete or programmatic strategy that was removed as a strategy and is no longer a priority.	The project was superseded by a project further upstream that treated the problem effectively. The project is no longer a priority for the state program.

This report depicts a watershed community that is pursuing permit compliance and implementing voluntary practices that work towards meeting the state's water quality and phosphorus reduction goals. This is achieved through the implementation of permit programs, installation of green stormwater practices, adoption of flood resilience measures, implementation of farm agronomic practices, and application of riparian restoration and conservation projects. As described in the final status report for the 2017 South Lake Champlain TBP Implementation Table (Table A-2), most of the actions associated

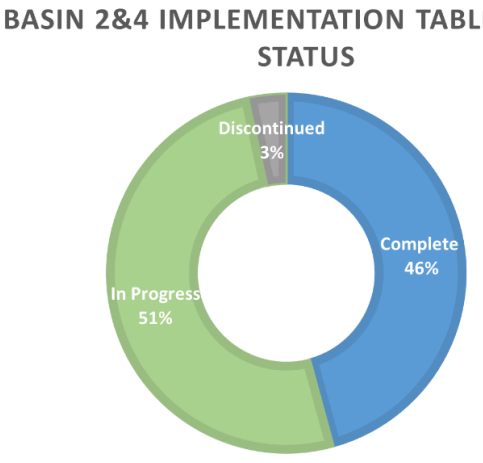

Figure A-1. Basin 2 & 4 Implementation Table action status of the 59 strategies in the 2017 TBP Implementation Table.

with regulatory programs were completed or were in progress in 2020. A majority of those were completed through Agency of Natural Resources (ANR) or Agency of Agriculture Farm and Market's (AAFM) financial support to permit holders as well as partners who distributed education, outreach, and technical assistance. Regulatory compliance outcomes include increased implementation of Required Agricultural Practices (RAPs) and agricultural best management practices (BMPs) and stormwater BMPs on roads. In addition, there was a steady increase in resources provided by the state to communities and partners, which in turn supported a steady increase of adoption of natural resource restoration practices, and stormwater management of developed land. Available funding and advanced coordination played a critical role in allowing watershed partners and municipalities to work together to complete and pursue 97% of strategies, that were not discontinued, from the 2017 South Lake Champlain TBP.

Phase 3 of the TMDL in the 2022 TBP provides additional information that explains sector progress on meeting TMDL goals. This progress is an outcome of strategy implementation in the 2017 TBP.

Eighteen percent of the 67 strategies in the 2017 plan are still in progress. Those strategies in progress that were pursued and then updated as a new strategy in the 2022 South Lake Champlain TBP, will be reported on during the next planning cycle. The narrative in Table A-2 provides additional detail in the explanation column for strategies in progress. Most projects in progress have completed the first phase of action, for example, a design may have been completed for a project, but the implementation of the project will be completed in the next year.

The 52 percent of strategies that were not pursued but carried over to the 2022 South Lake Champlain TBP (continued) have extended timelines for completion contingent upon other programs or permit requirements (e.g., hydroelectric related strategies, toxics impairments, etc.) or are strategies that did not receive enough interest or support to be completed but are still a priority for follow-up. These projects include identifying monitoring volunteers for lakes, assessment of lake shoreland, and stream and lake reclassification. DEC published new webpages on lakes and streams reclassification, which may catalyze reclassification efforts in the next five years. The narrative in Table A-2 provides detail in the explanation column for these strategies.

The six percent of strategies that were discontinued were mostly the result of a change in priority as recommended by a state program, or the project was removed from the strategy table as a discrete project and added to the Watershed Projects Database. The narrative in Table A-2 provides more detail in the explanation column for strategies that were discontinued.

In the 2022 TBP, a new set of strategies are identified that represent the next phase of work associated with regulatory programs, or improved approaches that partners can take with agency resources to encourage implementation in the community. Additional accounting methodology will encompass more activity on landscape and show a more accurate representative of total phosphorus reductions achieved.

In addition, the Clean Water Service Delivery Act (Act 76) will increasingly support the delivery of clean water services and increase regional capacity to develop and implement projects that fulfill actions.[57] An

[57] Act 76 website available here: https://dec.vermont.gov/water-investment/statues-rules-policies/act-76

explanation of DEC's expected progress based on these additional resources is included in the 2022 TBP's Chapter 3 (LC TMDL Phase 3) and Chapter 4. DEC will submit the interim report for the 2022 Tactical Basin Plans in 2025 and the final report in 2027.

Basins 2 & 4 Implementation Table Status

The status for each strategy (Table A-2) was compiled by the Water Investment Division's Watershed Planning Program using data from the DEC, NRCDs, RPCs, and additional watershed partners involved in project development and implementation for the five-year planning period.

The Implementation Table is not an exhaustive list of water quality strategies that lead to phosphorus reductions in a basin. A complete description of all the work that the state supports in the basin to meet water quality goals can be found in the 2021 Vermont Nonpoint Source Management Plan.[58] Additional information about progress associated with each sector can be found in Chapter 3 of the *Vermont Clean Water Initiative 2022 Performance Report* which provides comprehensive reporting of estimated total phosphorus load reductions associated with state funding, federal funding, and regulatory programs. These data are also available to the public through the Clean Water Portal's Clean Water Interactive Dashboard – an online tool that allows interested parties to examine and filter Performance Report data on investments, project outputs, estimated pollutant load reductions and project cost effectiveness.[59] Individual projects in the basin that are included or supported by strategies are describe in the Clean Water Explorer, also found through The Portal.

[58] Vermont Nonpoint Source Management Plan 2021-2025 available here: https://dec.vermont.gov/sites/dec/files/wsm/erp/docs/Vermont%20NPS%20Management%20Plan%202021-2025.pdf

[59] Clean Water Portal can be accessed here: https://anrweb.vt.gov/DEC/cleanWaterDashboard/

Table A-2. Basin 2 & 4 Implementation Final Status Report; includes data from a) SFY 2017 to SFY 2022 and b) calendar year 2017-2022, unless otherwise noted.

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Map parcels that will come under the three-acre stormwater (SW) permit and outreach to affected property owners.	Basin wide	Castleton, Dorset, Fair Haven, Pawlet, Poultney, Rupert, West Haven, West Rutland	Developed Lands - Other	Complete	The 2019 SW Program general permit for stormwater (SW) from "three-acre sites" applies to sites with three or more acres of impervious surface and lacking a SW permit based on the 2002 Vermont Stormwater Management Manual. The Program has identified and notified affected owners[60]. Basin 2 & 4 parcels will need to apply for permit coverage by 2023.	1
Complete Stormwater Master Plans (SWMP) for the towns of Castleton, Dorset, Fair Haven, Poultney, and West Rutland. Identify highest priority projects for implementation.	Castleton River Headwaters, Lake Bomoseen Watershed, Lower Castleton River Watershed	Castleton, Fair Haven, West Rutland	Developed Lands - Other	Complete	The Pawlet/Flower Brook SWMP identified 14 projects. One is installed and several were partially installed by the town. The 2018 Fitzgerald Environmental Associates (FEA)/ Poultney Mettowee Natural Resource Conservation District (PMNRCD) Castleton Headwaters SWMP assessed 30,608 acres, identified 75 potential projects, 12 project sketches, and five 30% designs were completed. The 2019 FEA/PMNRCD Lake Saint Catherine SWMP assessed 20,871 acres, identified 50 projects, the highest-scoring 20 projects received one-page summaries, and six 30% designs were completed. Poultney-Mettowee Natural Resources Conservation District (PMNRCD) received Design and Implementation Block Grants to implement 6 projects. Four were installed in 2021 and two will be installed in 2022. The 2022 Poultney River Watershed SWMP is in progress. 51 projects were identified. A Dorset SWMP has not started, but may be combined with a Mettowee SWMP or the Bennington County Conservation District may complete it.	2

[60] List of three-acre sites identified by the Stormwater Program: https://dec.vermont.gov/sites/dec/files/wsm/stormwater/docs/9050/3acreList_09252020.pdf

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Develop 90% designs for the highest priority projects identified in the Lake Bomoseen and Lake Saint Catherine (LSC) SWMP.	Lake Bomoseen, Wells Brook-LSC	Castleton, Hubbardton, Wells, Poultney, Tinmouth, Middletown Springs	Developed Lands - Other	In Progress	The PMNRCD coordinated and participated in a number of stormwater master plans. The 2016 FEA/PMNRCD Lake Bomoseen SWMP assessed 24,770 acres, identified 48 potential projects, and 20 were ranked as high priority. Six were selected for conceptual designs, two have final designs, and one was implemented. PMNRCD plans to complete more projects in 2023-24. The 2019 LSC SWMP assessed 20,871 acres, identified 50 projects, and six 30% designs were completed. PMNRCD received Design and Implementation Block Grants to implement 6 projects, 4 completed and 2 ready to install (one waiting on a signed Operations & Maintenance agreement).	3, 5
Create a Southern Champlain SW Collaborative to provide outreach to landowners about SW Best Management Practices (BMPs) including Green Stormwater Infrastructure (GSI) practices.	Basin wide-	All towns	Developed Lands - Other	Complete	The intent of this strategy was met through SW-related education and outreach events. During SFY 2017-2022, a total of 24 E&O and technical assistance (TA) events reached 1,509 participants in the basin. The Lake Champlain Basin Program (LCBP) and Lake Champlain Sea Grant funded additional Lake Wise efforts and 5 PMNRCD staff participated in outreach, Lake Wise assessments, and lake shoreline BMP implementation. In addition, this strategy was addressed through PMNRC-led SWMP initiatives (e.g., the Castleton Headwaters SWMP and at LSC and Lake Bomoseen). PMNRCD also completed outreach efforts to landowners in Pawlet to introduce 13 SW projects identified in the 2016 Flower Brook SWMP. Landowners 'voted' on BMPs to install in Pawlet and towns participated in SWMP project ranking discussions.	4

