Otter Creek, Little Otter Creek, and Lewis Creek Watershed

Basin 3

December 2024 | FINAL PLAN

Tactical Basin Plan was prepared in accordance with 10 VSA § 1253(d), the Vermont Water Quality Standards[1], the Federal Clean Water Act and 40 CFR 130.6, and the Vermont Surface Water Management Strategy.

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12/23/2024

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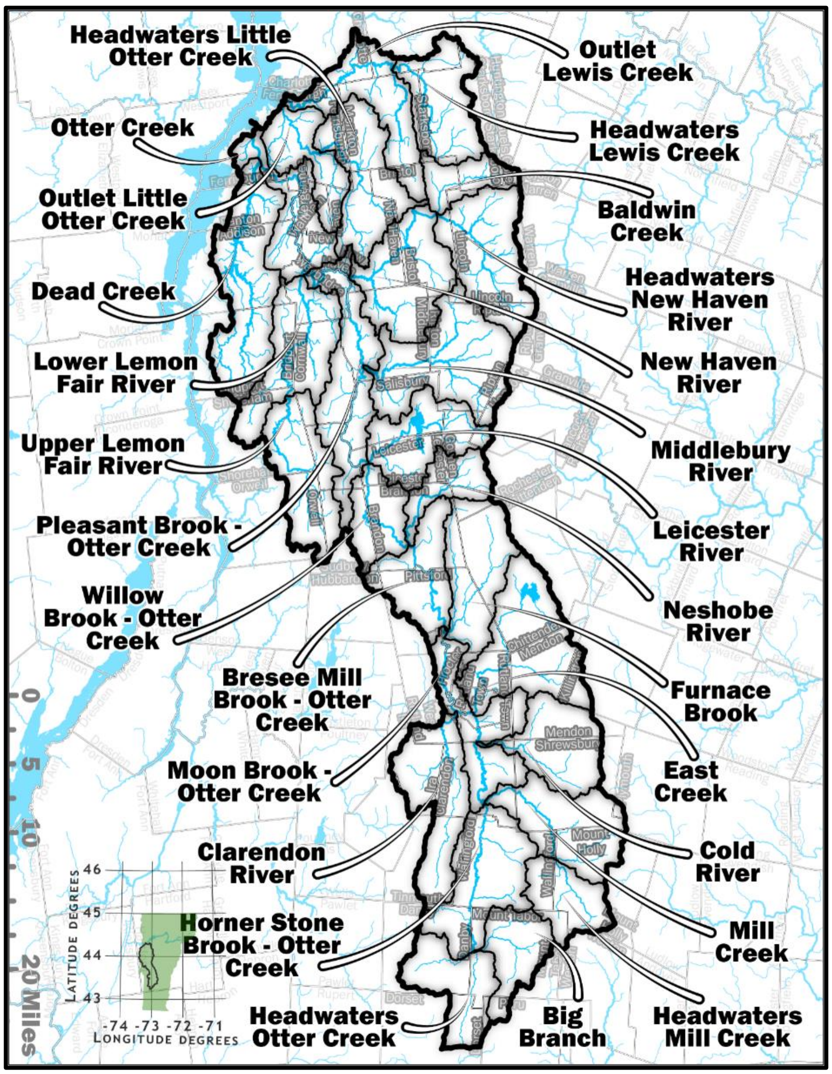
Towns of the Otter Creek Basin

Addison
Brandon
Bridport
Bristol
Charlotte
Chittenden
Clarendon
Cornwall
Danby
Dorset*
Ferrisburgh
Goshen
Hinesburg
Hubbardton
Huntington
Ira
Killington
Leicester
Lincoln
Mendon
Middlebury
Middletown Springs*
Monkton
Mount Holly
Mount Tabor
New Haven
Orwell
Panton
Peru*
Pittsford
Proctor
Ripton
Rutland
Rutland City
Salisbury
Shoreham
Shrewsbury
Starksboro
Sudbury
Tinmouth
Vergennes
Wallingford
Waltham
West Rutland
Weybridge
Whiting

**Only a very small area of the town is in the watershed and is covered in more detail in corresponding basin plans.*



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Executive Summary

Basin 3 consists of the Otter Creek, Little Otter Creek, and Lewis Creek watersheds, covers 936 square miles, and drains directly to Lake Champlain. The Basin includes 46 towns, portions of Bennington, Rutland, and Addison counties, and includes all surface waters that flow into the Otter Creek. The Basin can be divided into 27 HUC12 watersheds and the dominant land use and land cover types are forest (59%), agriculture (21%), wetlands (11%), and development (2%). This Tactical Basin Plan (TBP) provides a detailed description of current watershed conditions and identifies water quality focused strategies to protect and restore the Basin's surface waters.

Although many surface waters monitored meet or exceed water quality standards, there are waters in need of restoration and continued monitoring. Twenty-six lakes, ponds, or river segments are identified for restoration. Twenty-two river segments and eight lakes are considered impaired, eight lakes are impacted by aquatic exotic species, six river segments are considered to have altered flow regimes, and five lakes have increasing nutrient trends. Chapter 3 also includes progress reporting and target setting for Phase 3 of the Lake Champlain Phosphorus Total Maximum Daily Load (TMDL) Implementation Plan.

Sector-based strategies are proposed to meet overall protection and restoration goals, as well as strategies to achieve targets of the Lake Champlain Phosphorus TMDL, with a focus on voluntary participation and project implementation by watershed partners and the Basin's Clean Water Service Provider. 47 detailed strategies and 36 monitoring priorities are recommended for the next five years and summarized in Table 1. Monitoring priorities have been identified to fill data gaps, track changes in water quality condition, and identify waters for reclassification and Class I wetland designation.

Table 1. Focus areas and summary strategies for protection and restoration.

	Focus Areas	Priority Strategies
Agriculture	Lewis Creek, Little Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair	• Target field Best Management Practice implementation in high priority watersheds. • Improve nutrient management planning (NMP) through technical support, NMP workshops, and financial support for improved nutrient utilization. • Support farm teams, conservation equipment programs, soil health assessments, and farmer participation in the Vermont Pay for Phosphorus Program. • Increase education about available state and federal funding programs.

	Focus Areas	Priority Strategies
Developed Lands - Stormwater	Rutland City, Rutland Town, Middlebury, Chittenden, Mendon, Pittsford, Wallingford	• Develop, design, and implement stormwater treatment projects identified in Phosphorus Control Plans, Stormwater Master Plans, stormwater mapping reports, or other assessments. • Support the design and implementation of small-scale stormwater practices through formula grant funding. • Provide outreach and technical support to landowners with 3-acre impervious parcels. • Promote and, where appropriate, coordinate existing campaigns to raise awareness of simple residential stormwater management solutions and chloride application best practices.
Developed Lands - Roads	Basin-wide, with focus on Rutland City, Rutland Town, Middlebury, stormwater-impaired stream segments, lake watersheds with significant road networks	• Provide technical support to towns to implement priority Municipal Roads General Permit projects and to update road erosion inventories. • Develop private road phosphorus reduction estimates and complete private road segmentation and assessments.
Wastewater	Brandon, Middlebury, Otter Valley Union High School, Pittsford, Proctor, Rutland, Vergennes, Wallingford, West Rutland	• Support municipalities pursuing wastewater treatment facility phosphorus optimization, expansion projects, and upgrades to meet total maximum daily load allotments, phosphorus optimization and combined sewer overflow requirements. • Support and ensure monitoring and permit compliance for waste management systems. • Provide technical assistance and funding to towns interested in exploring and implementing village wastewater systems and septic replacement through ANR Village Wastewater Solutions. • Promote septic system maintenance in communities adjacent to nutrient- or bacteria-degraded waters via Wastewater Workshops.
Rivers	Moon Brook, Otter Creek, Lewis Creek, Middlebury River, New Haven River, Clarendon River	• Evaluate water quality benefits of restoration projects identified in state-supported plans and develop and implement priority projects. • Conserve high priority river corridors, floodplains, and wetlands to protect and restore floodplain and wetland function. • Pilot the identification, development, and implementation of low-tech, process-based restoration projects. • Support municipalities in updating flood hazard bylaws and considering adoption of river corridor protections with new Federal Emergency Management Agency maps. • Scope, development, and implement priority culvert upgrade and dam removal projects. • Encourage landowner and recreationist stewardship of riparian areas through established social marketing and signage campaigns for water quality and biodiversity benefit, e.g., Stream Wise. • Support outreach to towns on opportunities to reclassify waters based on recreation-fishing, aquatic biota and wildlife, and aquatic habitat uses.

	Focus Areas	Priority Strategies
Lakes	Monkton Pond, Chipman Lake, Lake Dunmore, Fern Lake, Porter Lake, Richville Pond, Star Lake, and Bristol Pond	• Implement Next Generation Lake Assessments to rapidly assess lake stressors and evaluate the need for more detailed lake assessments. • Evaluate community support for and implement Lake Wise assessments and Lake Watershed Action Plans in populated lake communities with fair to poor shoreland or watershed conditions. • Develop and implement priority projects identified during Lake Wise or Lake Watershed Action Plan assessment. • Maintain and build the capacity for existing aquatic invasive species management and prevention programs. • Where applicable, increase protections for high-quality lakes through reclassification or evaluate reclassification potential through additional monitoring.
Wetlands	Potential Class I wetlands, VRAM-assessed wetlands, RCPP-identified wetland restoration priorities	• Develop a process for crediting the phosphorus reduction of wetland protection and restoration projects. • Scope and develop small-scale (10 – 50-acre) wetland protection and restoration opportunities. • Provide support to the Wetlands Program for publicizing updated wetland mapping and local efforts for reclassification.
Forests	State lands, town forests, and large private lands with significant tributary networks	• Pilot forest road inventories and implement priority projects on state, municipal, and potentially private lands. • Identify and implement feasible forest erosion projects identified with emerging forest erosion mapping tools. • Support the use of skidder bridges through rental and incentive programs. • Encourage land conservation and Use Value Appraisal enrollment where landowners are interested and especially in drinking water source protection areas.

The 2019 Otter Creek basin plan identified 56 strategies to address protection and restoration of surface waters. Of the 56 strategies identified, 25 are complete, 8 are in progress, 19 are ongoing, and 4 are awaiting action (Figure 1). The Otter Creek basin report card was published in the 2024 Vermont Clean Water Initiative Performance Report and detailed updates for each strategy identified in the 2019 Plan. Several strategies will be carried over to this plan.

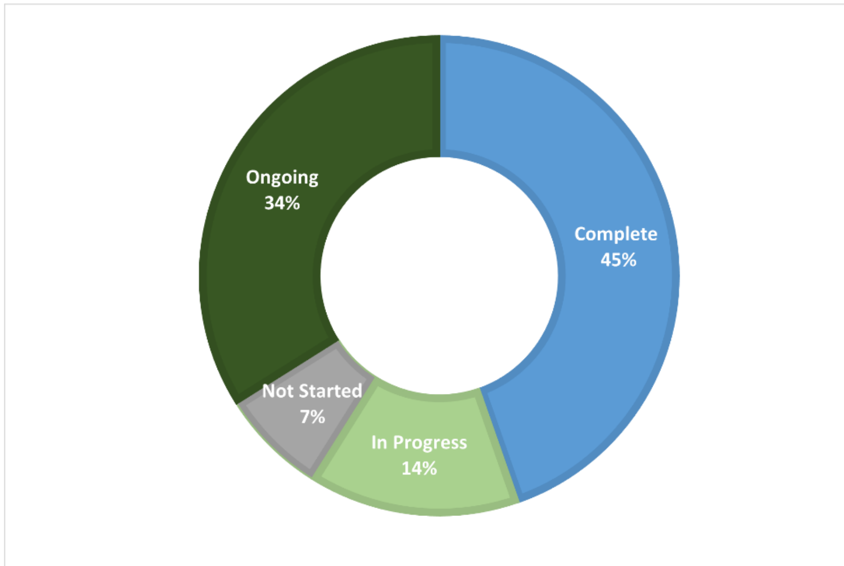


Figure 1. Status of strategies from the 2019 TBP.

The 47 priority strategies identified in this plan reflect input from the public, state and federal water quality staff, sector-based workgroups, watershed groups, and regional planning commissions. During the basin planning process, stakeholders expressed that unified clean water messaging, technical support and training on how to protect and maintain surface waters, and continued financial and technical support, are all critical to meet water quality goals. There was also a strong sentiment that all waters in the Otter Creek basin should be protected regardless of their current status. The importance of ensuring access to waters for all members of the community was identified including ensuring clean surface water for consumptive and recreational uses and the safe consumption of fish, access to waters for recreation for all abilities and economic levels, open space availability and access in more densely populated and equitable implementation of clean water projects.

What is a Tactical Basin Plan?

A Tactical Basin Plan (TBP) is a strategic guidebook produced by the Vermont Agency of Natural Resources (ANR) to protect and restore Vermont's surface waters. The agency develops these watershed plans for each of the 15 major basins in the State of Vermont. TBPs target strategies and prioritize resources to those actions that will have the greatest influence on surface water protection or restoration.

Figure 2. Policy requirements of Tactical Basin Planning.

Figure 3. Five-year basin planning cycle.

TBPs are integral to meeting a broad array of both state and federal requirements including the U.S Environmental Protection Agency's 9-element framework for watershed plans (Environmental Protection Agency, 2008) and state statutory obligations including those of the Vermont Clean Water Act, and 10 VSA § 925 and 10 VSA § 1253 (Figure 2).

Tactical basin planning is carried out by the Water Investment Division in collaboration with the Watershed Management Division and in coordination with other state agencies and watershed partners. A successful basin planning process depends on a broad base of partnerships with other state, federal, regional, and local government agencies, and other stakeholders, including community and non-profit groups and academic institutions. The partnerships support and strengthen the Agency's programs by proposing new ideas, offering input, increasing understanding of water quality issues, and building commitment to implementing solutions.

Basin-specific water quality goals, objectives, strategies, and projects described in this Plan aim to protect public health and safety and ensure public use and enjoyment of Vermont waters and their ecological health as set forward in the Vermont Surface Water Management Strategy and the

[Vermont Water Quality Standards](). The TBP process allows for the issuance of plans for Vermont's 15 basins every five years (Figure 3).