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Identify and correct potentially failed septic systems identified by IDDE assessment.	Basin wide	Pawlet	Developed Lands-Other	Complete	Pawlet IDDE report completed in 2016[61] Only one illegal connection was found and repaired.	6
Support brownfields restoration efforts that mitigate surface water pollution generated from these sites.	Basin wide	Rutland City	Developed Lands-Other	Complete	The Rutland Regional Planning Commission (RRPC) Brownfields program completed eight Environmental Site Assessments (ESA) in and around the City of Rutland. Sites include the former College of St. Joseph campus and Lynda Lee Fashions building in Rutland City. The former College of St. Joseph property is adjacent to the Otter Creek and there will be a limited cleanup of the site in association with redevelopment in 2021.	7
Complete annual Lake Wise trainings to develop capacity for local partners to evaluate properties for Lake Wise Assessments.	Priority sub-basins including lakes with increasing nutrients trends or elevated levels (including Beebe, Bomoseen, Saint Catherine, and Sunrise)	Castleton, Fair Haven, West Rutland	Lakes	Complete	The DEC Lakes and Ponds Program trained five PMNRCD staff members to conduct Lake Wise evaluations in 2018 and 2019. In 2021, the PMNRCD trained additional staff and trained staff at Friends of the Winooski watershed group. In 2022, PMNRCD and the LSC Association (LSCA) partnered with Castleton University to run a summer Lake Wise program at LSC (assessments available by PMNRCD for any area lake).	8

[61] Pawlet IDDE Report: https://anrweb.vt.gov/PubDocs/DEC/Stormwater/Town%20Reports%20and%20Maps/Pawlet/Pawlet%20IDDE%20Report.pdf

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Complete Lake Watershed SWMPs and Lake Wise assessments for Beebe, Bomoseen, Burr, Hortonia, Saint Catherine, Sunrise or other stressed lakes and implement priority projects.	Priority sub-basins including lakes with increasing nutrients trends or elevated levels (including Beebe, Bomoseen, Saint Catherine, and Sunrise)	Hubbardton, Castleton, Sudbury, Poultney, Wells, Benson, Orwell	Lakes	In Progress	Lake SWMPs are complete for Beebe, Bomoseen, Hortonia, Burr, Saint Catherine. The remaining lakes are covered by the Poultney River SWMP. Eight Lake Wise assessments[62] are complete for Lake Bomoseen and more are planned. PMNRCD will reach out to the other lakes and coordinate with the Watershed Planner and the DEC Lakes and Ponds Program. LSCA received funds to implement 10 projects identified in Lake Wise assessments and PMNRCD received funds to implement six projects identified in Lake Wise assessments. They are working together to implement approximately 20 projects in 2020-21. PMNRCD has funds for 2022 and currently have 60 sites assessed at LSC.	9, 10, 11
Complete Lake Wise assessments and implement priority projects at Bomoseen State Park to increase the visibility of BMP practices.	Lake Bomoseen Watershed	Castleton, Fair Haven, Hubbardton, Benson	Lakes	Complete	A 2017 shoreline planting project was implemented at Bomoseen State Park. Plantings were focused in areas being impacted by camping and recreation and fencing was installed to redirect foot traffic and protect the newly planted areas.	12

[62] https://dec.vermont.gov/watershed/lakes-ponds/lakeshores-lake-wise/lakewisemap

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Develop and evaluate the new Lake Watershed Action Plan (LWAP) process to identify and address sources of nutrients to lakes.	Priority sub-basins including lakes with increasing nutrients trends or elevated levels (including Beebe, Bomoseen, Saint Catherine, and Sunrise)	Wells, Poultney	Lakes	In Progress	Lake watershed SWMP assessments were completed for Lake Bomoseen and LSC. Due to continued community interest, PMNRCD and LSCA pursued 2021 LCBP funding to complete the DEC's LWAP for LSC. FEA, PMNRCD, and LSCA are the project team completing the LWAP.	13
Provide education and outreach to towns and communities about Municipal Road General Permit (MRGP) regulations. Prioritize implementation of projects that address road segments with significant water quality impacts.	Basin wide-all hydrologically connected surface waters	All towns	Developed Lands - Roads	In Progress	The intent of this strategy was met through MRGP-related education and outreach events. During SFY 2017-2022, a total of 21 E&O and technical assistance (TA) events reached 924 participants in the basin. The RRPC and Addison County RPC (ACRPC) transportation planners have monthly meetings with town select boards and road commissioners. In addition, a 2018 erosion control workshop coordinated by PMNRCD had 70 attendees and highlighted the importance of erosion control applications and new technologies/solutions to address erosion around homes, rivers, lakes, roads, and construction sites. RRPC staff are working with towns to prioritize MRGP projects and to-date, implementation is approximately 30 percent for projects addressing known water quality issues.	14, 15

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Update road erosion inventory (REI) template to incorporate MRGP requirements and highlight projects with water quality benefits. Support towns in completing at least five REIs and implementing priority road projects with the most significant water quality benefits.	Basin wide- All hydrologically connected surface waters	All towns	Developed Lands - Roads	Complete	All REIs are complete and information is tracked in the online MRGP Implementation Table Portal. During SFY 2017-2022, 384 hydrologically connected road miles were inventoried and 104 hydrologically connected road miles were identified that require water quality improvements. Seventeen miles of municipal road drainage and erosion control improvements were made and 81 municipal road drainage and stream culverts were replaced in the basin. Towns are using a combination of Regional Transportation Funds, VTrans Better Roads grants, DEC Grants-in-Aid funds, and their own municipal funds to implement projects to meet MRGP standards.	16, 17, 18
Complete ANR bridge and culvert surveys and replace structures identified as barriers to AOP and/or that are geomorphically incompatible.	Basin wide- focus in the East Creek and other Lower Champlain Direct watersheds	All towns	Developed Lands - Roads	In Progress	ANR bridge and culvert surveys are complete. During SFY 2017-2022, 81 municipal road drainage and stream culverts were replaced in the basin. As culverts are replaced on State and town roads, they are reviewed by the Rivers Program to ensure structures meet current standards for geomorphic compatibility. Towns are replacing culverts when funding is available. DEC, USFWS, and local partners continue working to prioritize high priority culvert replacements. PMNRCD works with a variety of partners on AOP projects and with Bennington County Conservation District hired Stone Environmental Consultants to design a culvert replacement for Purchase Brook in Danby in the Flower Brook watershed. USFWS has expressed interest in funding the new structure with PMNRCD.	19

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Implement six minimum control measures (MCMs) required in the State TS4 permit.	Basin wide	All towns	Developed Lands - Roads	In Progress	Per Part 6 of the TS4 Permit, VTrans is implementing and enforcing a 2018 SWMP, which includes six MCMs designed to reduce the discharge of pollutants from the TS4 to the maximum extent practicable, to protect water quality, and to satisfy the appropriate water quality requirements of the CWA. Implementation of the six MCM is ongoing. The BMPs that are being implemented by VTrans to address these six MCMs are included in Part 6.0 of the SWMP[63] (2018). A summary of annual reporting requirements and progress for each MCM is provided in the 2020 Annual Report Workbook[64].	20, 21
Complete assessments necessary to support the development of a phosphorus control plan (PCP) for the South Champlain Basin early in the next TS4 permit cycle.	Basin wide	All towns	Developed Lands - Roads	In Progress	VTrans submitted the generalized PCP on April 1st, 2020. It included identification of VTrans owned parcels, calculation of P base loads, P reduction targets for each segment of Lake Champlain as well as plans to investigate higher P source areas and develop P loading rates to help prioritize the highest source areas. A VTrans ArcGIS story map[65] details this information more fully. On October 1st, 2020, VTrans submitted their first implementation plan, where they seek to meet approximately 25 percent of the total P reduction target in four years. There will be three subsequent four-year implementation plans that will each seek to meet approximately 25 percent of the reduction target, with the goal of fully meeting their reduction targets by 2036.	21
Identify funding to complete "Park and Ride" SW treatment practices.	Basin wide	All towns	Developed Lands - Other	Discontinued	No progress recorded toward this project.	22

[63] https://anrweb.vt.gov/PubDocs/DEC/Stormwater/PublicNotice/7892-9007/VTrans%20Final%20SWMP%20-%20December%205%202017.pdf

[64] https://vtrans.vermont.gov/sites/aot/files/SupportServices/annual_rpt_wrkbk_vtrans_2020.pdf

[65] https://www.arcgis.com/apps/MapJournal/index.html?appid=af0d93d2e55f42f1803ca79e0c492f3f

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Develop and implement SW practices to address runoff from Route 30 that is entering Lakes Bomoseen and Saint Catherine (including Little Lake).	Lake Bomoseen Watershed, Poultney River Watershed	Castleton, Hubbardton, Wells, Poultney	Developed Lands - Other	In progress	The Lake Bomoseen SWMP identified a project focused on the Edgewater Resort and associated Route 30 drainage with about one acre of impervious (including ½ acre of gravel) contributing sediment and nutrients directly to the lake under Route 30. PMNRCD will work with the landowner to implement the project. The LSC SWMP identified a project on Fern Cliff Road (6), which was funded ($10,106) through a DEC Block Grant. It addressed runoff along Tucker Road and Route 30, and an eroded 18" culvert. PMNRCD completed the project in 2021. Additionally, the LSCA and PMNRCD received LCBP funds to complete a LWAP for LSC, which is ongoing and will evaluate the culverts crossing Route 30 and other hydrologically connected roads and address runoff from culverts and road ditches.	23
Create South Lake Champlain farmer workgroup to support the implementation of Required Agricultural Practices (RAP), agricultural BMPs, and education and outreach (E&O) to meet TMDL requirements in high priority catchments.	Basin wide	All towns	Agriculture	Complete	South Lake Farmer workgroup was not created, but PMNRCD and UVM are engaging farms through other stakeholder groups and there is the potential to leverage more, e.g., the Champlain Valley Farmer Coalition. During SFY 2017-2022 a total of 20 E&O and Technical Assistance (TA) events reached 545 participants in the basin. PMNRCD is currently working with the CVFC to document farmer funded BMPs not otherwise recorded for the TMDL. In 2022, several Mettowee Valley farms worked with the PMNRCD and VLT to create the Mettowee Valley Equipment Cooperative. They raised money to purchase specialized equipment to facilitate conversion from conventional to organic, grass-based farming techniques, support diversification of organic cropping practices, and protect water quality.	24, 25, 32

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Create a tracking system for Certified Small Farm Operations (CSFOs) that need Nutrient Management Plans (NMP) or that have up-to-date NMP, schedule to keep these up-to-date.	Basin wide	All towns	Agriculture	Complete	AAFM RAPs require CSFOs to submit an annual certification form by January 31st of each year, which includes the status of the CSFO's NMP. This information is available to Agricultural Clean Water Initiative Program (AgCWIP) partners for the purpose of NMP E&O and TA. Additionally, PMNRCD created an internal tracking system, surveyed the farming community, and is assisting farms with NMP development, updates, and implementation.	26
Support eight farmers in developing NMPs through UVM Extension's Digging In course and the development of NMPs for all certified farms through NRCS CAPS funding.	Basin wide	All towns	Agriculture	Complete	State and federal funds support the work of NRCDs and UVM Extension to provide NMP courses and TA to farms developing and implementing NMPs. PMNRCD works with an average of 30 farms per year and Agronomy & Conservation Assistance Program (ACAP)/AgCWIP report shows an average of six NMPs per year. Additionally, PMNRCD assists an average of 2-3 farms per year who do not want to attend the class, but the District is limited by capacity. Technical assistance related to NMP development and updates is expected to continue through the PMNRCD ACAP program with continued support from VAAFM AgCWIP through 2026.	27, 28
Generate funding so partners can work with priority farms NMPs and installing practices to address issues identified in NMP and Land Treatment Plans (LTPs).	Basin wide	All towns	Agriculture	Complete	Starting in SFY 2018, AAFM launched the AgCWIP made possible by the Vermont Clean Water Fund. Natural Resources Conservation Districts and UVM Extension staff working in the basin are recipients of AgCWIP grant awards, which include funding to provide TA for NMP and BMP implementation. PMNRCD implements NMPs, assists farms with applications to BMP and Pasture/Fence (PWSF) grants with VAAFM, and follow up work. PMNRCD also uses their own funding (private and federal funds) to install farm BMPs based on NMP/LTP.	29

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Include local dairy nutritionist in the (proposed) South Lake agricultural workgroup to support partners in make the bridge from NMP to feed & forage management.	Basin wide	All towns	Agriculture	In progress	A nutritionist position is unlikely and PMNRCD is meeting the strategy intent through E&O and TA visits.	30
Evaluate additional BMPs that could be used on hay land to reduce loading from this land use. Provide outreach to farmers to support effective BMPs.	Flower Brook, Poultney River, Mettowee River, Hospital Creek, Whitney Creek, East Creek	Pawlet, Danby, Tinmouth, Poultney, Fair Haven, West Haven, Middletown Springs, Tinmouth, Ira, Castleton, Pittsford, West Rutland, Hubbardton, Benson, Sudbury, Wells, Rupert, Dorset, Addison, Bridport, Shoreham, and Orwell.	Agriculture	Complete	The VT Agricultural Tracking and Accounting group assesses and analyzes the BMPs for reduction efficiencies and effectiveness in collaboration with state and federal agencies involved in developing and submitting data for state P accounting. New 2020 recommendations for BMPs eligible to be installed on hay lands from that inter-agency group include: 1. Multiple lines of evidence suggest that soil aeration may not be associated with reductions in total P loads from hay fields in VT. As a result, the workgroup decided to not adopt a P reduction efficiency for soil aeration practices. 2. Using a statistically driven approach to develop and evaluate P reduction efficiencies, a 40 percent manure injection reduction efficiency was determined. 3. A 24 percent reduction efficiency was determined for pastures under the Grazing Management BMP. The AAFM Farm Agronomic Practices (FAP) Program and NRCS Environmental Quality Incentives Program (EQIP) fund hay land and pasture practices including: No Till, Pasture and Hay Land Renovation, Rotational Grazing, and Manure Injection. From SFY 2017 to 2022, 26,187 acres of agricultural land were treated by conservation practices in the basin.	31

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Develop SW BMPs for farms and provide technical and financial support for farms to implement these to address runoff from impervious surfaces in farm production areas.	Basin wide	All towns	Agriculture	In progress	The RAPs Section 6.01(b) requires production areas, barnyards, animal holding or feedlot areas, manure storage areas, and feed storage areas utilize runoff and leachate collection systems, diversion, or other management strategies to prevent the discharge of agricultural wastes to surface water or groundwater. Technical and financial assistance is available to farmers to reduce production area runoff of agricultural wastes through the AAFM BMP Program and NRCS EQIP. Examples of barnyard and production area practices implemented on farms to address agricultural waste runoff are heavy use area protection, waste storage facilities, clean water diversions, and roof runoff structures. These are important and commonly used practices by farmers to manage runoff from impervious surfaces and protect nearby surface waters. From SFY 2017 to 2022, 335 structural agricultural practices were installed in the basin. While the majority of these structural practices are located within a farm's production area, pasture infrastructure such as fencing and animal trails are also included in this total number.	33

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Increase conservation equipment available for rental or through custom applicators to allow farmers to follow NMPs including equipment to measure crop yields, manure application rates, take soil samples, and to implement practices such as no-till drills, manure injectors, tine weeder air seeders.	Basin wide	All towns	Agriculture	Complete	Starting in SFY 2018, AAFM expanded the Conservation Equipment Assistance Program (CEAP) to provide opportunities for farmers, custom applicators, and non-profit organizations to receive grant funding for conservation equipment. Between SFY18 and SFY22, CEAP provided funding to 16 farmers and partners in the basin to purchase conservation equipment. To date, farms have implemented over 7,000 acres of conservation practices by acquiring conservation equipment through the program. In addition to the CEAP program, PMNRCD owns and rents one no-till drill, an aerator, and now the District partners with the Mettowee Valley Equipment Cooperative to manage a manure injector and other equipment for a subset of farms in the Mettowee Valley. PMNRCD recently purchased forage moisture meters that are being used for yield measurements. PMNRCD staff will soil sample for farmers on an as-needed basis after they have a complete NMP with priority given to those farms that have participated in the RCPP NMP program.	34

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Promote existing programs and develop programs to reduce financial match requirements for farmers to implement priority water quality improvement practices in coordination with Farm Viability Program.	Basin wide	All towns	Agriculture	Complete	AAFM provides funding through the AgCWIP program to UVM Extension Farm Viability Program/Agricultural Business Team to assist farms with certification and regulatory requirements, RAPs, and farm business planning, Water quality financial plans for BMP implementation, as well as grant funding opportunities and coordination. These services are available for South Lake Champlain farmers. Additionally, new innovative programs and initiatives have launched for Vermont Producers to incentivize conservation adoptions and support farm viability. One example is the Vermont Pay For Performance Program (VPFP) administered by the Water Quality Division of VAAFM. VPFP is a new and innovative program that provides performance based payments to Vermont farmers reducing phosphorus (P) losses from their agricultural fields. VPFP pays for outcomes of the practice: it recognizes that conservation practices generate value to the public and directly compensates farms for that value. Additional statewide initiatives promoting conservation and farm viability include the Payment For Ecosystem Services workgroup.	35, 40
Develop equine specific programming including support for installing horse manure compost bins and making pasture improvements.	Basin wide	All towns	Agriculture	Complete	PMNRCD created a RAP packet for Horse Owners, which it distributes to horse owners, stables, and at RAP workshops. Copies have also been left at the various town offices. From SFY 2017 to 2022, five RAP and pasture improvement workshops and two compost bins were implemented in the basin.	36

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Complete targeted water quality sampling on farms to identify source areas and evaluate nutrient reductions achieved through BMP implementation.	Basin wide with focus on East Creek, Stony Creek, Braisted Brook, Wards Creek, Hospital Creek, Dead Creek, Wells Brook, and Poultney River	Orwell, Addison, Bridport, Shoreham, Ferrisburgh, Panton, West Haven, and Pawlet	Agriculture	In progress	As BMPs are funded and implemented in the basin, PMNRCD will work with farms to bracket monitor agricultural BMPs. DEC will continue to monitor water quality in the receiving waters. PMNRCD monitored six sites on the Mettowee River for DEC (related to ag practice implementation through the state RCPP program).	37
Increase the participation of Dairy Farms in the Caring Dairy Program, as well as new AAFM Vermont Environmental Stewardship program to highlight farms with good water quality practices.	Basin wide	All towns	Agriculture	In progress	No farms in the basin participate in the Caring Dairy program, in part, because farms must belong to Dairy Farmers of America, which is mostly comprised of farms in northern VT. In 2018, AAFM began a pilot of the Vermont Environmental Stewardship Program (VESP)[66]. While the pilot program was completed in 2021, capacity and resources have been focused on the launch of the Vermont Pay-for-Phosphorus Program (VPFP), which provides performance-based payments to Vermont farmers for reductions in phosphorus losses from their agricultural fields. In Basin 2 & 4, five farms completed Phase 1 (Data Entry) during the first year of the VPFP Program. Additional work continues with the Vermont Payment for Ecosystem Services workgroup.	39
Develop Farm Conservation Corp program to support implementation of BMPs which can be done efficiently by hand labor.	Basin wide	All towns	Agriculture	Discontinued	No progress recorded for this project.	41

[66] https://agriculture.vermont.gov/vesp

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Support local land trusts and conservation organizations in conserving forest blocks that are important for protecting water quality in headwater streams.	Basin wide	All towns	Forests	In Progress	From January 2018 to July 2020, the Vermont Land Trust conserved 792 acres of forest land across the following towns: Addison, Benson, Bridport, Danby, Ferrisburgh, Orwell, Pawlet, Rupert, Shoreham, and West Haven. PMNRCD continues to target conservation in high quality forest blocks, e.g., the landscape assessment in the Flower Brook watershed. In 2020, PMNRCD worked with three landowners in the Mt. Hoag forest block and conducted small forest road improvement projects.	42
Coordinate workshops on minimizing water quality impacts of maple sugaring operations. Consider GSI/ infiltration BMPs to mitigate changes in hydrology due to RO water discharges.	Basin wide	All towns	Agriculture	Complete	The VT Maple Sugar Makers' Association partners with UVM Extension to host 3 workshops per year reaching approximately 200 attendees/event. At the workshops, they offer sessions and information on sugar house RO water discharges.	43
Host workshops on the new Acceptable Management Practices (AMP), as well as resources available for addressing logging road issues which could be held at local lumberyards.	Basin wide	All towns	Forests	Complete	VT Dept. of Forests, Parks, and Recreation has hosted workshops on the AMPs and responded to two AMP complaints and two technical assistance calls from 2018 to 2020. Neither of the complaints had evidence of discharge. PMNRCD has held landowner meetings, provided resources, and identified projects within forested land in the Flower Brook Watershed.	44