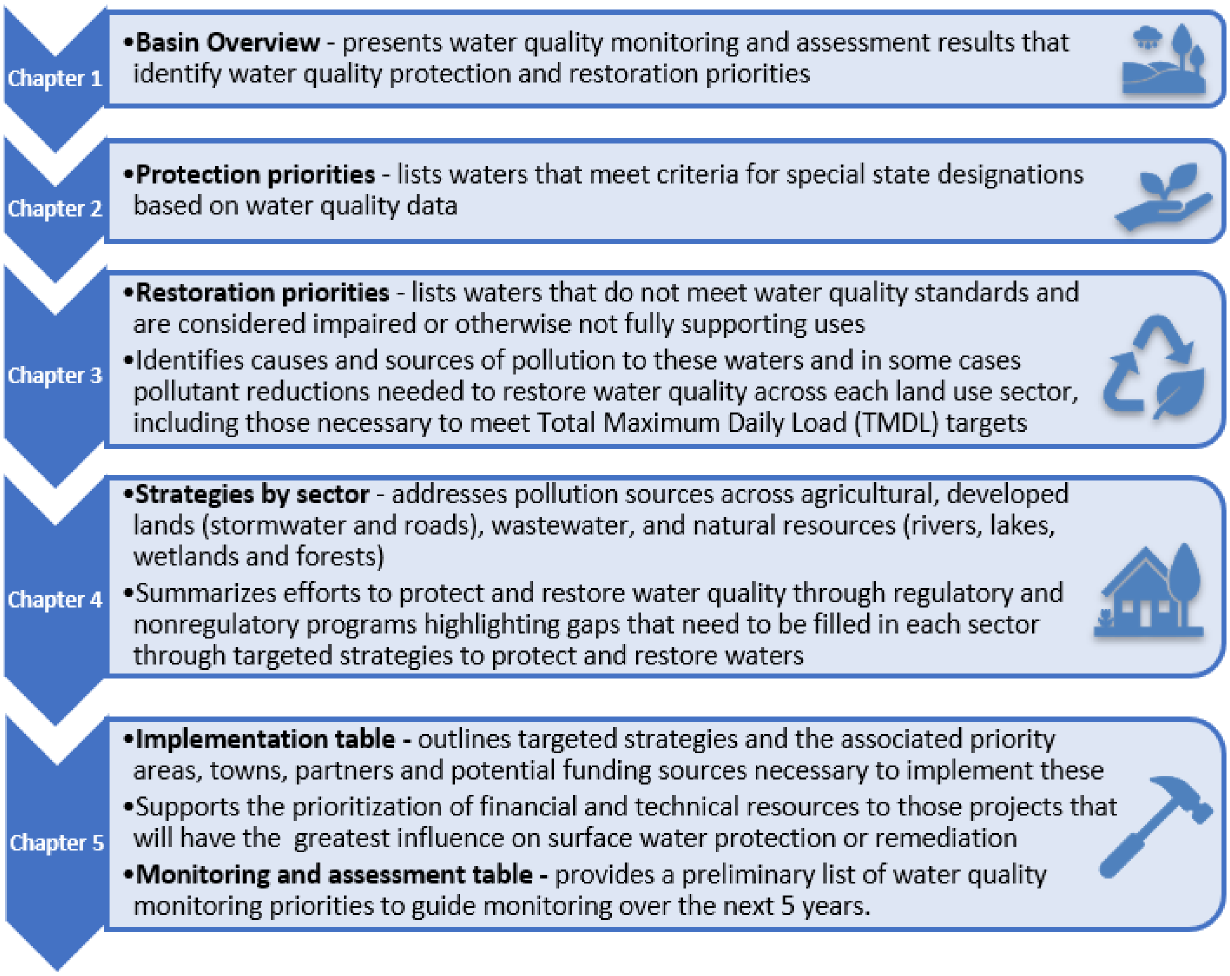


Figure 4. Chapters of Tactical Basin Plans.

Chapters 1 through 4 in the TBP describe water quality in the basin, protection and restoration priorities, and efforts to protect and restore water quality for each sector. This information supports the targeted strategies listed in the implementation table in Chapter 5 (Figure 4).

Tactical Basin Plans identify strategies that help ANR, and its partners, prioritize activities for the next five years. These strategies inform individual projects that are identified and tracked in the Watershed Projects Database and the Watershed Projects Explorer. The Project Database and Explorer are found on ANR's Clean Water Portal and are continuously updated to capture project information throughout the TBP process.

Chapter 1 – Basin Description and Conditions

A. Basin Overview

The 1,100 square mile Otter Creek watershed, Basin 3, lies primarily in Addison and Rutland Counties. The basin can be divided into 27 HUC12 watersheds with higher elevation headwaters draining the western slopes of the Green Mountain Range (Figure 5). The Otter Creek is the longest river in Vermont at approximately 113 miles and drains into Lake Champlain at Ferrisburgh. The northernmost portion of the basin is composed of the Little Otter and Lewis Creek watersheds; both drain directly to Lake Champlain. Detailed information about each of these rivers and other smaller watersheds within the basin can be found in previous individual basin assessment reports and the 2019 Otter Creek Tactical Basin Plan.

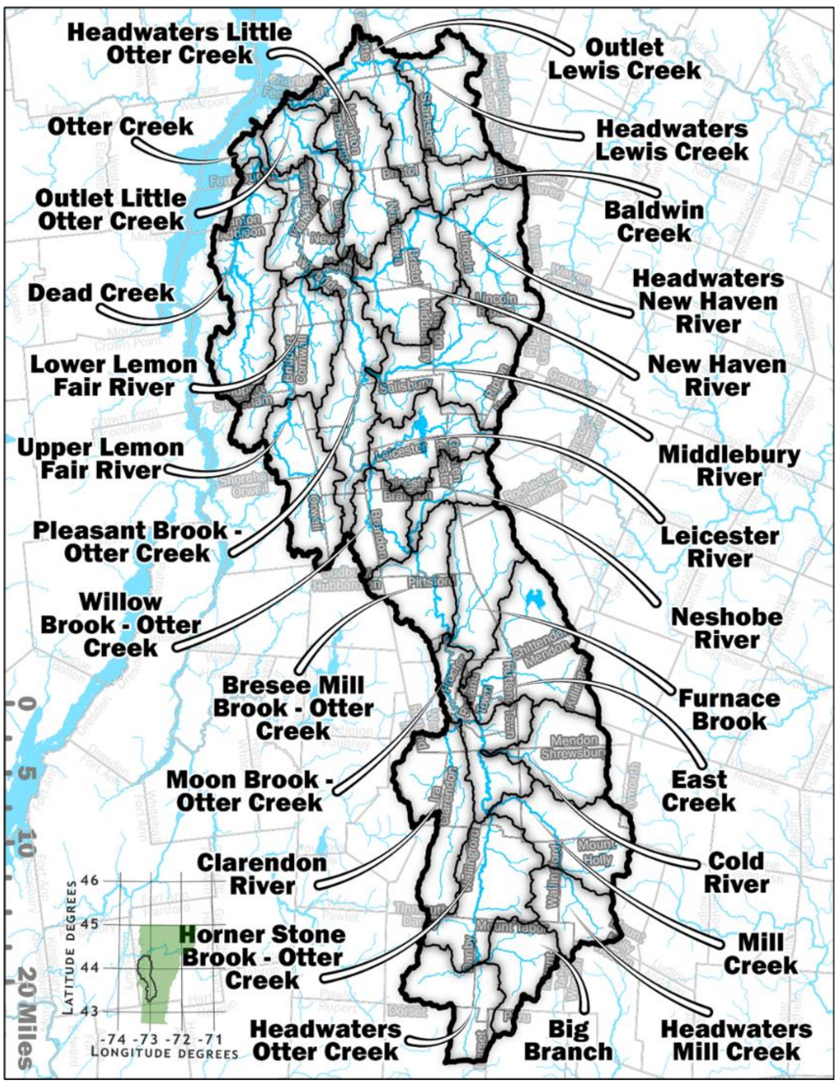


Figure 5. The Otter Creek basin is composed of 27 sub-watersheds that drain to Lake Champlain.

Land Use and Land Cover

Land use and land cover are primary determinants of surface water quality. Large areas of properly managed forests, riparian buffers, and wetlands are principally responsible for good water quality in Vermont. The Otter Creek basin is a predominantly forested landscape. Forested land covers about 59% of the basin while about 11% is wetlands and open water. Developed and agricultural land cover about 2% and 21% of the basin, respectively (Figure 6). Degraded waters in Basin 3 are often adjacent to agricultural lands and dense road and residential development. However, where good management practices and quality local stewardship exist on agricultural and developed lands, good water quality does, too.

Climate Change Implications for Water Resource Management

Vermont is experiencing climate-related events each year as evidenced by flooding in the summer of 2023 and 2024. Climate-related events are projected to increase in frequency, complexity, and severity. It is imperative that Vermont and Vermonters adapt to threats posed by climate change now and build resilience for the storms that we will inevitably face in coming decades (VT Climate Action Plan).

Adapting how we manage and use our surface waters in the face of climate change is one of the chief challenges for tactical basin planning. Climate is defined by long-term weather patterns, which in turn influence human and natural systems. In Vermont, climate change is causing increases in storm intensity and total precipitation (Betts, 2011) (National Oceanic and Atmospheric Administration, 2013). These increases will likely exacerbate flooding, water quality and ecosystem impairments, and reduced water-based recreational availability (Pealer & Dunnington, 2011). Of the many natural hazards that impact Vermont, flooding poses the greatest risk to Vermont infrastructure and communities.

The 2021 Vermont Climate Assessment established state-level climate change information with implications for local surface waters. Vermont's average annual temperature has increased by almost 2°F (1.11°C) since 1900 with warming occurring twice as fast in winter (Galford, 2021). The latter results in earlier thaw dates for rivers, lakes and ponds, and mountain snowpack. Common fish species such as trout and salmon, and warm-water fish like smallmouth bass rely on groundwater discharges for cooler refuges during summer seasons. These refugia will decrease in availability as groundwater temperature is expected to increase over time (Neidhardt & Shao, 2023). Fish are heavily reliant on their physical landscape and connectivity to migrate, move through different environments at different life stages, and take advantage of multiple habitat types. Infrastructure such as roads and dams have severely hampered the mobility of aquatic species and form barriers to fish migrating or seeking cold refuge during high temperatures.

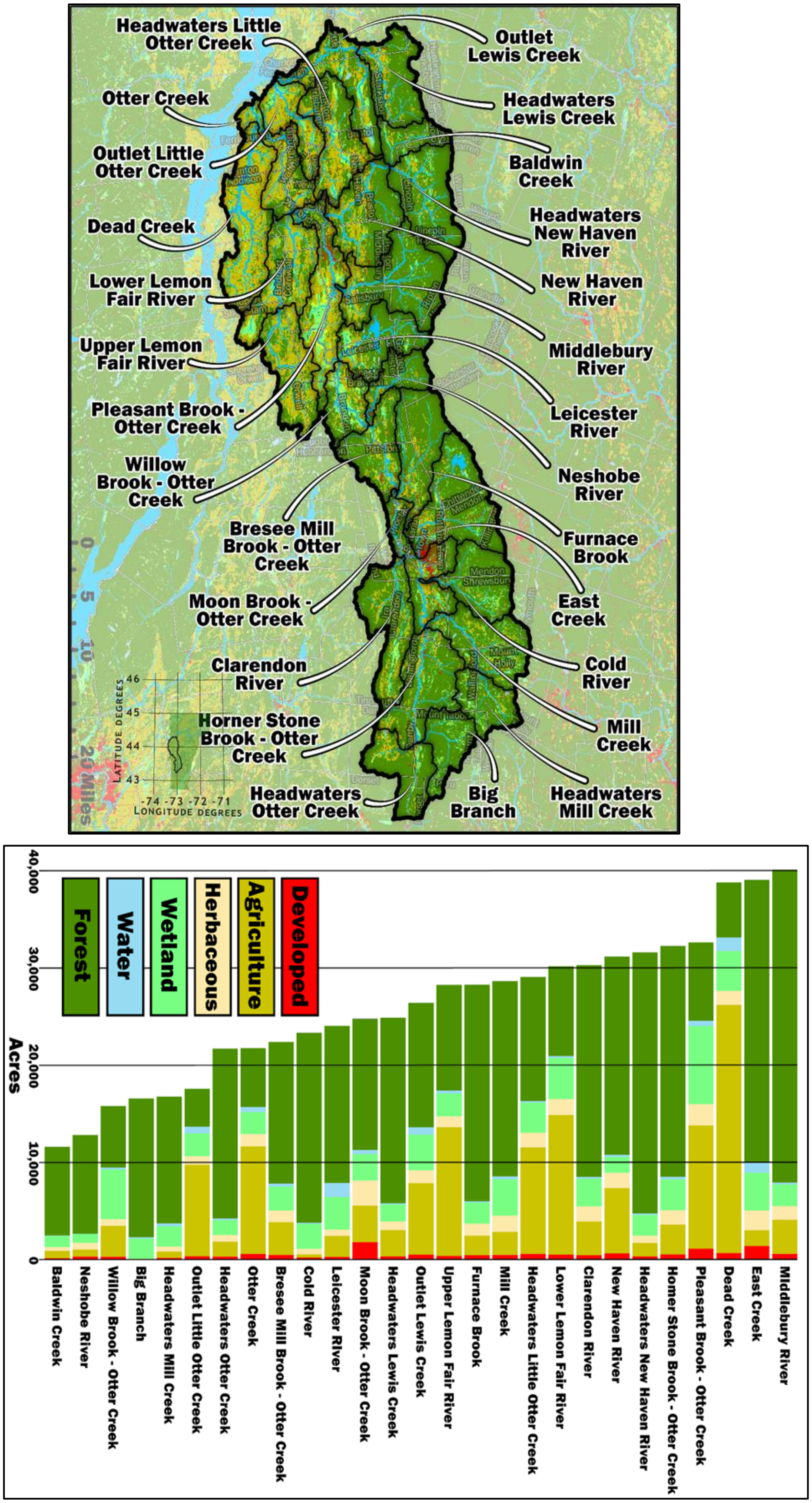


Figure 6. Land cover by acreage across Otter Creek basin sub-watersheds.

The 2021 Vermont Climate Assessment suggests extreme weather events such as droughts and floods are expected to continue to increase with climate change. Vermont experiences 2.4 more days of heavy precipitation than in the 1960s, typically in summer. Average annual stream flows are increasing, which is expected to continue in the future. High flows now happen more frequently, leading to increased inundation flooding and stream-related erosion, which can be exacerbated or alleviated by land-use management decisions. Aquatic habitats affected by increased runoff and streamflow could experience increases in sediment mobilization, nutrients and scouring in addition to increased water temperature. In response, local freshwater plant and animal species may shift their geographic ranges and alter their abundance and seasonal activities (Stamp et al., 2020).

The Vermont Climate Assessment highlights five key messages for water resources in Vermont:

- Due to extreme variation in precipitation with our changing climate, periods of prolonged dry-spells and drought, coupled with higher water usage in snowmaking and agriculture could exacerbate low water availability.

- Increases in overall precipitation, and extreme precipitation, have caused average annual streamflows to rise since 1960. Climate change will further this pattern, although the overall increase in streamflow comes with disruptions in seasonal flows cycles.

- Increases in heavy precipitation jeopardize water quality in Vermont. Storms produce large runoff events that contribute to erosion and nutrient loading. Combined with warm temperatures, this creates favorable conditions for cyanobacteria blooms.

- Increased occurrence of high streamflows increases the risk of flooding that causes damage to many roads and crossing structures. Risk reduction requires addressing outdated and unfit structures.

- Nature-based solutions are an effective, low-cost approach to climate change adaptation. River corridor, floodplain, and wetland protection dampen flood impacts and improve water quality along with green infrastructure.

Protective measures, such as strategic land acquisition and limitations on development in riparian areas, may be the most economical solution to address the challenges presented by climate change and to achieve healthy surface waters (Watson, Ricketts, Galford, Polasky, & O'Niel-Dunne, 2016) (Weiskel, 2007). But where pollution from historic and current land use occurs, strategies are identified in this plan that will complement protective measures, such as river corridor easements, riparian area plantings, floodplain and wetland restoration, dam removals, and agriculture, forestry, and stormwater best management practices. Ongoing efforts to strengthen ecological resilience and the role of natural infrastructure in protecting built communities can be found on the Climate Change in Vermont website. This website also details the 2020 Global Warming Solutions Act (Act 153), which sets Vermont greenhouse gas emissions reduction goals, establishes a Climate Council tasked with developing and updating a Climate Action Plan (2021 Initial Vermont Climate Action Plan), and requires the Agency of Natural Resources to adopt rules consistent with the plan.