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Use LiDAR data when available to identify gullies that may have been caused by historical logging operations to evaluate restoration potential.	Basin wide	All towns	Forests	In Progress	A project completed in 2017 used LiDAR to identify and map forest roads, trails, and log landings on private forests in VT, with specific focus on the South Lake watershed. The project confirmed that LiDAR can be used to: visualize forest roads, locate sites with high erosion potential, reveal landscape-level patterns of pollution loading, and highlight units that require further analysis. A subsequent consulting project is currently underway (focusing on the South Lake and Missisquoi Basins) that will further assess forestlands to identify and prioritize legacy erosion associated with critical source areas within forests. Ground truthing of this landscape analysis will be used to calibrate this prioritization framework of critical source areas to address legacy erosion in high priority basins (e.g., South Lake Champlain and Missisquoi Bay) to achieve target load allocations for lake segments that will not meet reduction targets through VT AMP compliance alone. During SFY 2017-2022, 43,560 square feet of gully erosion were remediated in the basin.	45
Continue to support local skidder bridge rental program and increase usage of bridges.	Basin wide	All towns	Forests	In Progress	PMNRCD does not have an active skidder bridge program. The DFPR is currently focused on providing loggers with assistance to build and own their own bridges. During SFY 2017-2021, 16 stream crossings were improved because of skidder bridge use in the basin.	46

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Stream Geomorphic Assessments (SGAs) and River Corridor Plans (RCPs) and identify projects with focus on stressed and impaired segments.	Basin wide-focus on Castleton River, Mettowee River, Poultney River, East Creek	Castleton, Fair Haven, Ira, Poultney Wells, Orwell, Benson, Addison, Bridport, Shoreham	Rivers	In Progress	SGAs complete-Castleton River (2007), Mettowee River (2005 and 2007), Poultney River (2006), Lewis Brook and Finel Hollow Brook Phase 2 SGA (2006), Poultney Tributaries Phase 1 SGA (2007), Poultney Trib.-Vail Brook Phase 2 SGA (2007) RCPs complete-Poultney River (2006), Town of Castleton (2007), East Creek (2011) Others- Poultney-Hubbardton River Debris Project (2006), Poultney-Hubbardton Alternatives Analysis (2006) In 2022, PMNRCD will hire a consultant and together they will review the phase 2 SGAs and facilitate project development for the Act 76 funds in subsequent years.	47, 48
Complete preliminary engineering for projects identified in existing and new SGAs, Bridge & Culvert inventories, and RCPs.	Basin wide-focus on Castleton River, Poultney River, East Creek Watershed	Castleton, Fair Haven, Poultney, Wells, Orwell, Benson, Addison, Bridport, Shoreham	Rivers	In Progress	All culverts and bridges are assessed. From SFY 2017 to 2022, 4 stream miles were reconnected for stream equilibrium/aquatic organism passage, 17 miles of municipal road drainage and erosion control improvements were made, and 81 municipal road drainage and stream culverts were replaced in the basin. Partners are working to replace those with known AOP issues. Nine priority projects were identified the in Castleton RCP (2007) and PMNRCD will begin project development in 2023.	49
Complete priority river corridor easement projects along priority reaches where the greatest stream equilibrium can be achieved.	Priority Sub-Basins include Poultney (lower) and Castleton Rivers	All towns	Rivers	In Progress	River corridor easements depend, in part, on landowner willingness. The Watershed Planner, PMNRCD, and Rivers program staff will work to identify willing landowners to implement easements. This action will be carried out as opportunities present themselves for conservation and restoration.	50

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Continue buffer plantings along rivers in priority locations through CREP, Trees for Streams program, and USFWS buffer planting efforts.	Priority Sub-Basins include Poultney (lower) and Castleton Rivers	All towns	Rivers	In Progress	From SFY 2017 to 2022, 35 acres of riparian corridor buffer were planted/restored in the basin using state funds. From 2018 to 2021, PMNRCD planted approximately 9,800 stems in riparian buffers in the basin. These plantings were funded by Pur Projet (a private foundation), Trees for Streams, 350VT, and USFWS. Large scale plantings were completed in the Flower Brook watershed, along the Indian River, and on Lewis Brook. Smaller scale plantings were completed along tributaries of the Mettowee and Poultney Rivers.	51
Enhance USFWS, USFS, and USDA-NRCS programs to encourage more efficient means to convert and revegetate cleared lands to floodplain forest.	Priority Sub-Basins include Poultney (lower) and Castleton Rivers	All towns	Rivers	In Progress	From SFY 2017 to 2022, 35 acres of forested riparian buffer restored through buffer planting in the basin. The VT Regional Conservation Partnership Program (RCPP) has been extended for an additional five years and has $1 million set aside for forestry practices that relate to water quality improvement. Funds can be used for revegetation as well as other forest practices, including road improvement, culverts, and crossings. This action will be carried out as opportunities present themselves for conservation and restoration.	52
Coordinate outreach to basin towns on adopting River Corridor Zoning.	Basin wide	All towns	Rivers	In progress	Castleton and Pawlet are the only towns in this basin to adopt river corridor protections. No other town is interested and the RRPC has found it difficult to get support for river corridor zoning or even adding protections in towns flood regulations. Outreach will be focused on the remaining towns, but it is unlikely that these towns will adopt river corridor standards by 2022.	53

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Identify wetland restoration opportunities and outreach to landowners of wetlands identified as priority restoration sites.	Basin wide	All towns- focus on wetlands in Sudbury, Poultney, Benson, Ferrisburgh, Orwell, Addison, Panton, Clarendon, Bridport, West Rutland, Dorset, Fair Haven	Wetlands	In Progress	During SFY 2017-2022, 65 acres of wetland conserved and restored through easements. These activities are ongoing and the DEC Wetlands Program supports this outreach to landowners. Updated Lake Champlain wetland restoration site prioritization modeling was completed in 2018 utilizing RCPP funds. The updated maps identify potential wetland restoration areas with the highest likelihood of P attenuation and are available on the ANR Atlas and the Wetland Inventory Mapper. Partners such as NRCDs, NRCS, VLT, TNC and DFW are using these maps and a subset of project packets to help target wetland restoration outreach. For example, DFW has initiated a wetland restoration and acquisition initiative with funding from EPA through the Lake Champlain Basin Program. The primary focus of this project is wetland restoration on new and existing DFW acquisitions with a goal of 40 percent lands restored.	54, 55
Review WWTF facilities and issue permits that meet these new phosphorus limits. Support towns pursuing phosphorus optimization, expansion projects, and upgrades.	Basin wide	Benson, Castleton, Fair Haven, Poultney, Pawlet	WW	Complete	Benson, Castleton, Fair Haven, Poultney, and Pawlet permits were renewed on July 1, 2019. Therefore, they have each been reviewed for reasonable potential regarding phosphorus criteria during the permitting process and per the current permits are required to pursue phosphorus optimization.	56, 57

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number
Identify non-functioning dams that are creating geomorphic discontinuity and aquatic organism/ fish passage barriers and pursue removal.	Castleton River, Mettowee River, North Breton Brook	Castleton, Hubbardton	Rivers	In Progress	The VFWD owns the Pelletier Dam on North Breton Brook in Castleton, which was removed in 2022. Plantings following removal to be completed by PMNRCD. Other potential dams for removal include: Kit Wallace Dam, Austin Pond Dam on Lake Bomoseen in Hubbardton, the Mettowee river low head dams, and several on Pond Hill Brook. The two low-head dams and the Wallace dam on the Mettowee River will be removed in 2022. The Sugar House Lane dam/bridge will be replaced w a bridge in 2023.	58
Review status of flow-altered waterbodies and, where necessary, take steps toward restoring more natural water level fluctuations and downstream flows.	Lake Bomoseen-Outlet Stream	Castleton	Rivers	Complete	The Lake Bomoseen outlet stream is the only waterbody in the basin on the 2020 flow-altered list. The Lake Bomoseen Dam is owned by the State and operated daily by a contractor on behalf of the State to maintain the water level in the lake in compliance with the May 1983 Water Resources Board Order. The order requires the lake level to be maintained at spillway gage zero plus or minus three (3) inches, with the desired level on the plus side in the summer. At this point, there are no plans to alter this operation.	59

Appendix B. Otter Creek, Little Otter Creek, and Lewis Creek (Basin 3) TMDL Implementation 2022 Progress Report

The Accountability Framework of the 2016 *Phosphorus Total Maximum Daily Loads (TMDL) for Vermont Segments of Lake Champlain* ensures TMDL implementation moves forward at a steady rate. A major driver of the Accountability Framework is the Vermont Department of Environmental Conservation's (DEC) development of basin-specific Tactical Basin Plans (TBP). TBPs are developed on a five-year rotating basis and include Implementation Tables that identify priority actions needed to implement the TMDL. It is through review of the Implementation Tables, and the progress made in accomplishing the tasks, that U.S. Environmental Protection Agency (EPA) tracks implementation progress in each basin. To facilitate EPA's evaluation of progress, DEC describes the status of each strategy midway through (2.5 years) and at the conclusion of the five-year planning cycle in interim and final report cards, respectively.

Appendix B is the interim report card for the Otter Creek, Little Otter Creek, and Lewis Creek Basin. The 2.5-year reporting period began in January 2020 coincident with the publication of the 2019 Otter Creek TBP and goes through June 30, 2022.[67] Data in this report align with this 2.5-year period and the SFY 2019–SFY 2022 granting period of the Clean Water Reporting Framework (CWRF).

The following sections describe progress towards completing phosphorus reduction strategies excerpted from the 2019 Otter Creek TBP Implementation Table. Each strategy is organized by one of five major sectors – agriculture, developed lands, natural resources, forestry, and wastewater. Progress described for each strategy includes status (defined in Table B-1) as well as an explanation of actions taken. The explanation describes how the Agency supported the strategy and resulting outcomes that together show that meaningful results were achieved. Information provided includes performance measures for Agency-supported assistance that were collected as part of the Accountability Framework. These performance measures provide a quantitative measure of implementation towards phosphorus reduction goals to accompany the description of collaborative effort.