Additionally, recently passed "The Flood Safety Act" (Act 121, 2024) relating to the regulation of river corridor development, wetlands, and dam safety. The Act seeks to improve flood resilience by requiring the development of a State River Corridor Base Map to identify areas suitable for development within existing settlements in river corridors that will not contribute to fluvial erosion hazards. It also establishes minimum flood hazard area standards. The Act protects, regulates, and restores wetlands so that the State achieves a net gain of wetlands acreage, and ensures updated wetland maps for all tactical basins by 2030. It also enables the Dam Safety Revolving Loan Fund to provide financial assistance for emergency and nonemergency dam projects.

B. Water Quality Conditions

The Vermont Water Quality Standards (VWQS) provide the basis used by the Vermont Department of Environmental Conservation (DEC) in determining the condition of surface waters including whether the water meets or does not meet certain criteria. The assessment of a water's condition within the context of the VWQS requires consideration of the water's classification, designated and existing uses, and the corresponding narrative and numeric water quality criteria (see Chapter 2 for definitions). This assessment categorizes Vermont's surface waters as either "full support, altered, or impaired".

The DEC uses a five-year rotational monitoring approach, where basin sites are typically monitored once every five years. State-collected data are augmented by community-science monitoring programs throughout the state, including the LaRosa Partnership Program and the Lay Monitoring Program. Water quality monitoring and assessment work is described in detail in the Water Quality Monitoring Program Strategy.

Most surface water monitoring is led by programs in DEC's Watershed Management Division (WSMD), including the Rivers Program, the Lakes and Ponds Management and Protection Program, and the Wetlands Program The result of this work offers site specific assessments of the basin's waters.

Within the Rivers Program, the Biomonitoring and Aquatic Studies Section focuses on biological monitoring of aquatic macroinvertebrate and fish communities, as well as targeted water chemistry and temperature monitoring. Biomonitoring staff also support the LaRosa Partnership Program, a community-based nutrient and chloride monitoring program. See the LaRosa Partnership Program's Power BI interface and database reports to interact with data collected through this program. The following Otter Creek basin organizations have all participated in the Program at least once since the 2019 TBP (links provides access to an organization's data, where available):

- the Addison County River Watch Collaborative

- the Lewis Creek Association
- Lake Dunmore Fern Lake Association (https://www.ldfla.com/).

The Rivers Program also supports stream geomorphic assessments that evaluate geomorphic and physical habitat conditions of rivers and the Streamflow Protection section administers a cooperative agreement with the U.S. Geological Survey to maintain and operate a number of stream gages in Vermont.

The Lakes and Ponds Management and Protection Program supports the Inland Lake Assessment and Lay Monitoring Programs, which evaluate nutrient conditions and trends on lakes, as well as shoreland condition and more in-depth lake assessments through the Spring Phosphorus Program and Next Generation Lake Assessments. The Lakes and Ponds Program also performs surveys to monitor the spread of aquatic invasive species in Vermont's public waters through the Vermont Aquatic Invasive Species Program.

Jointly, the Rivers Program and Lakes and Ponds Management and Protection Program maintain a network of 12 stream and 13 lake sentinel sites statewide respectively, which are monitored every year for biology, temperature, water chemistry and hydrology (at a subset of sites). These sentinel sites have negligible prospects for development or land use change and are closely monitored to isolate long term impacts related to climate change.

The Wetlands Program conducts biological assessments on the functions and values of wetlands.

In addition to the WSMD's surface water monitoring programs in this basin, the following programs also contribute monitoring data to determine the health of Vermont's surface waters:

- The Vermont Fish and Wildlife Department conducts fisheries assessments and targeted temperature monitoring to assess the health of recreational fish populations and opportunities for habitat restoration.
- The Vermont Agency of Agriculture, Food, and Markets conducts monitoring at sampling sites throughout Vermont. The Agency also runs the Ambient Surface Water Study to establish baseline levels of pollutants and to monitor for the presence of neonicotinoids, glyphosate, corn herbicides, and nitrate in Lake Champlain and its contributing tributaries.
- The Drinking and Groundwater Protection Division and the Watershed Management Division monitor Per- and Polyfluoroalkyl Substances.

Tactical Basin Plans include monitoring information reported by Vermont State agencies as results relate to the designated uses defined by the VWQS. Most of the DEC monitoring data can be accessed through the Vermont Integrated Watershed Information System online data portal.

The following is an overview of water resource health in the Otter Creek basin. More detail is provided in Chapters 2 and 3. Chapter 2 includes waters where values and uses exceed current classifications, while Chapter 3 includes waters on the [Vermont Priority Waters List](), the list of rivers and lakes that do not meet VWQS or other Agency criteria.

Rivers and Streams

Biological Assessment

Biological communities reflect overall ecological integrity (i.e., chemical, physical, and biological condition). Therefore, biomonitoring results can directly assess the status of a waterbody relative to the primary goal of the [federal Clean Water Act](). These communities integrate the effects of different stressors and thus provide a broad measure of the stressors' aggregate impact. Because they integrate stressors over time, they can provide an ecological measure of fluctuating environmental conditions.

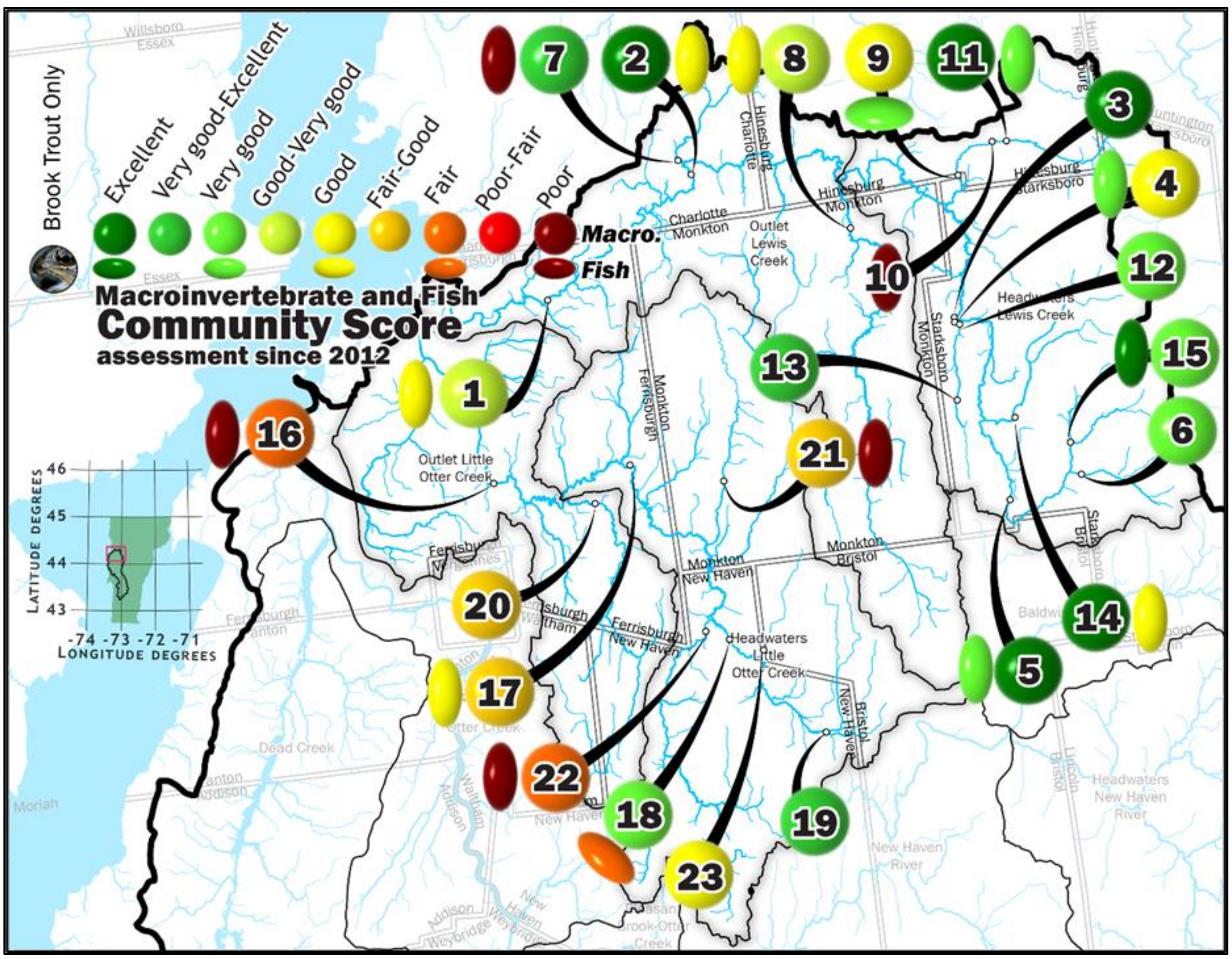
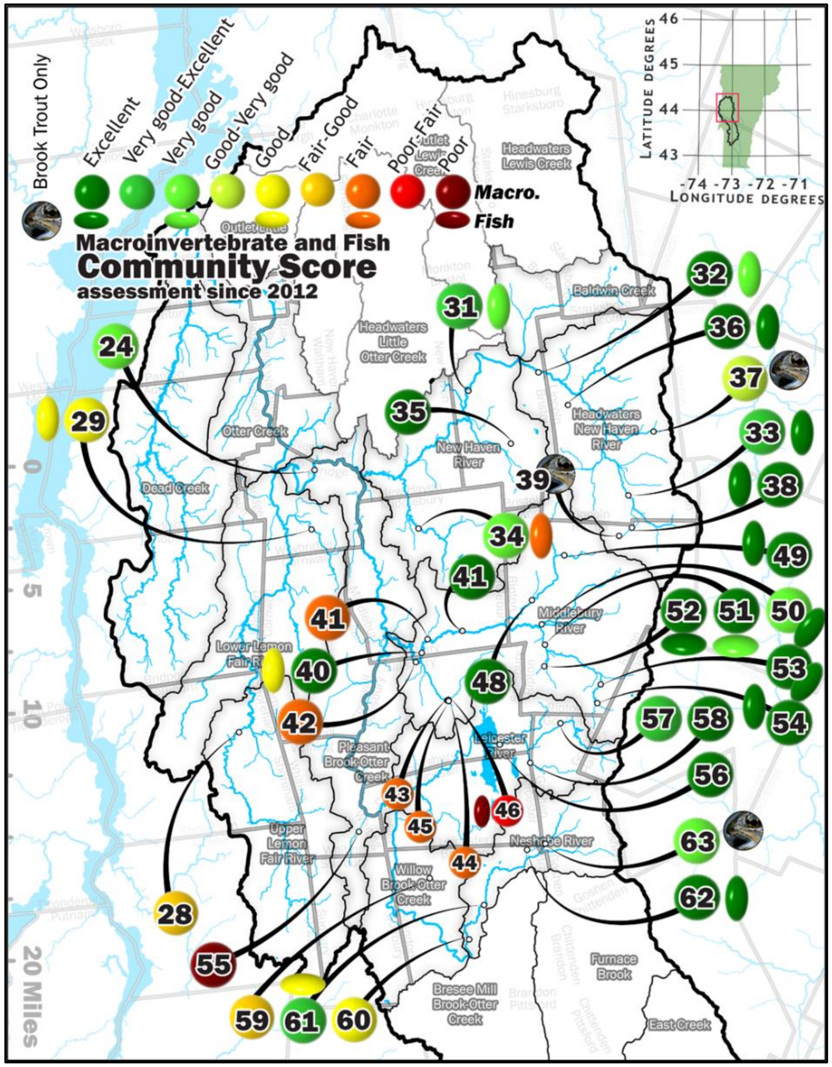
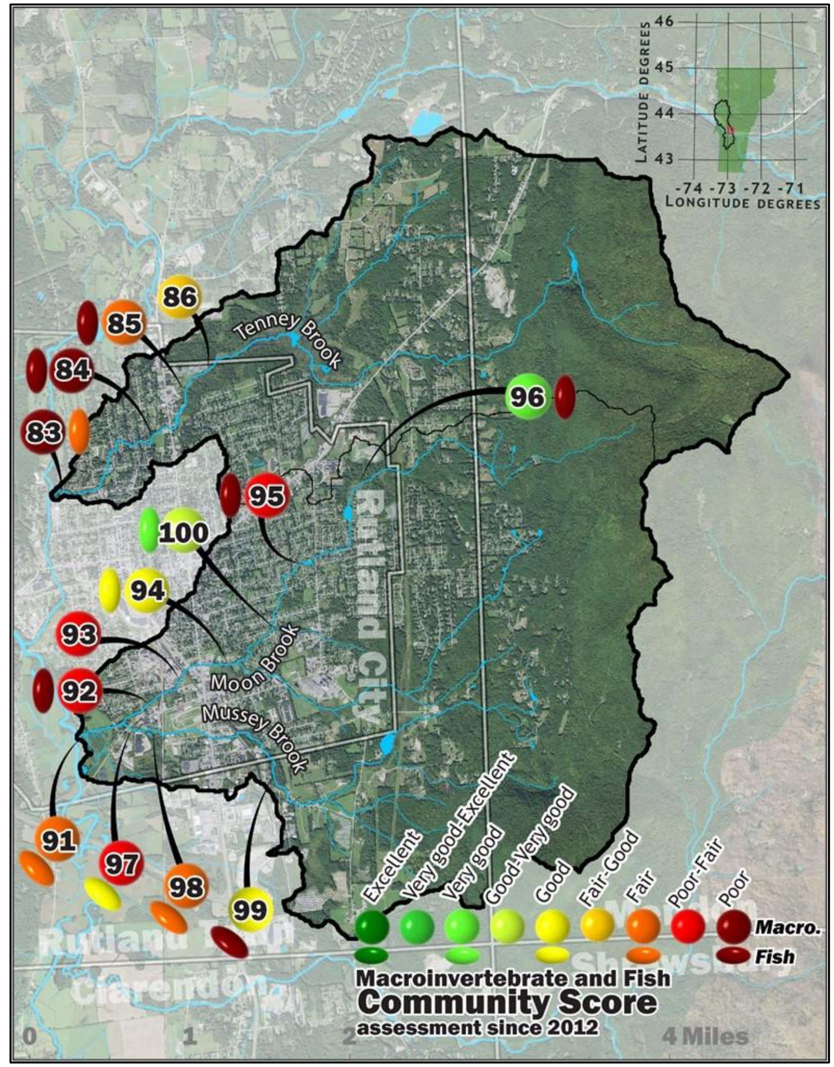


Figure 7a. Biological condition of fish and macroinvertebrate communities of the lower reaches of the Otter Creek basin sampled since 2012. Map IDs correspond with data in Table 2.

The WSMD uses biological monitoring (i.e., biomonitoring) to detect aquatic biota impairments in wadable streams, as well as the type and severity of potential stressors causing the impairment. Biomonitoring is also important for identifying streams at or near a reference level condition. Each community of macroinvertebrates and fish is rated from *Poor* (severely degraded and not meeting





Figures 7b and c. Biological condition of fish and macroinvertebrate communities of the b) middle reaches of the Otter Creek basin and c) the Rutland area sampled since 2012. Map IDs correspond with data in Table 2.

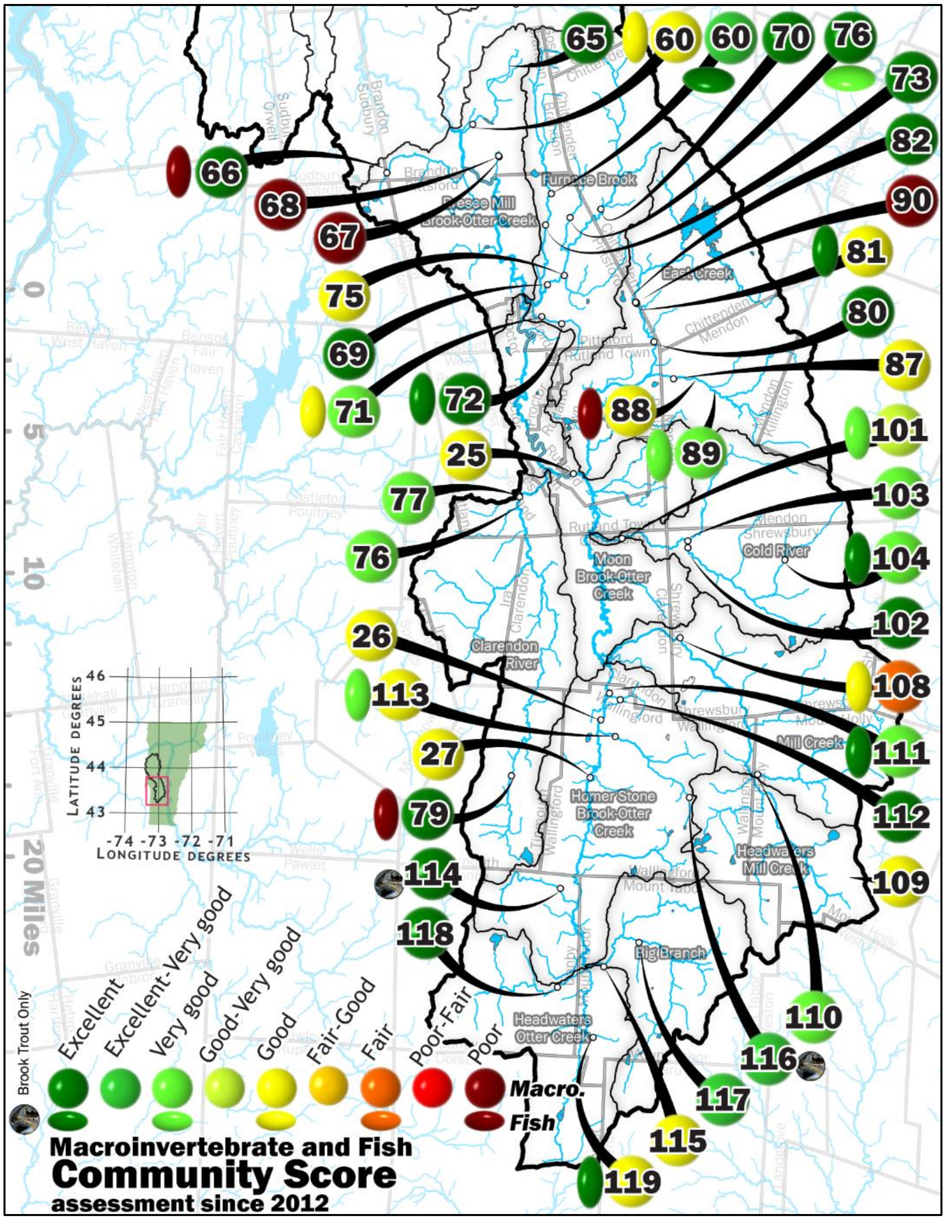


Figure 7d. Biological condition of fish and macroinvertebrate communities of the upper reaches of the Otter Creek basin sampled since 2012. Map IDs correspond with data in Table 2.

VWQS) to *Excellent* (similar to the natural condition and exceeding the VWQS). If a stream repeatedly fails to meet minimum aquatic biota expectations, it is a candidate for the Vermont Priority Waters List. If a stream has macroinvertebrate and fish communities consistently at or near a reference level condition, it is a candidate for increased protection through upward reclassification. Macroinvertebrate and fish monitoring is conducted following procedures outlined in the WSMD Field Methods Manual (DEC 2022). Applying biocriteria and determining assessments for both communities is outlined in the VWQS (2022).

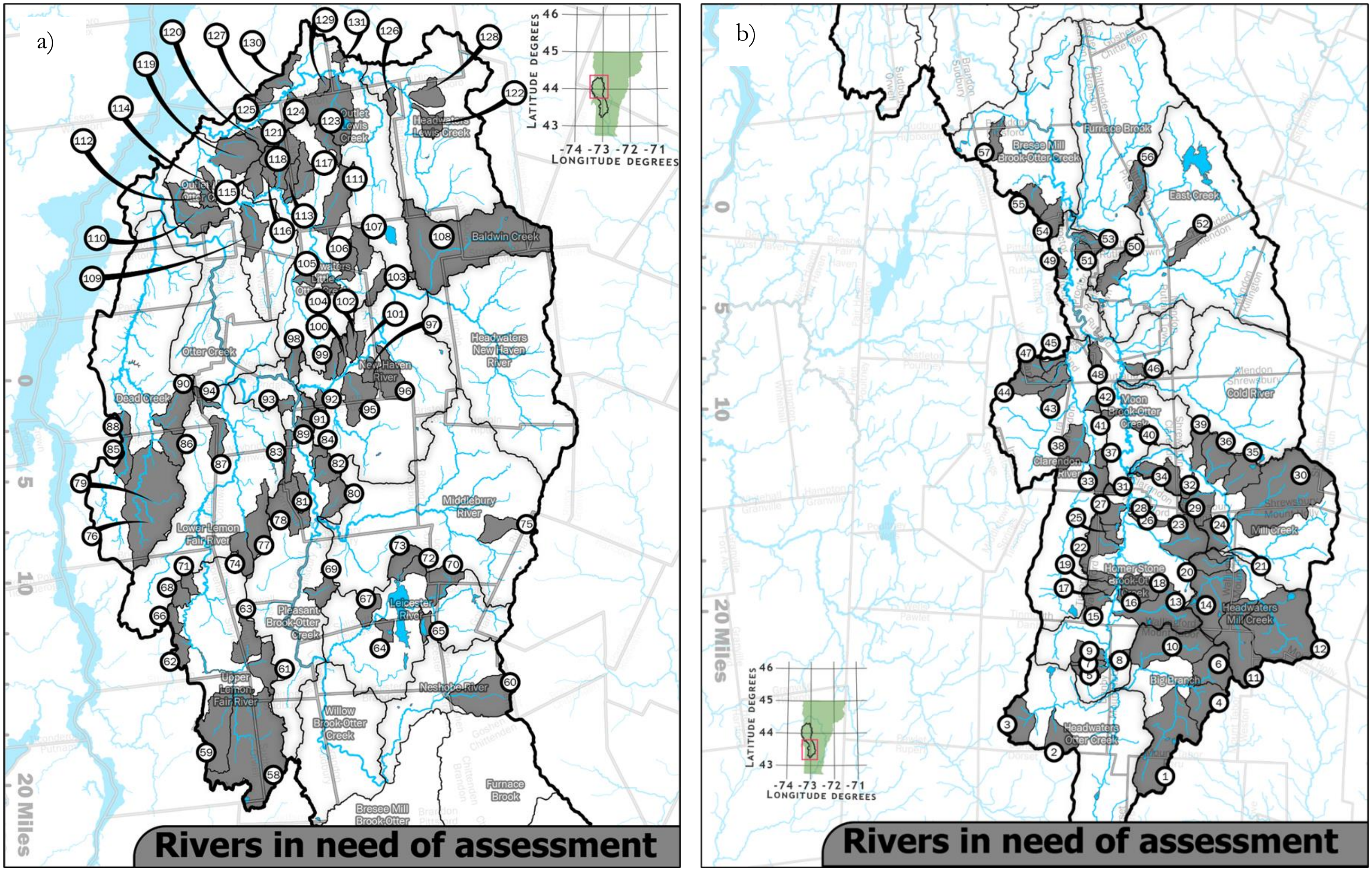


Figure 8. Stream catchments without biosurvey data in the a) lower and b) upper Otter Creek basin. Sites are listed in the Chapter 5 Monitoring Table (Table 21).

Macroinvertebrate Monitoring Results

Macroinvertebrate assessments were completed at 119 sites in the Otter Creek basin between 2012 and 2021 (Figure 7, Table 2). The results of the assessments are described below. In addition, to ensure a comprehensive understanding of water quality basin wide, a gap analysis was conducted by DEC to identify sites without current monitoring data (Figure 8). Some of these will be prioritized based on land use or other factors for the 2025 monitoring season and can be found in the Chapter 5 Monitoring and Assessment Table.

Of the 119 completed macroinvertebrate sites assessed, 60 monitoring sites (43%) exhibited *Very Good* or better condition in their most recent assessment. Of these, 19 were found to be *Excellent*, meaning their macroinvertebrate community is comparable to reference or natural condition. Most of these waters are either headwater streams or located higher up in the watershed. Another 41 were found to be in *Very Good* to *Very Good - Excellent* condition. Streams in *Very Good* or better condition exceed the VWQS criteria for B(2) classification and are priorities for additional assessment and protection. 48 (35%) macroinvertebrate assessments scored *Good* or *Good - Very Good*. These streams meet the VWQS B(2) criteria and are priorities for maintenance and protection. Ten sites (7%) had macroinvertebrate assessments that scored *Fair to Good*. Condition is indeterminate at these sites, and they require more monitoring to determine full aquatic biota support status. 20 sites (15%) scored *Fair* or lower, failing to meet VWQS B(2) criteria.

Fish Monitoring Results

Fish community assessments were completed at 65 sites between 2012 and 2021 in the Otter Creek basin (Figure 7, Table 2). Five of the sample sites had only Brook Trout, which means that a community assessment could not be made; however, a density criterion can be applied for upward reclassification of Brook Trout only streams. Of the 60 sites where fish communities could be assessed, 29 (48%) had fish communities in *Excellent* or *Very Good* condition, indicating the fish communities at these sites exceed the VWQS for Class B(2) streams. Thirteen (22%) sites with fish assessments exhibited communities in *Good* condition which meet the VWQS for Class B(2) streams and are priorities for maintenance and protection.

Twenty-three sites (38%) with fish assessments exhibited communities in *Fair* or *Poor* condition. Fish-based conditions at 10 of these sites scored similarly to the macroinvertebrate-based conditions. However, at the remaining 12 sites the *Fair* or *Poor* fish-based conditions were in contrast with *Good* to *Excellent* macroinvertebrate-based conditions. Often, a fish community can suggest different stressors from a macroinvertebrate community; therefore, assessing both the macroinvertebrate and fish community at a site is useful when resources allow it. Sites that fail to pass VWQS for a single community but score well for the other may be prioritized for further sampling to determine if anthropogenic impacts are responsible for the degradation. These sites are included in the Chapter 5 Monitoring Table (Table 21).

Table 2. Bioassessment results in the Otter Creek basin assessed between 2012 and 2021. Map ID corresponds to assessed sites in biological condition map above. For each site, only the most recent assessment result is given. 'BKT' indicates a brook trout only fish community.

Map ID	Site Name, River Mile	Year	Macroinvertebrate Assessment	Year	Fish Assessment
1	Lewis Creek, 3.7	2021	Good - Very Good	2021	Good
2	Lewis Creek, 8.5	2016	Excellent	2016	Good
3	Lewis Creek, 19.0	2017	Excellent		
4	Lewis Creek, 19.1	2021	Good	2021	Very Good
5	Lewis Creek, 24.0	2013	Excellent	2013	Very Good
6	Lewis Creek, 26.4	2014	Very Good	2013	Unable to assess
7	Prindle Brook, 0.3	2013	Very Good - Excellent	2013	Poor
8	Pond Brook, 1.0	2017	Good - Very Good	2021	Good
9	Hollow Brook, 0.9	2013	Good	2021	Poor
10	Hollow Brook, 2.2			2021	Poor
11	Hollow Brook, 2.5	2016	Excellent	2016	Very Good
12	Hogback Brook, 0.1	2021	Very Good	2017	Unable to assess
13	Hogback Brook, 1.7	2016	Very Good - Excellent		
14	High Knob Brook, 0.7	2016	Excellent	2016	Good
15	Hillsboro Brook, 0.5	2016	Very Good	2016	Excellent
16	Little Otter Creek, 4.2	2020	Fair	2020	Poor
17	Little Otter Creek, 7.0	2021	Fair-Good	2021	Good
18	Little Otter Creek, 12.7	2015	Very Good	2015	Fair
19	Little Otter Creek, 15.9	2016	Very Good - Excellent	2016	Unable to assess
20	Mud Creek, 0.8	2021	Fair-Good		
21	Mount Florona Brook, 1.7	2021	Fair-Good	2021	Poor
22	Little Otter Creek Trib #15, 0.5	2016	Fair	2016	Poor
23	Norton Brook, 0.2	2016	Good		
24	Otter Creek, 19.5	2016	Very Good		
25	Otter Creek, 71.5	2016	Good		
26	Otter Creek, 85.0	2016	Good		
27	Otter Creek, 87.5	2016	Good		
28	Lemonfair River, 16.7	2021	Fair-Good		
29	Beaver Brook, 1.6	2016	Good	2021	Good
30	Lemon Fair River Trib 7, 0.8	2012	Good		
31	New Haven River, 8.7	2018	Very Good-Excellent	2018	Very Good
32	New Haven River, 13.7	2016	Excellent	2016	Very Good
33	New Haven River, 21.8	2016	Very Good-Excellent	2016	Excellent

Map ID	Site Name, River Mile	Year	Macroinvertebrate Assessment	Year	Fish Assessment
34	Muddy Branch New Haven River, 3.3	2016	Very Good	2016	Fair
35	Gilmore Pond Outlet, 0.4	2016	Excellent		
36	New Haven River Trib 27, 0.5	2016	Excellent	2016	Excellent
37	Cota Brook, 2.5	2016	Good-Very Good	2016	Bkt
38	Blue Bank Brook, 1.7	2019	Excellent	2019	Excellent
39	Blue Bank Brook Trib 6, 0.2			2017	Bkt
40	Middlebury River, 3.6	2016	Excellent	2016	Good
41	Middlebury River, 6.4	2021	Excellent		
42	Halnon Brook, 0.2	2021	Fair		
43	Halnon Brook, 2.5	2021	Fair		
44	Halnon Brook, 2.6	2021	Fair		
45	Halnon Brook Trib 10, 0.1	2021	Fair		
46	Halnon Brook Trib 10, 0.2	2019	Poor-Fair	2012	Poor
47	Beaver Brook, 0.1	2021	Fair		
48	North Branch Middlebury River, 1.8	2021	Excellent		
49	Alder Brook, 0.4	2021	Excellent	2019	Unable to assess
50	Middle Branch Middlebury River, 0.2	2021	Very Good	2021	Excellent
51	South Branch Middlebury River, 1.0	2021	Excellent	2021	Very Good
52	Goshen Brook, 0.9	2021	Excellent	2021	Excellent
53	Goshen Brook, 0.4	2021	Excellent	2021	Excellent
54	Goshen Brook Trib 2, 0.2	2017	Excellent	2017	Excellent
55	Pleasant Brook, 1.1	2019	Poor		
56	Sucker Brook, 0.4	2021	Excellent		
57	Sucker Brook, 4.4	2021	Very Good - Excellent		
58	Dutton Brook, 0.7	2016	Excellent	2016	Unable to assess
59	Arnold Brook, 1.7	2016	Fair-Good		
60	Neshobe River, 0.9	2016	Good		
61	Neshobe River, 3.6	2016	Very Good - Excellent	2016	Good
62	Leicester Hollow Brook, 0.1	2016	Excellent	2016	Excellent
63	North Branch Neshobe River, 0.5	2021	Very Good	2021	Excellent
64	Jones Brook, 0.5	2014	Good	2014	Good
65	Jones Brook Trib 2, 1.6			2019	Excellent
66	Bresee Mill Brook, 4.9	2019	Excellent	2019	Poor