Estimations of total phosphorus loading reductions to the lake are not presented in this report. Instead, estimated total phosphorus load reductions are presented in Chapter 3 of the *Vermont Clean Water Initiative 2022 Performance Report* to allow comparison to the TMDL phosphorus allocations.

Basin 3 Update

The 2019 TBP strategies were evaluated and their associated actions were assigned a status condition using the rationale described in Table B-1. Of the 53 strategies identified to date, 10 have been completed, 8 are in progress, 6 have not been started, and 29 are ongoing (Figure B-1).

[67] The 2019 Otter Creek Tactical Basin Plan available at: https://dec.vermont.gov/sites/dec/files/wsm/mapp/docs/B3_TBP_FINAL_ARA.pdf

Strategies identified as "in progress" were evaluated based on their likelihood of being completed by 2023. The next plan will also be released in 2023, including the Phase 3 content for the Lake Champlain Phosphorus TMDL. Of the 8 actions that are in progress, 4 have a high likelihood of being completed, and 3 have a medium likelihood of being completed by 2023. The strategies with a high likelihood of being completed are those that have received funding, have a strong partner, local support, and positive momentum. They are also farther along in the process. In addition, some strategies are regulatory and are required to be completed. Strategies that have a medium likelihood of completion have been initiated and may have received funding, but the end date for completion is beyond 2023. In many cases, medium likelihood strategies have support, but may lack funding or a partner to bring the project to fruition. These projects are next in line to be completed once the high likelihood actions are complete, which will free up capacity for partners that carry out the projects. Strategies with low likelihood of completion by 2023 are those that require significant funding and resources to complete. In some cases, support exists, and funding may be available, but the capacity to develop the associated action(s) is lacking.

Table B-1. Status conditions assigned to strategies and actions in the TBP Implementation Table (Table B-2).

Action Status	Description	Example
Complete	A discrete action with a clear end point that has been implemented	Provided 3 trainings to partners to evaluate 5 properties for Lake Wise assessments.
In Progress	A discrete action identified in a strategy with a clear end point that is in process or in the queue	Of the 8 high priority projects identified through the Castleton Stormwater Master Plan, 3 have been implemented and 2 are in progress
Ongoing	A programmatic or multi-layered action that is in progress but has no end date	Towns are replacing culverts when funding is available.
Not Started	A discrete or programmatic strategy that has not been initiated or taken up	The project stalled due to lack of funding

This interim report depicts a community that is pursuing permit compliance and implementing voluntary practices that work towards meeting the state's water quality and phosphorus reduction goals. This is achieved through the implementation of permit programs, installation of green stormwater practices, adoption of flood resilience measures, implementation of farm agronomic practices, and application of riparian restoration and conservation projects. While success is in part documented by performance measures included in this Appendix and the *Vermont Clean Water Initiative 2022 Performance*

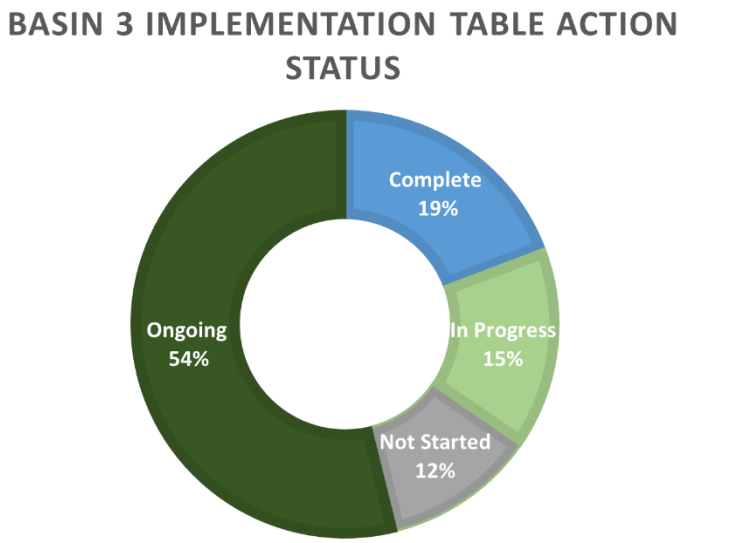

Figure B-1. Basin 3 Implementation Table action status of the 53 strategies in the 2019 TBP Implementation Table.

Report, the narrative adds additional information including a description of the role of the Agency-supported collaborative effort in driving the acceptance of practices within the community.

Most of the actions associated with regulatory programs were completed, in progress, or ongoing in 2022. A majority of those were completed through Agency of Natural Resources (ANR) or Agency of Agriculture Farm and Market's (AAFM) financial support to permit holders as well as partners who distributed education, outreach, and technical assistance. Regulatory compliance outcomes include increased implementation of Required Agricultural Practices and agricultural best management practices and stormwater best management practices on roads. In addition, there was a steady increase in resources provided by the state to community and partners which in turn supported a steady increase of adoption of natural resource restoration practices, and stormwater management of developed land. Available funding and advanced coordination played a critical role in allowing watershed partners and municipalities to work together to complete and pursue 88% of strategies from the 2019 Otter Creek TBP to-date.

Fifteen percent of the 53 strategies in the 2019 plan are still in progress. The narrative in Table B-2 provides additional detail in the explanation column for strategies in progress. Most projects in progress have completed the first phase of action, for example, a design may have been completed for a project, but the implementation of the project will be completed in the next year.

The 12 percent of strategies that were not yet started may have extended timelines for completion contingent upon other programs or permit requirements (e.g., hydroelectric related strategies, toxics impairments, etc.) or are strategies that did not receive enough interest or support to be completed but are still a priority for follow-up. These projects include identifying monitoring volunteers for lakes, assessment of lake shoreland, and stream and lake reclassification. DEC published new webpages on lakes and streams reclassification, which may catalyze reclassification efforts in the next 2.5 years. The narrative in Table B-2 provides detail in the explanation column for these strategies.

In addition, the Clean Water Service Delivery Act (Act 76) will increasingly support the delivery of clean water services and increase regional capacity to develop and implement projects that fulfill actions.[68] An explanation of DEC's expected progress based on these additional resources will be included in the 2023 Basin 3 TBP's Chapter 3 (LC TMDL Phase 3) and Chapter 4. DEC will submit the final status report in 2024.

Basin 3 Implementation Table Status

The interim status for each strategy (Table B-2) was compiled by the Water Investment Division's Watershed Planning Program using data from the DEC, NRCDs, RPCs, and additional watershed partners involved in project development and implementation for the 2.5-year interim period.

The Implementation Table is not an exhaustive list of water quality strategies that lead to phosphorus reductions in a basin. A complete description of all the work that the state supports in the basin to meet

[68] Act 76 website available here: https://dec.vermont.gov/water-investment/statues-rules-policies/act-76

water quality goals can be found in the 2021 Vermont Nonpoint Source Management Plan.[69] Additional information about progress associated with each sector can be found in Chapter 3 of the *Vermont Clean Water Initiative 2022 Performance Report* which provides comprehensive reporting of estimated total phosphorus load reductions associated with state funding, federal funding, and regulatory programs. These data are also available to the public through the Clean Water Portal's Clean Water Interactive Dashboard – an online tool that allows interested parties to examine and filter Performance Report data on investments, project outputs, estimated pollutant load reductions and project cost effectiveness.[70] Individual projects in the basin that are included or supported by strategies are describe in the Clean Water Explorer, also found through The Portal.

[69] Vermont Nonpoint Source Management Plan 2021-2025 available here: https://dec.vermont.gov/sites/dec/files/wsm/erp/docs/Vermont%20NPS%20Management%20Plan%202021-2025.pdf

[70] Clean Water Portal can be accessed here: https://anrweb.vt.gov/DEC/cleanWaterDashboard/

Table B-2. Basin 3 Implementation Interim Status Report; includes data from a) SFY 2019 to SFY 2022 and b) calendar year 2020-2022, unless otherwise noted.

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Support meetings and workshops between ACRWC, VAAFM, UVM Ext., CVFC, and local farmers	Lewis Creek, Little Otter, Middlebury River, Dead Creek, Lemon Fair	Middlebury, Panton, Ripton, Cornwall, Bristol, Starksboro, and Ferrisburgh	Agriculture	Complete	Beginning in 2019, the ACRWC hosts an annual Agricultural Partners and Water Quality meeting. In total, the three meetings had 43 attendees from the following groups: ACRWC, AAFM, CVFC, UVM Ext., LCA, OCNRCD, DEC, and local farmers. The next meeting is scheduled for 12/13/2022.	1	NA

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Host annual workshops on improving soil and water health, RAPs, implementing agronomic practices, and buffer plantings.	Basin wide with focus on Lewis Creek, Little Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair	All towns	Agriculture	Complete	Workshops, trainings, field days, and webinars have been provided to farms in Basin 3 covering a range of topics, including soil health, RAPs, conservation tillage, cover cropping, and other conservation practices. During SFY2020 - 2022, 21 events were hosted in Basin 3 by partners supported through the AAFM Agricultural Clean Water Initiative Program (AgCWIP). These events included partnership development workshops, Basin 3 farm field days showcasing conservation practice implementation, workshops highlighting the benefits of farm agronomic practices including conservation tillage and cover cropping, pasture and grazing practices, nutrient management planning, soil health, and more. Additionally, in recent years virtual webinars have expanded farm access to information statewide, including Basin 3 farmers. Between SFY2021 and SFY2022, 61 virtual/online events were hosted providing information related to Nutrient Management Planning, soil health, conservation assistance programs and initiatives, and more. Additional workshops and events may have occurred in the Basin beyond those supported, tracked, and reported by partners funded by AAFM AgCWIP.	2, 8	NA

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Support farmers in developing NMPs through UVM Extension's Digging In course and the development of NMPs for all certified farms through NRCS CAPS funding.	Basin wide with focus on Lewis Creek, Little Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair	All towns	Agriculture	Complete	State and federal funds support the work of NRCDs and UVM Extension to provide NMP courses and TA to farms developing and implementing NMPs. During SFY 2019-2022, 28 farms received NMP assistance supported by state TA in the basin. NRCD staff provide support as needed for certified farms that are not interested in the Digging in course.	3, 4	NA
Track # of NMPs developed and implemented in priority sub-basins	Basin wide with focus on Lewis Creek, Little Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair	All towns	Agriculture	Complete	During SFY 2019-2022, 3,721 acres of nutrient management occurred in the basin. Ranked in descending order, watersheds with the most acreage were Dead Creek (944 acres), Pleasant Brook (753), Otter Creek (469), Headwaters of Little Otter Creek (448), Outlet of Lewis Creek (422), Outlet of Little Otter Creek (404), and Lower Lemon Fair (228).	5	NA
Track and inspect CSFOs that need NMPs or that have up to date NMPs, schedule to keep these up to date.	Basin wide	All towns	Agriculture	Ongoing	VAAFM RAPs require CSFOs to submit an annual certification form by January 31st of each year, which includes the status of the CSFO's NMP. This information is available to Agricultural Clean Water Initiative Program (AgCWIP) partners for the purpose of NMP E&O and TA. In addition to the annual reporting and NMP status information provided by farmers, VAAFM documents NMP status through routine inspections. In 2022, VAAFM shared a list of farms needing NMP updates with Conservation District and UVM Extension staff to coordinate technical assistance and NMP Updates.	6	NA

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Install practices on agricultural lands that will reduce runoff in areas where bacteria and nutrient levels are above the VWQS and/or have been identified in NMP or LTPs. Ground truth to reconcile modeled P source areas with field data.	Lewis Creek, Little Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair	All towns	Agriculture	Ongoing	From SFY 2019-2022, a total of 66,938 acres of agricultural practices were installed in these priority subbasins. The most acres were installed in Dead Creek (24,248), followed by the Lower Lemon Fair (8,435), and the Otter Creek (8,192). See strategy #14 for information regarding an ongoing CEAP paired watershed study in the Dead Creek and Little Otter Creek watersheds.	7, 12	NA
Provide technical assistance to farmers to ensure tile drain systems comply with RAPs.	Basin wide	All towns	Agriculture	Ongoing	During SFY 2019-2022, 3 events provided E&O and TA related to the RAPs to 222 participants. In November of 2018, the RAPs were amended to include requirements for reducing nutrient contributions to waters of the State from subsurface tile drainage on agricultural fields. Following this amendment, Agency of Agriculture RAP educational materials have been updated to include the tile drain rules and regulations.	9	NA
Implement regional equipment sharing programs to support the implementation of conservation practices	Basin wide	All towns	Agriculture	Ongoing	During 2020 & 2021, UVM Extension offered the following pieces of equipment to farms: no-till drills: 35 farms, soil probes & penetrometers, truck scales (used for calibrating manure spreaders and weighing forage trucks for yield records): approximately 20 farms. UVM Extension also paid a contractor to use a manure injector on interested farmers' land (approximately 5000 acres treated).	10	NA

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Establish vegetated riparian buffers and/or filter strips above and beyond existing compliance standards (i.e., RAPs or shoreline protection).	Basin wide	All towns	Agriculture	Complete	During SFY 2019-2022, 28 acres of agricultural forested and filter strip buffers were installed in the basin. Currently, it is not possible to track those acres that are above and beyond compliance standards.	11	NA

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Develop practical stormwater BMPs for farms and provide technical and financial support for farms to implement these to address stormwater runoff from impervious surfaces in farm production areas.	Basin wide	All towns	Agriculture	Ongoing	The RAPs Section 6.01(b) requires production areas, barnyards, animal holding or feedlot areas, manure storage areas, and feed storage areas utilize runoff and leachate collection systems, diversion, or other management strategies to prevent the discharge of agricultural wastes to surface water or groundwater. Technical and financial assistance is available to farmers to reduce production area runoff of agricultural wastes through the AAFM BMP Program and NRCS EQIP. Examples of barnyard and production area practices implemented on farms to address agricultural waste runoff are heavy use area protection, waste storage facilities, clean water diversions, and roof runoff structures. These are important and commonly used practices by farmers to manage runoff from impervious surfaces and protect nearby surface waters. From SFY 2019 to 2022, 409 structural agricultural practices were installed in the basin. While most of these structural practices are located within a farm's production area, pasture infrastructure such as fencing and animal trails are also included in this total number.	13	NA

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Complete water quality monitoring on/near farms to help identify source areas and evaluate nutrient reductions achieved through BMP implementation.	Lewis Creek, Little Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair	All towns	Agriculture	Ongoing	The ACRWC monitors streams draining the prioritized subbasins and presents their findings at their annual Agricultural Partners and Water Quality meeting (#1 above). CEAP is an ongoing USDA funded paired watershed study that began in September 2019. The treatment watershed is a combination of the East and West Branch of Dead Creek in Addison County and the control watershed is Headwaters of Little Otter Creek. This project is collecting water chemistry, flow, and soil health data from each watershed as well as evaluating individual practices, as well as synergies obtained through stacking practices at the field scale.	14	NA
Conduct outreach to farmers with potential natural resource protection opportunities (e.g., river corridor or wetlands)	Lewis Creek, Little Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair, Clarendon River	All towns	Agriculture	Ongoing	In December 2022, the Basin 3 CWSP (ACRPC) released the first RFP to distribute formula grants and that includes projects on agricultural land if the farm in question does not meet the minimum eligibility criteria for the Required Agricultural Practices. Beginning in 2019, the ACRWC hosts an annual Agricultural Partners and Water Quality meeting. In total, the three meetings had 43 attendees from the following groups: ACRWC, AAFM, CVFC, UVM Ext., LCA, OCNRCD, DEC, and local farmers. The next meeting is scheduled for 12/13/2022.	15	NA

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Analyze LCBP 1m data to identify agricultural lands lacking riparian buffers and use these to prioritize BMP implementation and outreach on RAPs.	Basin wide	All towns	Agriculture	Not started	The project stalled due to lack of capacity.	16	NA
Provide technical support to farmers and assistance tracking BMP practices implemented with(out) state or federal funding.	Basin wide	All towns	Agriculture	Ongoing	During SFY 2019-2022, there were 19 E&O and TA events related to BMP practice implementation that had 317 participants.	17	NA
Publish success stories where farmers have installed BMP practices and seen improved farm operations and improved water quality conditions.	Basin wide	All towns	Agriculture	Ongoing	Organizations providing technical and financial assistance to farmers, as well as organizations representing farmers in this Basin feature farms and farm projects that are having positive impacts to water quality and the community. Organizations that provide project stories, farmer highlights, and community engagement in the basin include Champlain Valley Farmer Coalition (CVFC), UVM Extension – Champlain Valley Crops, Soils and Pasture Team, NRCS, VAAFM, Otter Creek NRCD, and ACRWC.	18	NA

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Develop stormwater master reports or plans.	Basin wide	Addison, Bridport, Chittenden, Cornwall, Goshen, Leicester, Mendon, Mount Tabor, Monkton, New Haven, Panton, Ripton, Shrewsbury, Salisbury, Tinmouth, Waltham, Weybridge, Whiting	Developed Lands-Other	Ongoing	RRPC worked with RNRCD and DEC to get Chittenden, Mendon, and Pittsford to be part of a block SWMP grant that will be funded and administered by the State. This SWMP effort is underway with the overall goal of identifying and developing opportunities to mitigate stormwater runoff thereby improving water quality and flood resiliency. Efforts continue to encourage Mount Tabor, Shrewsbury and Tinmouth in seeking funding for SWMPs. In 2022, the RNRCD received funding through LCBP to hire Watershed Consulting Associates to complete a SWMP for the Town of Proctor.	19	NA
Outreach to landowners that will come under the 3-acre stormwater permit.	Basin wide	Rutland city, Rutland town, and Middlebury	Developed Lands - Other	Complete	The 2019 SW Program general permit for SW from “three-acre sites” applies to sites with three or more acres of impervious surface and lacking a SW permit based on the 2002 Vermont Stormwater Management Manual. The Program has identified and notified affected owners. When requested, RRPC has been providing assistance to the City of Rutland, Town of Rutland, and other municipalities.	20	NA

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Determine if high priority practices identified in Stormwater Mapping Reports should be carried out singularly or through multi-town Stormwater Master Planning.	Basin wide	Bristol, Charlotte, Danby, Dorset, Ferrisburgh, Hinesburg, Ira, Killington, Lincoln, Mount Holly, Pittsford, Proctor, Orwell, Shoreham	Developed Lands - Other	In Progress	A singular approach was taken with Pittsford and its Mapping Report. Since the town did not have a SWMP, RRPC secured a block grant to address one of the priority projects in the report. Pittsford subsequently has decided to be part of a block SWMP with seven other municipalities (including Chittenden and Mendon) around the State. Outreach continues with Danby, Ira, Killington, and Mount Holly. In 2022, the RNRCD received funding through LCBP to hire Watershed Consulting Associates to complete a SWMP for the Town of Proctor.	21	Medium
Develop and implement GSI practices at local schools	Basin wide	All towns	Developed Lands - Other	In Progress	RNRCD completed a final design for the stormwater BMP at Wallingford Elementary School on March 29, 2022. Implementation is delayed, because the school owns the property and they are asking the Town to take ownership of the Stormwater practice.	22	Low
Provide outreach and education for development of stormwater bylaws.	Basin wide	All towns	Developed Lands - Other	Ongoing	To date no municipalities have expressed interest in developing stormwater bylaws. RPCs offer this assistance whenever a municipality begins updating its bylaws.	23	NA
Complete REIs for all towns in the basin by 12/31/2020.	Basin wide	All towns	Developed Lands - Other	Complete	REIs for all municipalities in this basin are complete.	24	NA

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Provide support to towns to upload REI data into MRGP database by 2020.	Basin wide	All towns	Developed Lands - Roads	Ongoing	Towns are required to submit their implementation requirements (15% of noncompliant segments upgraded to meet the MRGP standards) by April 1, 2023. Support is being provided to all municipalities in this basin as ongoing assistance through the Grants in Aid program.	25	NA
Implement high priority road projects across the basin to meet MRGP requirements.	Basin wide	All towns	Developed Lands - Roads	In Progress	During SFY 2019-2022, 413 hydrologically connected road were segments inventoried, 129 hydrologically connected municipal road miles were identified that require water quality improvements, and 35 miles of municipal road drainage and erosion control improvements were implemented in the basin. Towns are using a combination of Regional Transportation Funds, VTrans Better Roads grants, DEC Grants-in-Aid funds, and their own municipal funds to implement projects to meet MRGP standards. More details on priority of completed projects will be available for the 2024 TBP.	26	High
Provide technical assistance to towns for developing project proposals, budgets, and funding opportunities for implementing priority projects that have the largest water quality benefits.	Basin wide	All towns	Developed Lands - Roads	Ongoing	This assistance is available to all municipalities in this basin on an ongoing basis. At RRPC this is being provided as ongoing assistance through VTrans grants, Grants in Aid program, and RRPC's Municipal Project Management assistance.	27	NA