Map ID	Site Name, River Mile	Year	Macroinvertebrate Assessment	Year	Fish Assessment
67	Otter Creek Trib 27, 1.0	2021	Poor		
68	Otter Creek Trib 27, 1.1	2021	Poor		
69	Furnace Brook, 1.9	2016	Excellent		
70	Furnace Brook, 5.9	2016	Excellent		
71	Warner Brook, 0.5	2014	Very Good	2014	Good
72	Warner Brook, 1.3	2016	Excellent	2016	Excellent
73	Sugar Hollow Brook, 3.0	2016	Excellent		
74	Sugar Hollow Brook, 4.2	2016	Very Good - Excellent	2014	Excellent
75	Pondy Brook, 0.1	2021	Good		
76	Little Brook, 1.8	2016	Excellent	2016	Very Good
77	Clarendon River, 1.7	2017	Very Good		
78	Clarendon River, 1.8	2017	Very Good		
79	Clarendon River, 14.5	2016	Excellent	2016	Poor
80	East Creek, 7.8	2017	Excellent		
81	East Creek, 9.8	2021	Good	2017	Excellent
82	East Creek, 9.9	2016	Excellent		
83	Tenney Brook, 0.1	2021	Poor	2018	Fair
84	Tenney Brook, 1.0	2021	Poor	2021	Poor
85	Tenney Brook, 1.3	2021	Fair	2021	Poor
86	Tenney Brook, 1.6	2016	Good		
87	Mendon Brook, 1.0	2021	Good		
88	Mendon Brook, 1.8	2012	Good	2012	Poor
89	Mendon Brook, 2.5	2012	Very Good	2012	Very Good
90	East Creek Hydro Bypass Trib, 0.1	2016	Poor		
91	Moon Brook, 0.1	2021	Fair	2014	Fair
92	Moon Brook, 0.9	2021	Poor-Fair	2021	Poor
93	Moon Brook, 1.1	2012	Poor-Fair		
94	Moon Brook, 1.5	2014	Good	2014	Good
95	Moon Brook, 2.5	2014	Poor-Fair	2021	Poor
96	Moon Brook, 3.3	2014	Very Good	2021	Poor
97	Mussey Brook, 0.1	2021	Poor-Fair	2014	Good
98	Mussey Brook, 0.2	2013	Fair	2013	Fair
99	Mussey Brook, 1.2	2016	Good	2016	Poor
100	Paint Mine Brook, 0.1	2014	Good-Very Good	2014	Very Good
101	Cold River, 1.4	2020	Good-Very Good	2012	Very Good
102	Cold River, 4.3	2021	Excellent	2021	Very Good
103	North Branch Cold River, 0.1	2021	Very Good		
104	Sargent Brook, 1.6	2016	Very Good	2016	Excellent

Map ID	Site Name, River Mile	Year	Macroinvertebrate Assessment	Year	Fish Assessment
105	Airport Brook, 0.2	2014	Excellent	2014	Poor
106	Airport Brook, 0.3	2014	Good		
107	Airport Brook, 1.2	2016	Good	2016	Poor
108	Mill River, 3.9	2016	Fair	2016	Good
109	Mill River, 17.4	2012	Good	2012	Unable to assess
110	Mill River Trib 15, 0.3	2021	Very Good		
111	Button Brook, 0.1	2014	Very Good	2014	Excellent
112	Button Brook, 0.6	2014	Excellent		
113	Roaring Brook, 0.6	2016	Good	2016	Very Good
114	Baker Brook, 1.2	2016	Excellent	2016	BKT
115	Big Branch, 0.8	2021	Good		
116	Bully Brook, 2.3	2021	Very Good-Excellent	2020	BKT
117	Lost Pond Brook, 0.1	2016	Very Good-Excellent		
118	Mill Brook, 1.3	2016	Excellent	2016	Unable to assess
119	McGinn Brook, 0.7	2016	Good	2016	Excellent

Stream Geomorphic Assessment

Fluvial geomorphology investigates how flowing water shapes and modifies Earth's surface through erosional and depositional processes. The Rivers Program employs a three-phase approach to assess the physical condition of rivers in the State of Vermont. Phase 1 is a watershed assessment, phase 2 is a rapid field stream assessment, and phase 3 is a survey assessment.

Phase 1 Stream Geomorphic Assessments have been completed on about 16% of perennial stream miles in the watershed, and 3% of perennial stream miles have had Phase 2 Stream Geomorphic Assessments completed. Most of the stream reaches with Phase 2 Assessments have been rated as fair to poor condition (Figure 9). Most larger tributaries in the Otter Creek basin have been subject to Phase 2 Assessments; therefore, the fair geomorphic conditions noted by Phase 2-assessed reaches are likely representative of basin conditions. No Assessments have been completed in the basin since the 2019 TBP.

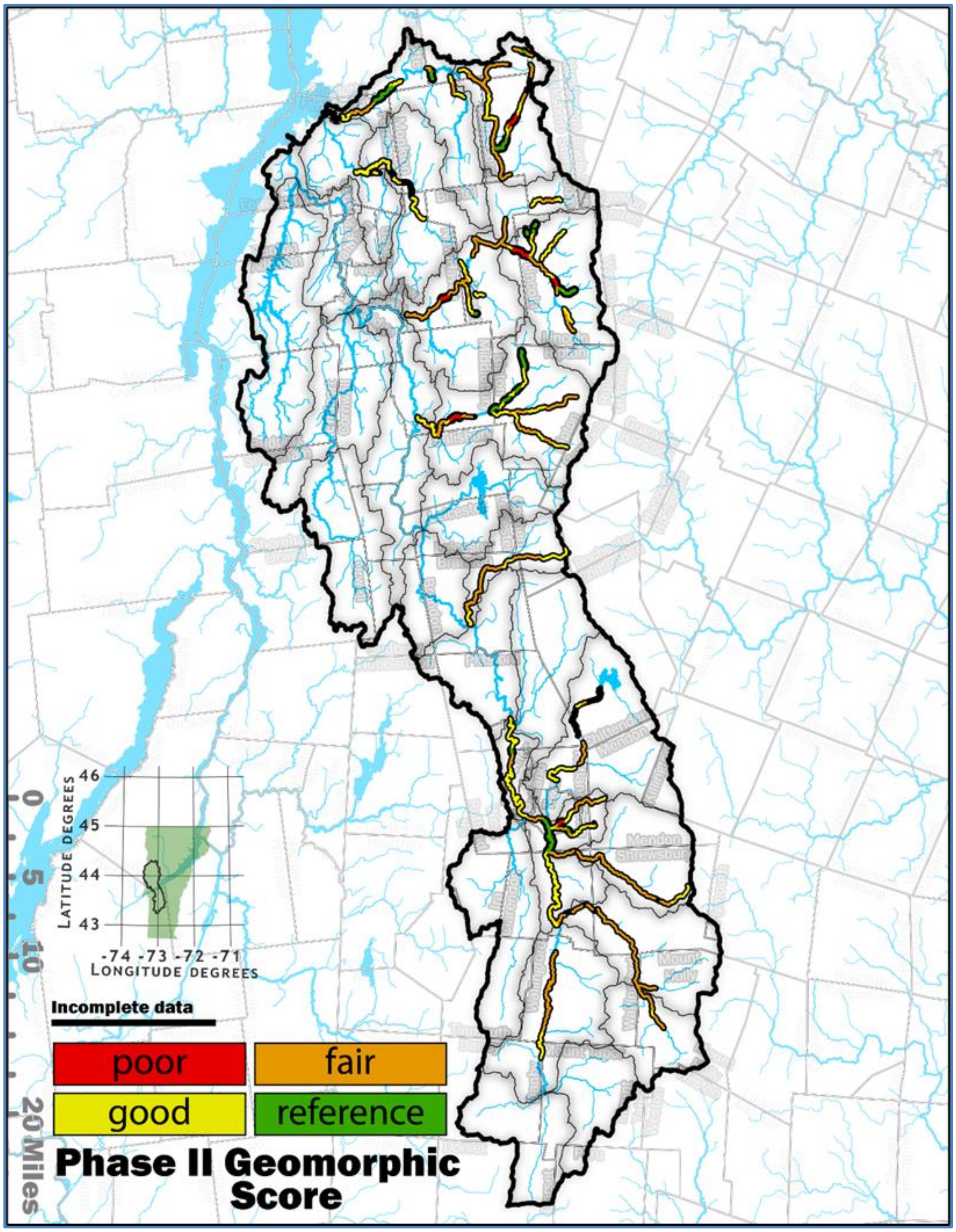


Figure 9. Geomorphic condition of assessed Otter Creek basin rivers and streams.

PFAS Monitoring

Per- and polyfluoroalkyl substances (PFAS) are a large group of human-made chemicals that have been used in industry and consumer products worldwide since the 1950s. PFAS chemicals from household and commercial products may find their way into water, soil, and biosolids. As a result, PFAS have been found in people, fish, and wildlife all over the world. Some PFAS do not break down easily and therefore stay in the environment for a very long time, especially in water.

In 2022, the Vermont Department of Environmental Conservation (VT DEC) Watershed Management Division, in cooperation with the Vermont Department of Fish & Wildlife (VT F&W), completed a study to evaluate levels of PFAS in northern Vermont surface waters and fish tissues. They collected surface water and fish tissue samples from waterbodies in northern Vermont and analyzed the samples for PFAS. The sampling targeted locations with known and probable sources of PFAS. Sites included the Lake Memphremagog watershed, the Winooski River, the Otter Creek, and the Stevens Branch.

There were no surface water detections above laboratory reporting limits at any Otter Creek location. Results of fish tissue analysis indicated that PFAS concentrations were low, though of these, the most elevated concentrations were in fish tissue from the mouth of the Winooski River and the mouth of Otter Creek. PFOS concentrations in fish tissue collected at these sites were 15.1 ppb and 9.82 ppb, respectively. The fish tissue data from this monitoring effort will be used by the Vermont Department of Health to determine if these levels pose any health risk to consumers. For additional details of the 2021 site selection and sampling effort refer to the [2021 Monitoring Report].

The DEC is working with the Vermont Department of Health to continue to identify sources and reduce the use and release of and public exposure to PFAS. The [PFAS Road Map] outlines strategic priorities relating to PFAS and summarizes the actions taken by DEC to address PFAS in Vermont.

Chloride Monitoring

Chloride is a naturally occurring element in the environment but usually occurs in relatively small amounts in Vermont surface waters. Most sources of chloride result from human activities including deicing agents in road salt, agriculture (animal waste), dust suppression, human waste, and water softeners. In most areas, road salt is believed to be the most significant contributor of chloride to the environment in Vermont.

For the protection of aquatic biota, the VWQS have chloride specific criteria for both acute and chronic exposures that were recommended to states by the US Environmental Protection Agency in 1988. There is also evidence that negative impacts occur below the VWQS criteria concentrations. Macroinvertebrate community health in Vermont streams appears to be negatively impacted at chloride levels as low as 50 mg/l. The Environmental Protection Agency is currently in the process of reviewing recent toxicity studies regarding chloride impacts to aquatic biota, but future recommendations to revise the VWQS are still several years away.

Chloride is routinely sampled in lakes and streams as part of several monitoring programs conducted by the WSMD. Since 2019, 13 lakes and 61 streams were sampled for chloride concentration in the Otter Creek tactical basin. Sixteen stream sites from five streams showed elevated concentrations

(>50 mg/l). The 5 streams are Barnes Brook, Beaver Brook, Moon Brook, Mussey Brook, and Tenney Brook. Where elevated levels exist, there is a greater chance of impairment existing; however, sufficient data needs to be collected to make impairment determinations according to assessment methodologies supportive of the VWQS.

More information on the WSMD approach to chloride monitoring and reduction is available in the 2022-2023 Water Quality Monitoring and Assessment Report.

Lakes and Ponds

There are 39 lakes and ponds in the basin that are ten acres or greater. Four lakes with good water quality, intact shoreline, high biodiversity, few invasive species, and scenic features, are identified as the best lakes in this basin. High Pond in Sudbury is a sentinel lake, and Mud Pond, Johnson Pond, and Sugar Hollow Pond are identified as high quality.

Lake Scorecard Assessment

The Vermont Lakes and Ponds Management and Protection Program shares lake assessments using the [Vermont Inland Lakes Scorecard] (Figures 10 and 11, Table 3). The scorecard provides available data on overall lake health by providing a rating of a waterbody's nutrient trend, shoreland and lake habitat, atmospheric pollution, and aquatic invasive species. The [Lake Scorecard's rating system is detailed here]. Lake-specific water quality and chemistry data can be accessed online through [the Lay Monitoring Program webpage]. The Otter Creek basin Lake Scorecard results are summarized below for lakes larger than 10 acres.

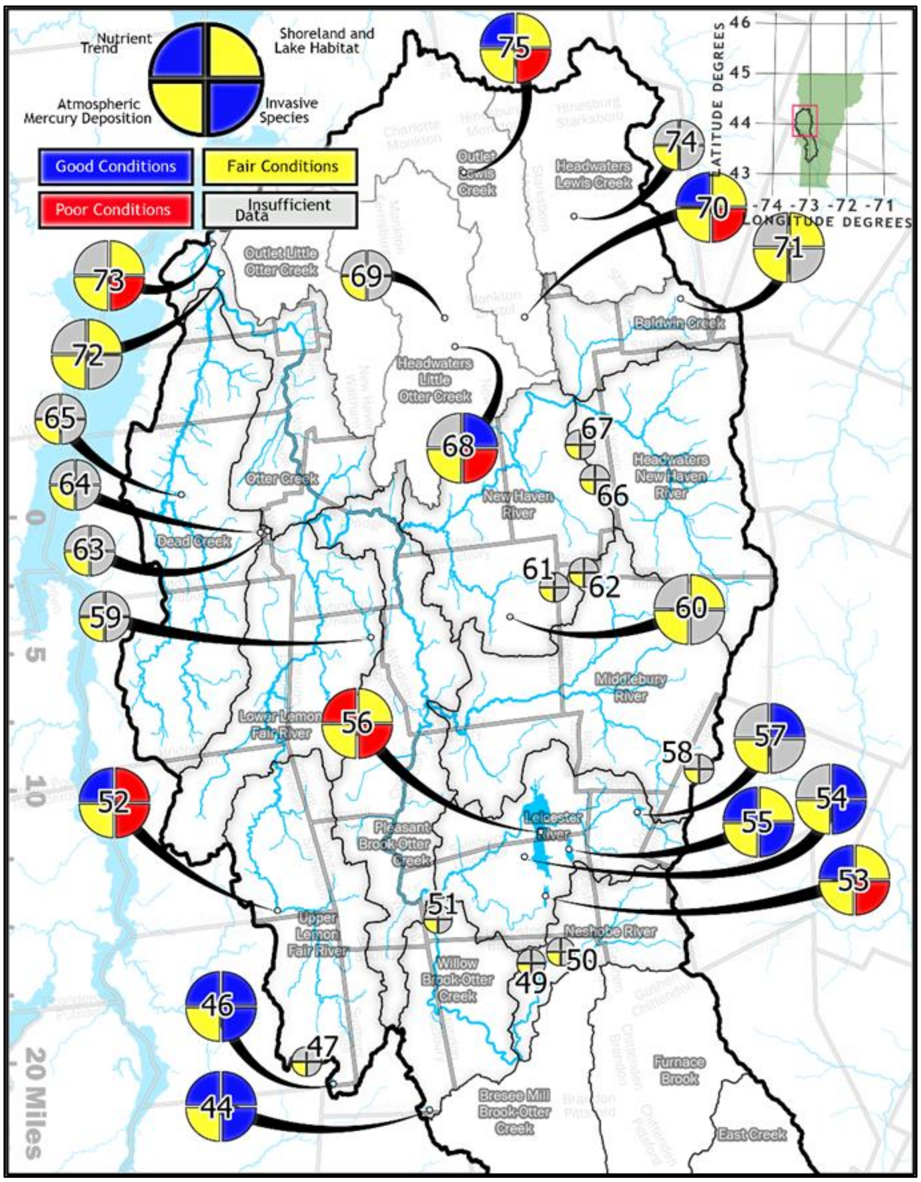


Figure 10. Condition of Otter Creek basin lakes and ponds in the lower watershed. Map ID corresponds with data in Table 3.