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Host workshops and peer to peer sharing on best practices for using new equipment to meet MRGP standards and support equipment purchase.	Basin wide	All towns	Developed Lands - Roads	Ongoing	At the RPCs this is being provided as part of ongoing assistance through the Grants in Aid program and through quarterly road foremen meetings for all municipalities in the basin.	28	NA
Create an equipment sharing program and track use of equipment used to meet MRGP requirements.	Basin wide	All towns	Developed Lands - Roads	Not Started	This is being done informally among most municipalities and it seems to be working using this approach.	29	NA
Support the development and implementation of Phosphorus Control Plans (PCP) and the Flow Restoration Plans (FRP).	MS4 entities	MS4 entities	Developed Lands - Other	In progress	RNRCD received funding through the LCBP to hire Fitzgerald Engineering to complete a PCP for the City of Rutland. RRPC is assisting the Town of Rutland in the implementation of its SWMP, PCP, and FRP by finding funding and administering grants. Two (out of 17) priority BMPs in its FRP that have been implemented: An outlet retrofit at Hitzel Terrace and an outlet retrofit at Wynnmere has been designed.	30	Medium

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Implement six minimum control measures required in the State TS4 permit.	Basin wide	All towns	Developed Lands - Other	Ongoing	Per Part 6 of the TS4 Permit, VTrans is implementing and enforcing a 2018 SWMP, which includes six MCMs designed to reduce the discharge of pollutants from the TS4 to the maximum extent practicable, to protect water quality, and to satisfy the appropriate water quality requirements of the CWA. Implementation of the six MCM is ongoing. The BMPs that are being implemented by VTrans to address these six MCMs are included in Part 6.0 of the SWMP[71] (2018). A summary of annual reporting requirements and progress for each MCM is provided in Tabs 6.0, 6.1, and 6.3.a of the 2019 Annual Report Workbook	31	NA
Reissue permits to 9 WWTFs in the basin in 2021 that meet the P limits. Support municipalities pursuing P optimization, expansion projects, and upgrades.	Basin wide	Brandon, Middlebury, Otter valley Union High School, Pittsford, Proctor, Rutland, Vergennes, Wallingford, West Rutland	Wastewater	Ongoing	Brandon – Issued 6/1/2022 Middlebury – In Draft Otter valley Union High School – In Draft, public notice soon Pittsford – Issued 6/1/2022 Proctor – in comment response period – issuance soon Rutland - Issued 6/1/2022 (under appeal regarding 1272 order for CSO control, but permit still in effect) Vergennes – In Draft Wallingford - Issued 6/1/2022 West Rutland – Issued 12/1/2022 All the facilities are required to optimize TP removal in their renewed permits under the 2016 TMDL.	32	NA

[71] https://anrweb.vt.gov/PubDocs/DEC/Stormwater/PublicNotice/7892-9007/VTrans%20Final%20SWMP%20-%20December%205%202017.pdf

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Increase education and outreach on minimizing water quality impacts of maple sugaring operations.	Basin wide	All towns	Forests	Ongoing	The VT Maple Sugar Makers' Association partners with UVM Extension to host 3 workshops per year reaching approximately 200 attendees/event. At the workshops, they offer sessions and information on sugar house RO water discharges.	33	NA
Provide outreach, technical assistance and workshops to private forestland owners, foresters, and loggers on AMPs, use of skidder bridges, and voluntary harvesting guidelines.	Basin wide	All towns	Forests	In progress	Starting in 2018, the DFPR has been providing cost-share funding for loggers and foresters to receive temporary portable skidder bridges. Statewide, the DFPR distributed 12 free wooden bridges in 2018 and administered 9 cost share grants for bridges in 2019 and 2020. From SFY 2019 to 2022, one E&O/TA event focused on AMPs and it had 16 attendees.	34	High
Map and assess forest access networks on state lands.	Basin wide	All towns with state lands	Forests	Ongoing	In SFY24, clean water funds are available for planning/design and implementation of road and trail BMPs to reduce erosion and nutrient and sediment pollution on ANR's road and trail networks, including State Forests, Wildlife Management Areas, State Parks, and recreational access points. Road and trail segments are identified and prioritized for BMP implementation using a modified Municipal Roads General Permit (MRGP) inventory methodology, a field application for data collection, and a companion database to gather and store data (inventory work is funded with prior year Clean Water Fund dollars). BMPs implemented bring whole road segments up to standards for water quality improvement.	35	NA

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Natural resource assessments of state lands should explicitly identify flood resiliency as a management objective and be included in Long Range Management Plans.	Basin wide	All towns with state lands	Forests	Ongoing	Watershed Planners increasingly seek to bring flood resiliency elements into the Water Resources section of LRMPs. In addition, examples of ways to address this strategy via the District Stewardship teams and collaboration with watershed partners can be found in a 2015 consultant report entitled "Improved Flood Resiliency on Vermont State Lands".	36	NA
Provide outreach to communities around Chipman Lake and Richville Pond to generate interest in Lake Wise Program	Chipman Lake, Richville Pond	Tinmouth, Shoreham	Lakes	Not started	RRPC will reach out again to DEC LPP Lake Wise staff to coordinate work and priorities.	37	NA
Complete Lake Wise planning for lakes where there is community support for such efforts.	Chipman Lake, Richville Pond	Tinmouth, Shoreham	Lakes	Not started	RRPC will reach out again to DEC LPP Lake Wise staff to coordinate work and priorities.	38	NA
Implement priority projects identified in Lake Wise assessments.	Chipman Lake, Lake Dunmore, Fern Lake, Richville Pond	Tinmouth, Shoreham, Salisbury, Leicester	Lakes	In Progress	The Lake Dunmore Fern Lake Association hired Fitzgerald Environmental Associates to complete a Lake Watershed Action Plan in 2021. The LWAP identified 17 out of 62 projects as high priority projects. To-date two of these have been implemented and others will be pursued as funding and capacity become available. Due to a lack of funding and losing a Watershed Grant during COVID, this has not started at Chipman Lake in Tinmouth.	39	High

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Establish Lay Monitor on lakes recommended by the Lakes and Ponds Program (e.g., on lakes with significant shoreline development and potential water quality issues).	Cedar Lake (Monkton Pond), Silver Lake, Winona Lake (Bristol Pond)	Monkton, Leicester, Bristol	Lakes	Not started	No progress has been made on this strategy.	40	NA
Implement high priority projects recommended in the Moon Brook River Corridor Plan.	Moon Brook	Rutland City and town	Rivers	Ongoing	High priority projects from more current Moon Brook assessments are being implemented in Rutland Town (as described in #30) and others will follow as funding become available.	43	NA
Develop and implement priority river corridor protection projects and floodplain/channel restoration projects where there is landowner support.	Basin wide	All towns	Rivers	Complete	RNRCD received DEC funding to purchase river corridor easements from 2 landowners along the Cold River in the Town of Clarendon. In 2022, a berm was removed so that the river can access its floodplain, which will assist the Town of Clarendon with flooding issues. Other projects will be pursued as funding and capacity become available.	44	NA
Provide information on the benefits of the NFIP program and technical support for towns that are interested in joining the program.	Basin wide	Tinmouth, Mount Tabor, Killington	Rivers	In Progress	None of the target towns have adopted the NFIP, but the Killington town plan suggests adopting or taking steps towards adoption of flood hazard bylaws adequate for NFIP participation. Outreach will continue to be focused on these towns when the opportunity allows.	45	Medium

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Work with towns to retrofit or replace culverts and/or bridges to restore AOP.	Basin wide	All towns	Rivers	Ongoing	All towns are replacing culverts as local or State funding becomes available. In addition, as culverts are replaced on State and town roads, they are reviewed by the Rivers Program to ensure structures meet current standards for geomorphic compatibility. In discussions with municipalities, RRPC now has a new tool for considering AOP. Using AOP data from the VCGI database called “Stream Crossings” and developed through ANR and VT Dept. of Fish and Wildlife, we have begun to add AOP information to our culvert inventory maps. Not every bridge/culvert was included in the ANR/VT Dept. of Fish and Wildlife data, but it’s a starting point for addressing problem culverts. RRPC has completed maps for Chittenden, Danby, Poultney, Shrewsbury, and Wallingford to include AOP data. During SFY 2019-2022, 35 miles of municipal road drainage and erosion control improvements and 64 municipal road drainage and stream culverts were replaced.	46	NA

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Strategic additions of large wood material to restore aquatic habitat in streams which were historically impacted by logging operations.	USFS lands in the Green Mtn. National Forest identified in the next Integrated Resource Project (IRP)	The IRP will include the Basin 3 towns of Chittenden, Mendon, and Goshen	Rivers	In Progress	There are opportunities in the Otter Creek drainage within the Middlebury Ranger District for large woody material (LWM) addition. Specifically, Sparks Brook, Brandy Brook, and the middle and south branches of the Middlebury River. Sucker Brook also offers opportunities for additional LWM efforts. There have been two AOP culverts replaced on Brandy Brook since 2019, and one more is planned, designed, and funded(implementation 2023). This will be the final of 5 structures replaced on Brandy Brook. This culvert will be the last culvert to upgrade before reaching Breadloaf Dam. Breadloaf Dam is the final barrier on Brandy Brook. The Breadloaf Dam is planned for removal and the project is under development (VNRC, USFWS, USFS). The USFS is also looking for opportunities to implement beaver dam analogs in low gradient portions of streams in this area. Currently, the Forest and partners are modelling high probability beaver habitat in this area utilizing the Beaver Restoration Action Tool (BRAT Model). A portion of the Telephone Gap area has been modeled and additional model runs are underway to assess this area again as well all the lands adjacent to the GMNF.	47	High