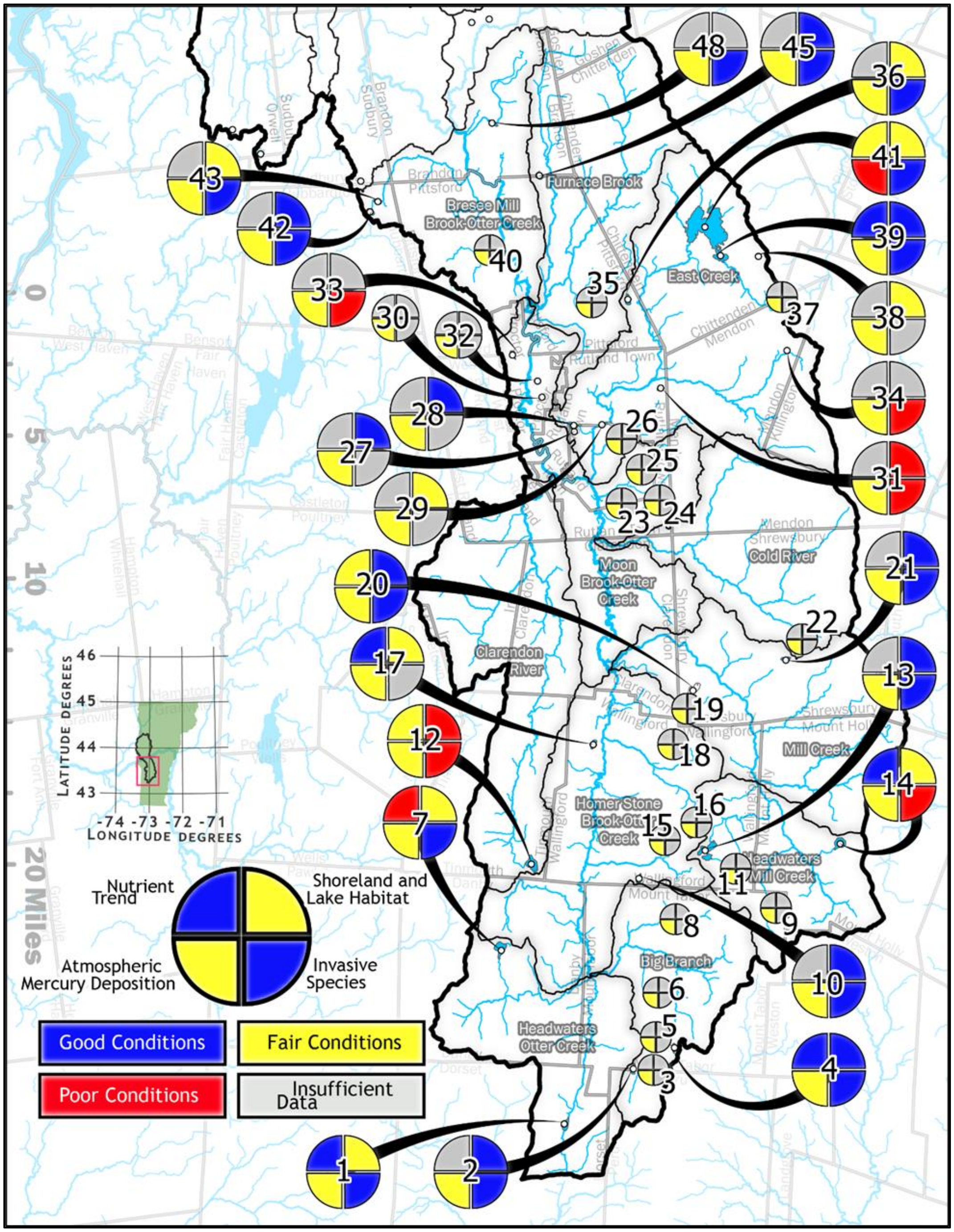


Figure 11. Condition of Otter Creek basin lakes and ponds in the upper watershed. Map ID corresponds with data in Table 3.

Shoreland Condition and Nutrient Trends

Of the 37 lakes evaluated for shoreland condition in the basin, 15 have *Good* ratings, 3 have a *Poor* rating (Chipman Lake, Rutland City, and Richville Pond), and 18 have a *Fair* rating. Of the 17 lakes monitored for nutrient water quality trends, 2 lakes (Danby, Dunmore) have a *Poor* rating, while

Chipman Lake, Spring Lake, and Chittenden Reservoir scored as *Fair*. Spring phosphorus levels are significantly increasing in Chittenden Reservoir, Spring Lake, and High Pond, while both spring and summer phosphorus are significantly increasing in Lake Dunmore and Danby Pond. One waterbody, Jerome Pond, is officially impaired by elevated phosphorus.

Acid Impairment

Vermont also has acid-impaired lakes and ponds due to airborne pollution from sulfur oxides, nitrogen oxides, and mercury. These pollutants are attributable to the prevailing weather pattern that carries mid-west air pollution through the region, the proximity to those pollution sources and to the lack of buffering capacity of the bedrock geology.

Sulfur and nitrogen oxides transported to Vermont from out of state air emissions result in acid forming pollutants raising in-lake acid concentrations. Lakes and ponds are regularly monitored for low pH (high acidity), which impacts biological communities. Thirty-nine lakes and ponds are included in the Vermont Acid Impaired Lake Total Maximum Daily Load. Since the USEPA began enforcing the Clean Air Act and its amendments, nationwide emissions and deposition of acid forming pollutants have declined. As a result, Vermont's in-lake acid concentrations have improved. North Pond, Gilmore Pond, Big Mud Pond, Little Mud Pond, Long Hole Pond, and Griffith Lake are acid-impaired lakes in the basin. More information about long term monitoring of Vermont's acid lakes can be found at: https://dec.vermont.gov/watershed/map/monitor/acid-rain.

Mercury Contamination

Mercury contamination has resulted in fish consumption advisories in nearly every lake in Vermont. Mercury is an atmospherically deposited contaminant, which arrives in Vermont primarily because of coal burning emissions, or solid waste incineration. Much has been accomplished in recent years to control emissions nationally, yet this remains a long-term issue. Atmospherically deposited mercury is transferred up the food chain from plankton to fish, loons, and larger birds and mammals. All lakes in the basin received a fair condition score for mercury and Chittenden Reservoir is impaired by Mercury in fish tissue.

Aquatic Invasive Species

Eleven of the 39 lakes greater than 10 acres that have been surveyed for aquatic invasive species have *Poor* ratings – Chipman Lake, Star Lake, Rutland City, Beaver Pond (Proctor), Richville Pond, Fern Lake, Lake Dunmore, Vergennes Watershed, Winona Lake, Porter Lake, and Cedar Lake. A poor score indicates that there is at least one invasive species present, regardless of its abundance or 'nuisance' level.

Table 3. Otter Creek basin Lake Scorecard ratings for lakes greater than ten acres.

Map ID	Lake ID	Area (ac)	Depth (ft)	Nutrient Trend	Shoreland Condition	Aquatic Invasive Species	Atmospheric Mercury Deposition
1	EMERALD	31.4	40	Good	Fair	Good	Fair

Map ID	Lake ID	Area (ac)	Depth (ft)	Nutrient Trend	Shoreland Condition	Aquatic Invasive Species	Atmospheric Mercury Deposition
2	GRIFFITH	15.6	14	Insufficient Data	Good	Good	Fair
3	BIG MUD	18.3	1.5	Good	Good	Good	Fair
4	DANBY	65.1	6	Poor	Fair	Good	Fair
5	LITTLE ROCK	19.6	32	Insufficient Data	Good	Good	Fair
6	FIFIELD	13.9		Insufficient Data	Insufficient Data	Insufficient Data	Fair
7	CHIPMAN	79.6	11	Fair	Poor	Poor	Fair
8	WALLINGFORD	88.2	28	Insufficient Data	Good	Good	Fair
9	STAR	62.2	8	Good	Fair	Poor	Fair
10	ELFIN	20.4	28	Good	Fair	Insufficient Data	Fair
11	SPRING (SHRWBY)	63.7	84	Fair	Good	Good	Fair
12	COOKS (SHRWBY)	21.3	3	Insufficient Data	Good	Good	Fair
13	JOHNSON (SHRWBY)	34.5		Insufficient Data	Insufficient Data	Insufficient Data	Fair
14	MUDDY (RUTLDC)	26.8	6	Insufficient Data	Good	Insufficient Data	Fair
15	BEAVER (PROCTR)	11.1		Insufficient Data	Insufficient Data	Poor	Fair
16	BURR (PITTFD)	19.8	18	Insufficient Data	Fair	Good	Fair
17	LEFFERTS	66	8	Good	Good	Good	Fair
18	CHITTENDEN	748	46	Fair	Fair	Insufficient Data	Poor
19	MUDD	19.3	7	Insufficient Data	Good	Good	Fair
20	WALKER (HUBDTN)	14.8	33	Insufficient Data	Fair	Good	Fair
21	HIGH (SUDBRY)	17.5	56	Good	Good	Good	Fair
22	SUGAR HOLLOW	25	3	Insufficient Data	Good	Good	Fair
23	JOHNSON (ORWELL)	35.6	18	Good	Good	Good	Fair
24	RICHVILLE	112.9	8	Good	Poor	Poor	Fair
25	FERN	67.3	43	Good	Fair	Poor	Fair
26	MUD (LEICTR)	25.2	10	Insufficient Data	Good	Good	Fair
27	SILVER (LEICTR)	104.4	70	Good	Fair	Good	Fair

Map ID	Lake ID	Area (ac)	Depth (ft)	Nutrient Trend	Shoreland Condition	Aquatic Invasive Species	Atmospheric Mercury Deposition
28	DUNMORE	1039.6	105	Poor	Fair	Poor	Fair
29	SUGAR HILL	47.2	35	Insufficient Data	Good	Insufficient Data	Fair
30	PERRY-JACKSON	24.5		Insufficient Data	Insufficient Data	Insufficient Data	Fair
31	DOW	10.6	10	Insufficient Data	Fair	Insufficient Data	Fair
32	JEROME	21.9	3	Insufficient Data	Insufficient Data	Insufficient Data	Fair
33	GILMORE	15.4	2	Insufficient Data	Insufficient Data	Insufficient Data	Fair
34	VERGENNES WATERSHED	11.2	16	Insufficient Data	Good	Poor	Fair
35	WINONA	273.6	9	Good	Fair	Poor	Fair
36	HALLOCK	10.1	2	Insufficient Data	Fair	Insufficient Data	Fair
37	DANYOW	28	2	Insufficient Data	Fair	Insufficient Data	Fair
38	PORTER	21.2	10	Insufficient Data	Fair	Poor	Fair
39	CEDAR	127.8	13	Good	Fair	Poor	Fair

Lake Champlain

Unlike other lakes in the basin, Lake Champlain is not located within the boundaries of the basin but instead receives water from the Otter Creek and several other large watersheds. In 2024, the Lake Champlain Basin Program released the 3-year Lake Champlain State of the Lake and Ecosystem Indicators Report. The report describes several ongoing needs and challenges:

- The amount of phosphorus delivered to the Lake each year must be reduced to implement the Lake Champlain P Total Maximum Daily Load (see Chapter 3).
- High flows transport most of the nutrients and sediment to the Lake and as a result, phosphorus loading is driven by annual differences in precipitation, snowpack, and drought. Annual variability in loading is likely to continue and may increase as climate changes alters precipitation patterns.
- Warm weather cyanobacteria blooms continue to impact recreation in many parts of the Lake leading to beach closures.
- Despite several invasive species interceptions and prevention measures, the fishhook waterflea was discovered in the Lake in 2018 and the entire lake faces continuing

threat due to the possibility of introduction of new aquatic invasive species. Round Goby, an invasive fish, is of particular concern.

- The European water chestnut management in the Black Creek in St. Albans as well as the South Lake region limits population growth, while new populations recently appeared in the Main Lake and Missisquoi Bay lake segments.
- Increasing flood events spread invasive Japanese knotweed throughout riparian habitats. If left unmanaged, this plant will line rivers and streams for miles in thick, dense stands, outcompeting and replacing the native species that insects, fish, birds, and mammals rely on. The ground beneath these dense stands also rarely supports other vegetation, leaving the soil very susceptible to erosion.

Long-term increases in phosphorus loading have been documented in Lewis, Otter, and Little Otter Creeks and in the Missisquoi and Poultney Rivers. All other monitored tributaries show no significant long-term trends in phosphorus loading. While reductions to lake phosphorus loading via the Lake Champlain Total Maximum Daily Load is an ongoing need, phosphorus reduction from wastewater treatment facilities is a notable basin-wide improvement according to the 2021 Report. The natural wetland systems found within the Otter Creek basin provide important ecosystem functions including ground water storage, pollution reduction, and flood control. A 2016 study of Otter Creek found that wetlands and floodplains reduced flood damage by up to 78% in a 10-year period, limiting property damage and recovery costs significantly.

Wetlands

The Vermont Wetlands Program houses the Wetland Bioassessment Program which assesses the biological condition and ecological integrity of Vermont wetlands. Plant species are used as the primary biological indicator to assess wetland health. Based on a 2017 analysis of bioassessment data, the principal factors that correlate with poor wetland condition are:

- presence of invasive plant species,
- disturbance to the wetland buffer or immediate surrounding area,
- disturbance to wetland soils, and
- disturbance to wetland hydrology (how water moves through a wetland) through ditching (e.g., agricultural), filling (e.g., roads) and draining (e.g., culverts).

Wetlands in remote areas and at high elevations tend to be in good condition, with the most threatened wetlands occurring in areas of heavy agricultural use and high development pressure often exhibiting habitat loss.

Wetland Bioassessment and Vermont Rapid Assessment Method

A total of 178 wetlands in the basin have been assessed using the Vermont Rapid Assessment Method (VRAM; Figure 12). The VRAM assigns each wetland a score ranging from 15 to 100 with higher numbers representing more intact ecological condition and higher levels of wetland functions and values. The highest scoring wetland, Beaver Meadow All, scored a 100. Thirty other wetlands scored above 80, indicating excellent condition and/or very high levels of function and value. Sixty-two wetlands scored below 50, and the average score was 59. Note that the VRAM assessments in this watershed may not necessarily be representative of the basin's wetlands, as random sampling was not conducted and a full inventory of all the wetlands in the basin is not possible at this time.