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Continue and expand riparian buffer programs. Prioritize buffer plantings based upon recommendations in completed River Corridor Plans, P reduction potential, and known water quality issues.	Basin wide	All towns	Rivers	Ongoing	From SFY 2019 to 2022, 23 acres of forested riparian buffer were restored through buffer planting.	48	NA
Municipal outreach to towns without river corridor protection in town plans/by-laws	Basin wide	All towns	Rivers	Ongoing	RRPC has reached out to Chittenden and Killington. No interest in Chittenden; Killington is considering adding to its bylaws.	49	NA
Continue work on dam removal prioritization, design, and implementation on high priority sites	Basin wide	All towns	Rivers	Ongoing	In 2021, VNRC, DEC, and other partners removed the Dunklee Pond Dam on Tenney Brook in Rutland, which restored 2 acres of floodplain, reconnected 13 miles of riverine habitat and restored 900 lineal feet of instream channel. The restoration planting took place in spring 2022. PMNRCD completed a 2-acre planting and installed 718 bareroot plants, 230 live stakes, and 27 willow fascines. Other dam removal projects underway in the basin include: Youngs Brook Dam, the Breadloaf Dam, Wainwright Mill Dam, Connolly Pond Dam, Moon Brook Dam, Austin Pond, Tenney Brook Court, and GMNF Dam in Chittenden.	50	NA

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Identify high priority sites for wetland restoration based on P reduction ranking	Dead Creek, Lower Lemon Fair, and Pleasant Brook-Otter Creek watersheds	Brandon, Pittsford, Addison, Bridport, Panton, Cornwall, Shoreham, Weybridge	Wetlands	Ongoing	Updated Lake Champlain wetland restoration site prioritization modeling was completed in 2018 utilizing RCPP funds. The updated maps identify potential wetland restoration areas with the highest likelihood of P attenuation and are available on the ANR Atlas and the Wetland Inventory Mapper. Partners such as NRCDs, NRCS, VLT, TNC and FWD are using these maps and a subset of project packets to help target wetland restoration outreach. For example, FWD has initiated a wetland restoration and acquisition initiative with funding from EPA through the Lake Champlain Basin Program. The primary focus of this project is wetland restoration on new and existing FWD acquisitions. The Agency's Functioning Floodplain Initiative is currently developing method that DEC will use to prioritize floodplain restoration based on P reduction potential as well as flood resilience. No wetland restoration has been funded during this reporting period. If time allows, RRPC would be willing to add this work to its TBP workplan.	53	NA
Reclassify wetlands recommended for Class 1 status to protect their key functions and values.	Otter Creek Wetland Complex	Cornwall, Salisbury, Middlebury, Sudbury, Whiting, Leicester, Brandon	Wetlands	Not started	This project is apparently stalled due to a lack of interest among municipalities.	54	NA

Strategy Description	Priority Subbasin(s)	Priority Towns	Sector	Status	Explanation	Crosswalk to Plan Strategy Number	Likelihood of Completion
Outreach to landowners of wetlands identified as restoration priorities– with a focus on lands with new landowners, actively being conserved or where landowners are making changes in land management.	Basin wide	All towns	Wetlands	Ongoing	From SFY 2019 to 2022, 681 acres of wetland were conserved and restored through easements and 4 E&O and TA events reached 63 attendees. If time allows, RRPC would be willing to add this work to its TBP workplan.	55	NA
Review new natural resource mapping and make recommendations for improving wetland mapping in target towns.	Basin wide	All towns	Wetlands	Ongoing	A comprehensive remapping effort is underway within this Basin to be published for public access in 2023 and in all of Vermont in year 2025. A General Determination is also moving forward to identify wetlands that are Class II wetlands based on the presumptions of significance under the Vermont Wetland Rules. This effort will also be made public facing in 2023 through the mapping platforms.	56	NA

Appendix C. Results of State Stormwater Regulations

This appendix summarizes the contributions that Operational Stormwater Permits have made toward meeting Vermont's water quality goals.

Click symbol to view description of accountability measures.

Scope of Data	
Data include:	Stormwater permit data includes new or amended operational stormwater permits issued in state fiscal year (SFY) 2018–2022. Permits authorize new, redeveloped, and existing impervious surfaces meeting regulatory thresholds. DEC tracks permit issuance, not actual construction of impervious. Actual construction and change in phosphorus load may occur one to several years behind authorization under the permit.
Data does not include:	Phosphorus load data from outside the Lake Champlain and Lake Memphremagog basins.
Future improvements:	More precise tracking of the drainage area and size of each practice is needed to improve the accuracy of the reductions.

Table C-1. Stormwater treatment practice types installed to comply with new operational stormwater permits in SFY 2018–2022 and average estimated phosphorus removal rates.

Practice Tier	Definition and examples	Average Phosphorus Removal	Permitted in SFY 2018[72]	Permitted in SFY 2019[72]	Permitted in SFY 2020[72]	Permitted in SFY 2021[72]	Permitted in SFY 2022[72]
Tier 1 practices	Infiltrating practices, impervious disconnection	>80%	149	107	230	182	174
Tier 2 practices	Gravel wetlands and bioretention with underdrains	60-80%	20	37	55	51	46
Tier 3 practices	Wet ponds, filters and dry swales not designed to infiltrate	50-60%	47	18	15	13	6
2002 VSMM[73] practices	Grass lined channels, non-structural credits	<50%	48	0	0	0	0
Total number of practices permitted			264	162	300	246	226
Average total phosphorus load removal of permitted practices[74]			48%/72%[75]	70.1%	67.6%	74.3%	75.6%

[72] Through the end of calendar year 2020, the stormwater management database tracks if a practice is present in a drainage area, not the number of practices. The real number of practices is higher. In SFY 2021 and going forward, practices are tracked individually.

[73] VSMM is defined as Vermont Stormwater Management Manual.

[74] Phosphorus removal efficiencies were assigned to each practice assuming that it was sized to meet the water quality volume. See Standard Operating Procedures for Tracking & Accounting of Developed Lands Regulatory Projects & Non-Regulatory Clean Water Projects for phosphorus removal efficiencies: https://dec.vermont.gov/water-investment/cwi/projects/tracking-accounting#SOP

[75] Average phosphorus removal was 48% for treatment practices permitted under the 2002 Vermont Stormwater Management Manual (VSMM) and 72% for treatment practices permitted under the 2017 VSMM.

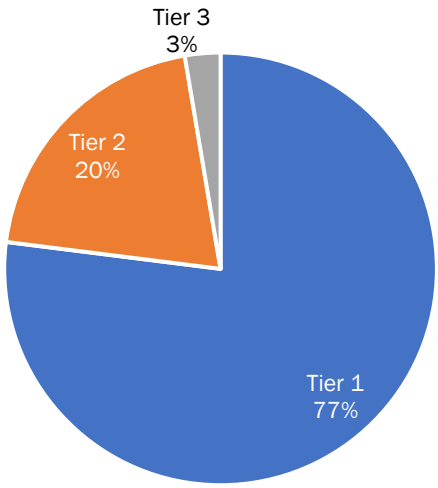

Figure C-1. Percent stormwater treatment practices by tier for new operational stormwater permits issued in SFY 2022.

Table C-2. Impervious surface area covered by operational stormwater permits issued in SFY 2018–2022 by large drainage areas.

Permitted Impervious Surface Type	SFY 2018	SFY 2019	SFY 2020	SFY 2021	SFY 2022
Lake Champlain					
New impervious (acres)	127.9	87.6	171.7	155.8	86.1
Redeveloped impervious (acres)	20.6	24	29.6	19.9	6.1
Existing impervious (acres)	19.6	0.8	6.2	17.3	59.4
Total impervious (acres)	168.1	112.3	207.5	193.0	151.6
Percent of impervious permitted	70%	74.6%	74.2%	85.2%	78.0%
Lake Memphremagog					
New impervious (acres)	10.2	1.1	12.1	8.1	0
Redeveloped impervious (acres)	3.2	0	2.5	0.1	0
Existing impervious (acres)	1.5	0	9.8	0.2	0
Total impervious (acres)	14.9	1.1	34	8.4	0
Percent of impervious permitted	6%	0.8%	8.7%	2.0%	0%
Other Drainage Areas					
New impervious (acres)	28.1	26.1	43.7	18.2	16.0
Redeveloped impervious (acres)	9.5	8	3.5	10.0	0
Existing impervious (acres)	20.7	3.1	0.5	8.0	26.7
Total impervious (acres)	58.3	37.1	47.6	19.5	18.6
Percent of impervious permitted	24%	24.7%	17%	12.8%	22.0%

Figure C-2. Vermont's Large Scale Drainage Areas

Table C-3. Estimated change in total phosphorus load associated with operational stormwater permits in the Lake Champlain and Lake Memphremagog basins (kilograms/year), SFY 2018–2022.

Estimated Change in Total Phosphorus Load	SFY 2018	SFY 2019	SFY 2020	SFY 2021	SFY 2022
Lake Champlain					
Increase in phosphorus from operational permits, prior to treatment[76] (kilograms/year)	103.3	90.7	172.7	47.7	85.3
Phosphorus reduced by treatment practices (kilograms/year)	101.6	115.2	202.0	45.8	133.6
Net change in phosphorus of operational permits (kilograms/year)	**0.5**	**-26.7**[77]	**-29.3**[77]	**-7.3**[77]	**-48.3**[78]
Lake Memphremagog					
Increase in phosphorus from operational permits, prior to treatment[76] (kilograms/year)	42.6	1.5	79.0	9.6	0
Phosphorus reduced by treatment practices (kilograms/year)	30.0	0.8	51.8	9.8	0
Net change in phosphorus of operational permits (kilograms/year)	**12.6**	**0.7**	**27.2**	-0.2	0

[76] Permitted impervious and phosphorus load calculations include both new and amended permit authorizations. For amended permits, only the increased impervious acres and phosphorus load relative to the previous permit are summarized here. Phosphorus increases from new development assumed that the permitted area was forested prior to development. Redeveloped and existing impervious does not result in a phosphorus change related to change in land use.

[77] A net reduction in phosphorus in Lake Champlain is likely due to treatment of redeveloped impervious.

[78] The net reduction in phosphorus in Lake Champlain in SFY 2022 is likely due to early implementation of the 3-acre permitting requirements, as well as treatment of redeveloped impervious.