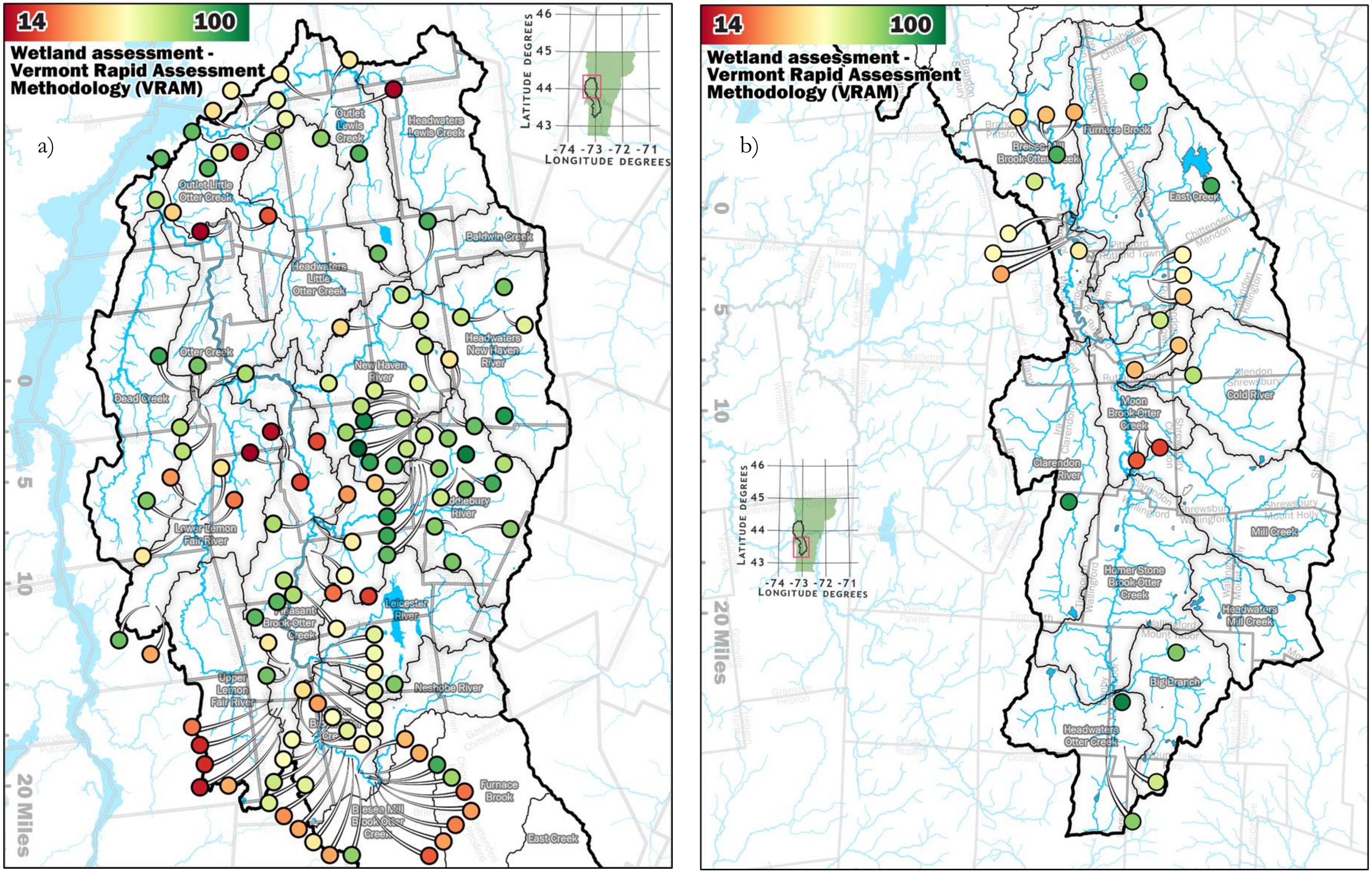


Figure 12. Completed Wetland VRAM assessments in the a) lower and b) upper watershed. Green indicates better wetland condition and red indicates poorer condition.

Chapter 2 – Priority Areas for Surface Water Protection

The state protects lakes, wetlands, and rivers by establishing and supporting surface water management goals. Tactical Basin Plans (TBPs) identify surface waters that consistently attain a higher level of quality and value based on physical, chemical, and biological criteria. These waters are prioritized for reclassification or designation. This allows for the establishment of enhanced management objectives and supports implementation of strategies to protect these surface waters.

Additional pathways such as land stewardship programs, local protection efforts, conservation easements, and land acquisition are also used to increase protection of priority waters. These are described in Chapter 4 - Strategies for Protection and Restoration. Two lakes and 15 streams in this basin meet or exceed standards for very high-quality condition and are prioritized for reclassification.

A. Surface Water Reclassification and Designation

Vermont's surface water classification system establishes management goals and supporting criteria for designated uses in four classes of water. Designated uses include aquatic biota and wildlife, aquatic habitat, aesthetics, fishing, boating, swimming, public water supply, and irrigation. The VWQS begin classification with two broad groups based on elevation:

- All waters above 2,500 feet in elevation are designated Class A(1) for all uses, unless specifically designated Class A(2) for use as a public water source.
- All waters at or below 2,500 feet in elevation are designated Class B(2) for all uses, unless specifically designated as Class A(1), A(2), or B(1) for any one or more uses.

Current classifications of surface waters and their uses are published in the VWQS and are identified through the tactical basin planning process or on a case-by-case basis. Table 4 lists the possible classes for each designated use.

Table 4. Uses of Vermont waters by classification.

Classification	Applicable Uses
Class A(1)	One or more of: Aquatic biota and wildlife, aquatic habitat, aesthetics, fishing, boating, or swimming
Class A(2)	Public water source
Class B(1)	One or more of: Aquatic biota and wildlife, aquatic habitat, aesthetics, fishing, or boating
Class B(2)	Aquatic biota and wildlife, aquatic habitat, aesthetics, fishing, boating, swimming, public water source or irrigation

Surface waters may be protected by the anti-degradation policy of the VWQS (DEC, 2022) or through one of the following pathways:

- Reclassification of surface waters
- Class I Wetland designation
- Outstanding Resource Waters designation

The tactical basin planning process includes the review of ANR monitoring and assessment data to identify and document surface waters that meet the criteria for a higher classification or designation. (10 V.S.A. § 1253).

Public involvement is an essential component of protecting river, wetland, and lake ecosystems. The VWQS indicate that in the basin planning process, "Public participation shall be sought to identify and inventory problems, solutions, high quality waters, existing uses and significant resources of high public interest." The public, watershed partners, and stakeholders are encouraged to make recommendations for additional monitoring and research where very high-quality waters may exist.

In addition, the public may petition the DEC to reclassify streams and lakes, and to designate Outstanding Resource Waters. DEC has developed procedures and documents for Class I wetland designations and draft documents for stream reclassification. When the public is involved in developing proposals regarding management objectives, the increased community awareness can lead to protection of uses and values by the community and individuals.

Further information on reclassification and the petition process can be found on the following WSMD webpages: Stream Reclassification, Lakes and Ponds Reclassification, and Class I Wetlands. Strategies for enhanced protection of surface waters are described in further detail in the following sections. Surface waters in need of supplemental monitoring to determine their potential for enhanced management are included in Chapter 5 in the Monitoring and Assessment Table.

A(2) Public Water Sources

Fourteen waters are designated as A(2) public water sources in Basin 3 (Figure 13). Nine waters are abandoned A(2) public water sources and are candidates for reclassification to A(1) or B(1) for better long-term management.

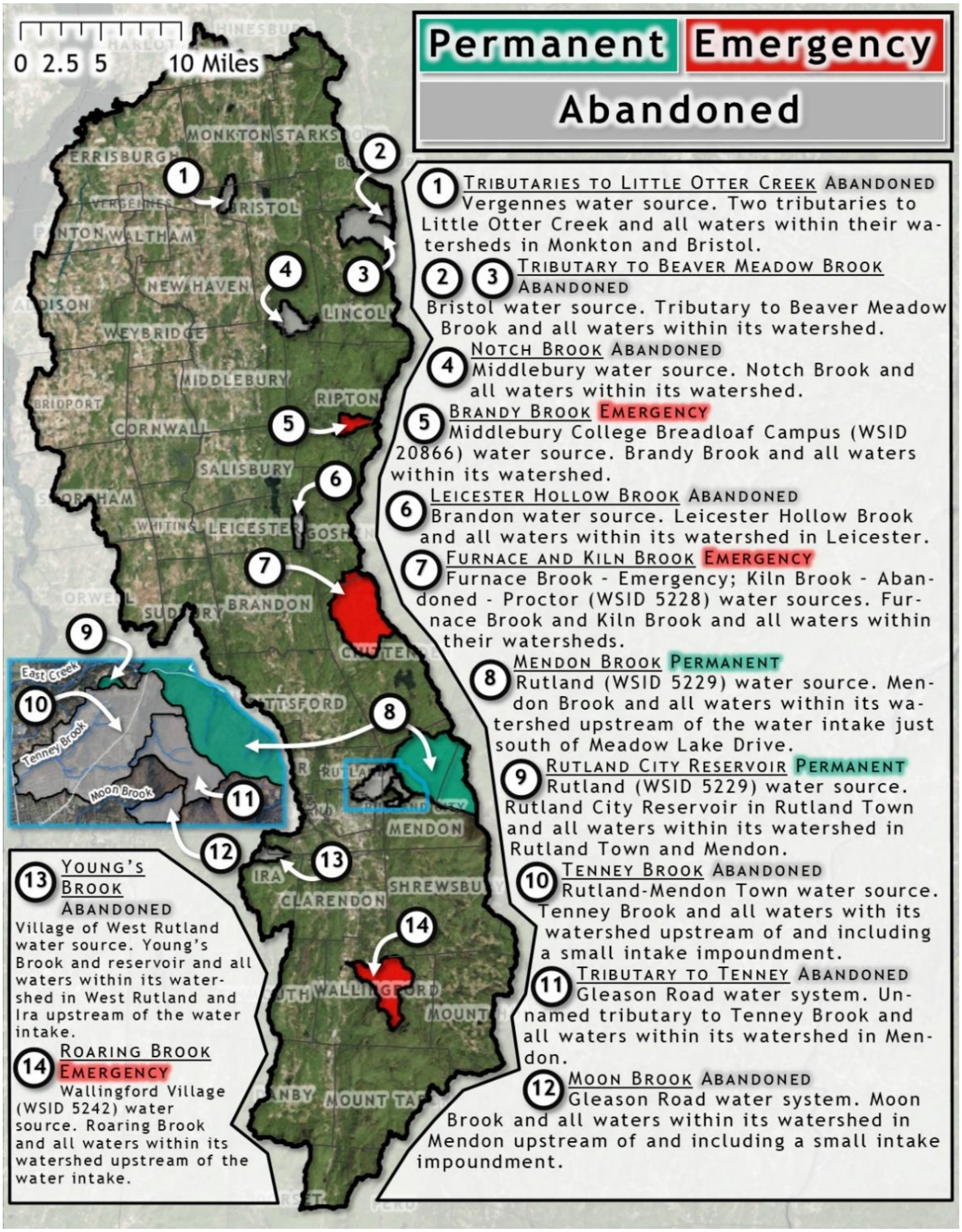


Figure 13. Class A(2) designated public water sources in Basin 3.

A(1) & B(1) Waters for Aquatic Biota and Fishing

Biomonitoring assessments by the WSMD identified 25 surface waters as consistently and

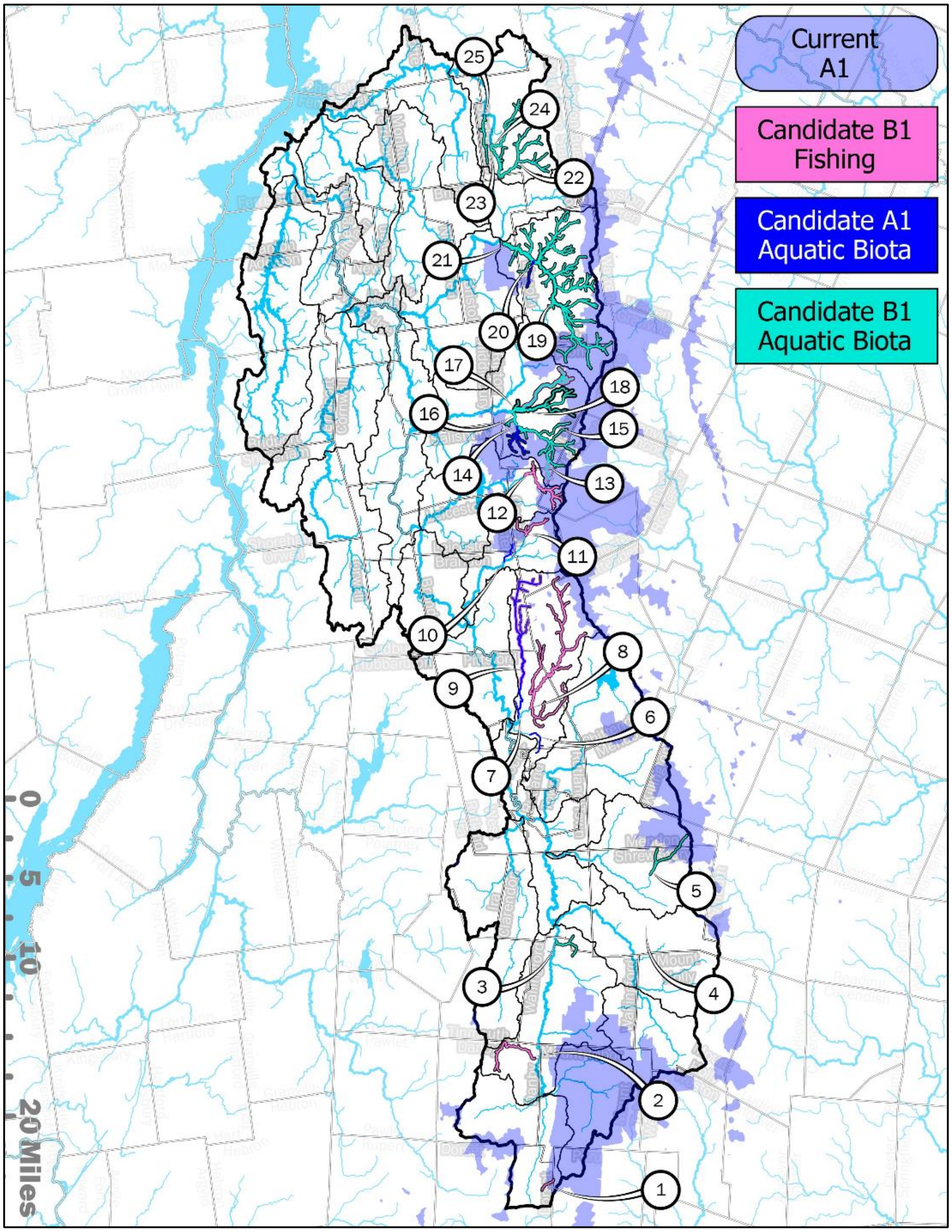


Figure 14. Rivers that are A(1) and B(1) reclassification candidates.

Table 5. A(1) and B(1) reclassification candidates in rivers in the Otter Creek basin. Map ID corresponds to assessed sites in the map above.

Map ID	Site Name, River Mile	Class	Use
1	Otter Creek	B1	Fishing
2	Baker Brook	B1	Fishing
3	Button Brook, 0.6, Button Brook, 0.1	B1	Aquatic biota
4	Connolly Pond Brook	B1	Fishing
5	Sargent Brook, 1.6	B1	Aquatic biota
6	Warner Brook, 1.3	A1	Aquatic biota
7	Sugar Hollow Brook, 3.0, Sugar Hollow Brook, 4.2	A1	Aquatic biota
8	Furnace Brook	B1	Fishing
9	Sugar Hollow Brook	B1	Fishing
10	Leicester Hollow Brook, 0.1	A1	Aquatic biota
11	North Branch Neshobe River	B1	Fishing
12	Sucker Brook	B1	Fishing
13	Goshen Brook	B1	Fishing
14	Goshen Brook, 0.9	A1	Aquatic biota
15	Brandy Brook	B1	Fishing
16	South Branch Middlebury River, 1.0	B1	Aquatic biota
17	Middle Branch Middlebury River, 0.2	B1	Aquatic biota
18	Sparks Brook	B1	Fishing
19	New Haven River, 21.8	B1	Aquatic biota
20	New Haven River Trib 27, 0.5	A1	Aquatic biota
21	New Haven River, 13.7	B1	Aquatic biota
22	Hillsboro Brook, 0.5	B1	Aquatic biota
23	Lewis Creek, 24.0, Lewis Creek, 26.4	B1	Aquatic biota
24	High Knob Brook, 0.7	B1	Aquatic biota
25	Hogback Brook, 0.1, Hogback Brook 1.7	B1	Aquatic biota

demonstrably attaining a higher level of quality than Class B(2) based on draft criteria for aquatic biota reclassification and recreational fishing criteria: 10 meeting Class B(1) for aquatic biota, 10 meeting Class B(1) for fishing, and 5 meeting Class A(1) for aquatic biota (Figure 14, Table 5).

Waters In Need of Further Assessment

Nine rivers and streams need supplemental monitoring to determine their potential for enhanced protection (Figure 15). These waters are included in Chapter 5 in the Monitoring and Assessment Table.

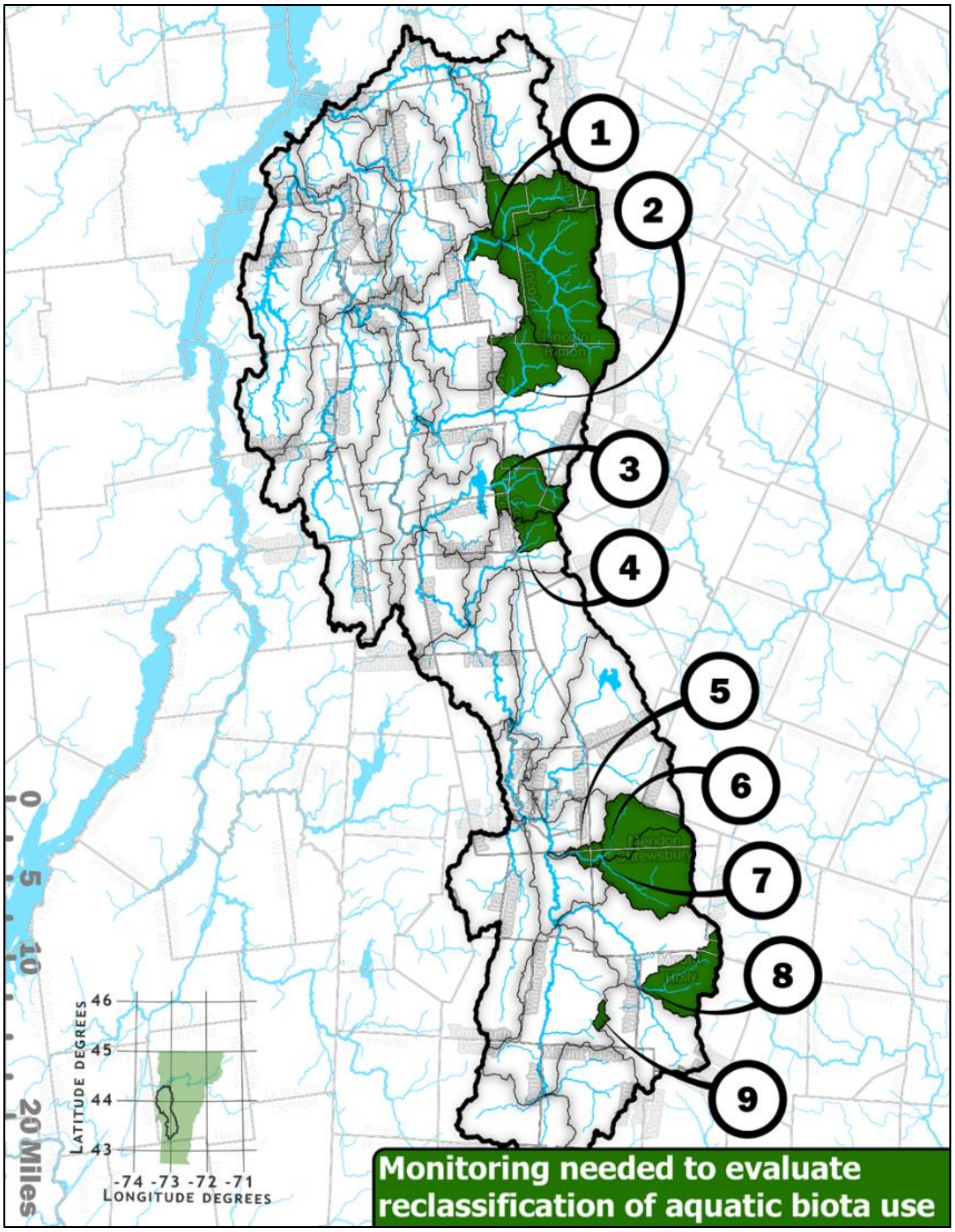


Figure 15. Priority streams for additional monitoring to determine eligibility for A(1) or B(1) reclassification for aquatic biota.

B(1) Waters for Recreational Fishing

Rivers and streams classified as B(1) recreational fishing waters support wild, self-sustaining salmonid populations characterized by the presence of multiple age classes and a minimum abundance of 1,000 individuals per mile (all species/ages/sizes); and/or 200 large (> 6 inches total length) individuals per mile; and/or 20 pounds/acre (all species/ages/sizes). Ten streams meet B(1) criteria for recreational fishing (§29A-306 of the VWQS) (Figure 14; Table 5). Unless otherwise noted, B(1) classification would apply to the stream from the given point of sampling to its headwaters. These waters shall be managed to achieve and maintain the documented quality of fishing. It is important to note that all waterbodies that would naturally support fish populations are protected and maintained for this use in perpetuity.

There are other streams in Basin 3 that are candidates for B(1) but have not been surveyed recently enough to qualify. A list of these streams can be found in Table 21. Fisheries biologists with the Vermont Fish and Wildlife Department (VTFWD) are making a concerted effort to continue evaluating historic survey sites and exploring additional streams in Basin 3 to continue updating the list of B(1) class waters.

A(1) & B(1) Waters for Aesthetics

The VWQS include a designated use for aesthetic conditions. DEC has developed numeric nutrient criteria for lakes and ponds in relation to this use which are reflected in Table 3 of the VWQS. Lake Dunmore and Chipman Pond currently meet the nutrient criteria for B(1) aesthetics, and Wallingford Pond is recommended for additional monitoring to determine its B(1) eligibility. No lakes currently meet the criteria for A(1) aesthetics given the available data.

B. Class I Wetland Designation

The State of Vermont identifies and protects the functions and values of significant wetlands to achieve no net loss of wetlands. Based on an evaluation of the extent to which a wetland provides functions and values, it is classified as:

- **Class I**: Exceptional or irreplaceable in its contribution to Vermont's natural heritage and therefore, merits the highest level of protection.
- **Class II**: Merits protection, either taken alone or in conjunction with other wetlands.
- **Class III**: Neither a Class II nor a Class I wetland.

Impacts to Class I wetlands may only be permitted when the activity is necessary to meet a compelling public need for health or safety. The Wetlands Program Class I Wetlands website highlights the designated Class I wetlands statewide and lists those recommended for Class I designation.

In 2017 the Beaver Meadows Wetland Complex was reclassified from a Class II to Class I with a 400-foot buffer zone. The wetland is located off Upper Notch Road in Ripton, VT (Figure 16). In 2001 the Tinmouth Channel Wetland Complex was designated as Class I wetlands. The Otter Creek Wetland Complex in the towns of Cornwall, Middlebury, and Whiting is deemed a candidate Class I wetland.

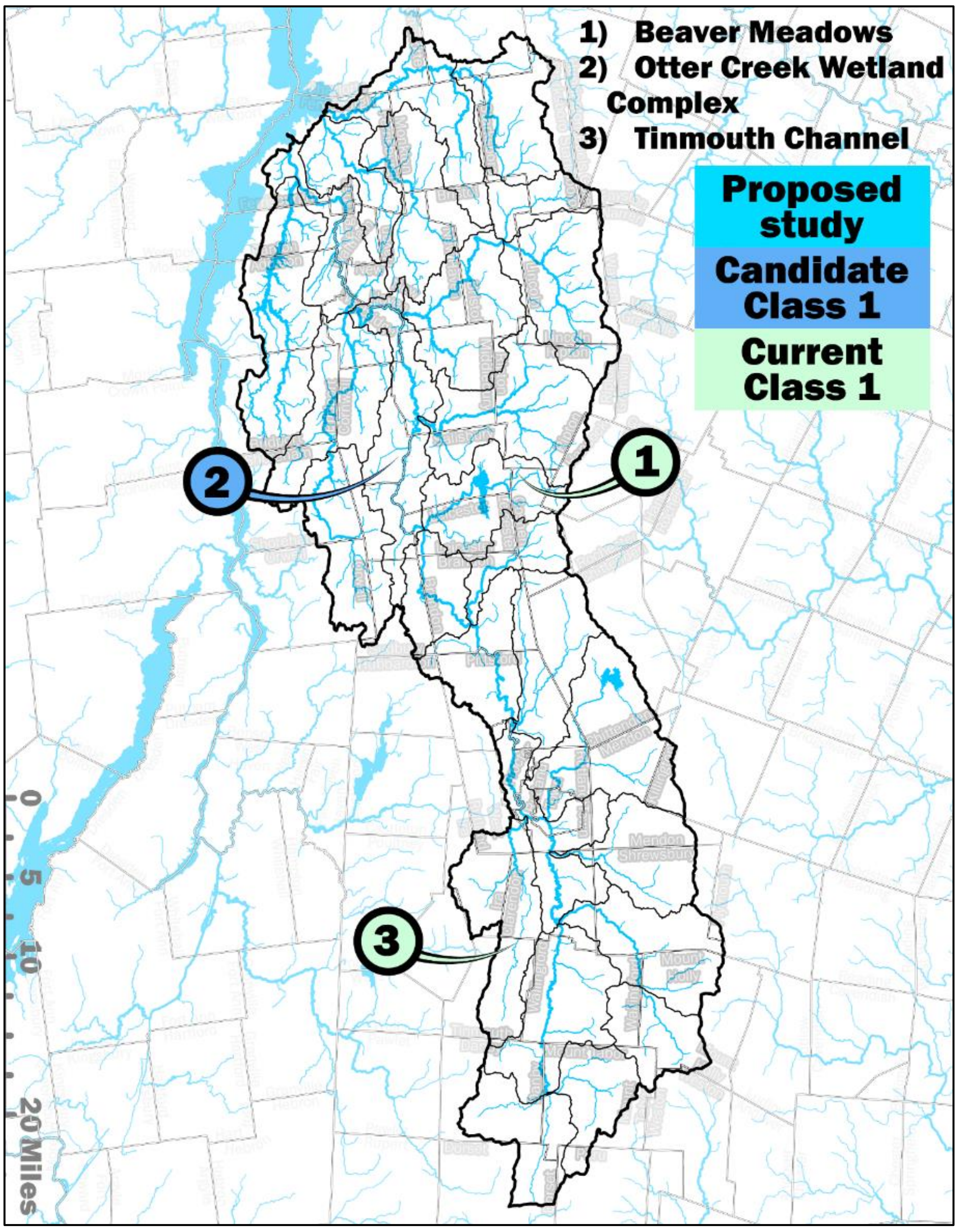


Figure 16. Current and candidate Class I wetlands in the Otter Creek basin.

DEC supports the further study and reclassification of wetlands, and the Wetlands Program welcomes recommendations for Class I candidates. Wetlands that are found to meet criteria for designation may be proposed for reclassification through petition or departmental rulemaking authority, consistent with the Vermont Wetland Rules.

C. Outstanding Resource Waters Designation

Rivers, streams, lakes, and ponds that have "exceptional natural, cultural, recreational, or scenic values" can be protected through designation as Outstanding Resource Waters (ORW). ORW designation protects exceptional waters through permit conditions for in-stream alterations, dams, wastewater discharges, aquatic nuisance controls, solid waste disposal, Act 250[1] projects, and other activities. ORWs can be designated by the ANR through a public petition process. There are currently no ORW designated waters in the Otter Creek basin.

D. Identification of Existing Uses

Existing uses of waters and the level of water quality necessary to protect those existing uses shall be maintained and protected regardless of the water's classification (DEC, 2022).

The ANR may identify existing uses of waters during the tactical basin planning process or on a case-by-case basis during application reviews for State or Federal permits. Consistent with the federal Clean Water Act, the VWQS stipulate that existing uses may be documented in any surface water location where that use has occurred since November 28, 1975. Pursuant to the definition of Class B(1) in Act 79, the ANR may identify an existing use as Class B(1) when that use is demonstrably and consistently attained.

The ANR stipulates that all lakes and ponds in the state have existing uses of swimming, boating, and fishing. The ANR recognizes that fishing activities in streams and rivers are widespread and too numerous to thoroughly document for the basin. In the case of streams too small to support significant fishing activity, the ANR recognizes these as potential spawning and nursery areas, which contribute fish stocks downstream where fishing may occur. These small streams support the use of fishing and therefore, are protected at a level commensurate with downstream areas.

Existing uses listed in the basin plan should be viewed as a partial accounting of known existing uses based upon limited information. The list does not change protection under the Clean Water Act or VWQS for unlisted waters. Existing uses are listed in Appendix B of the 2019 Otter Creek Tactical Basin Plan and include swimming, boating, fishing, and public water sources.

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[1] Vermont's land use and development law, established in 1970. The law provides a public, quasi-judicial process for reviewing and managing the environmental, social, and fiscal consequences of major subdivisions and development in Vermont through the issuance of land use permits.

The public is encouraged to recommend waters for the existing uses of swimming, boating, fishing, public water source, and ecological significance given that they provide evidence of such use.

Chapter 3 – Priority Areas for Surface Water Restoration

A. Impaired and Altered Surface Waters

The DEC monitors and assesses the chemical, physical, and biological status of individual surface waters to determine if they meet the VWQS per the 2022 Vermont Surface Water Assessment and Listing Methodology (DEC, 2022). Surface waters are assessed as: full support, altered, or impaired.

The assessment results are the basis for the biennial statewide 303(d) List of Impaired Waters and List of Priority Surface Waters Outside the Scope of 303(d) (Table 6 and 7-8; Figures 17 and 18), waters altered by invasive species or flow regulation (Table 9; Figure 19), as well as the priority waters for protection for aquatic biota and wildlife (Chapter 2). The lists identify impaired or altered waters and includes preliminary information on responsible pollutant(s) and/or physical alterations to aquatic and riparian habitat and identifies the problem, if known. Altered and impaired waters become a priority for restoration.

The Vermont Lake Score Card identified lakes and ponds that have increasing nutrient trends and therefore are a priority for nutrient reduction strategies.

The strategies proposed in the Chapter 5 Implementation Table are prescribed based on the land use sector-specific practices outlined in the Vermont Surface Water Management Strategy.

Thirteen rivers and streams have biomonitoring data that indicate fair or poor condition, but there is not enough data to fully evaluate the attainment of Aquatic Biota use, or monitoring results show volatile conditions from year to year (Figure 20). These streams are a priority for further assessment and are listed in Table 11 and Chapter 5's Monitoring and Assessment Table (Table 21).

The following figures and tables are grouped to show the impaired or altered waterbodies in the Otter Creek basin, their known or suspected pollutant sources, and monitoring needs for further evaluation.

Impaired Lakes and Ponds

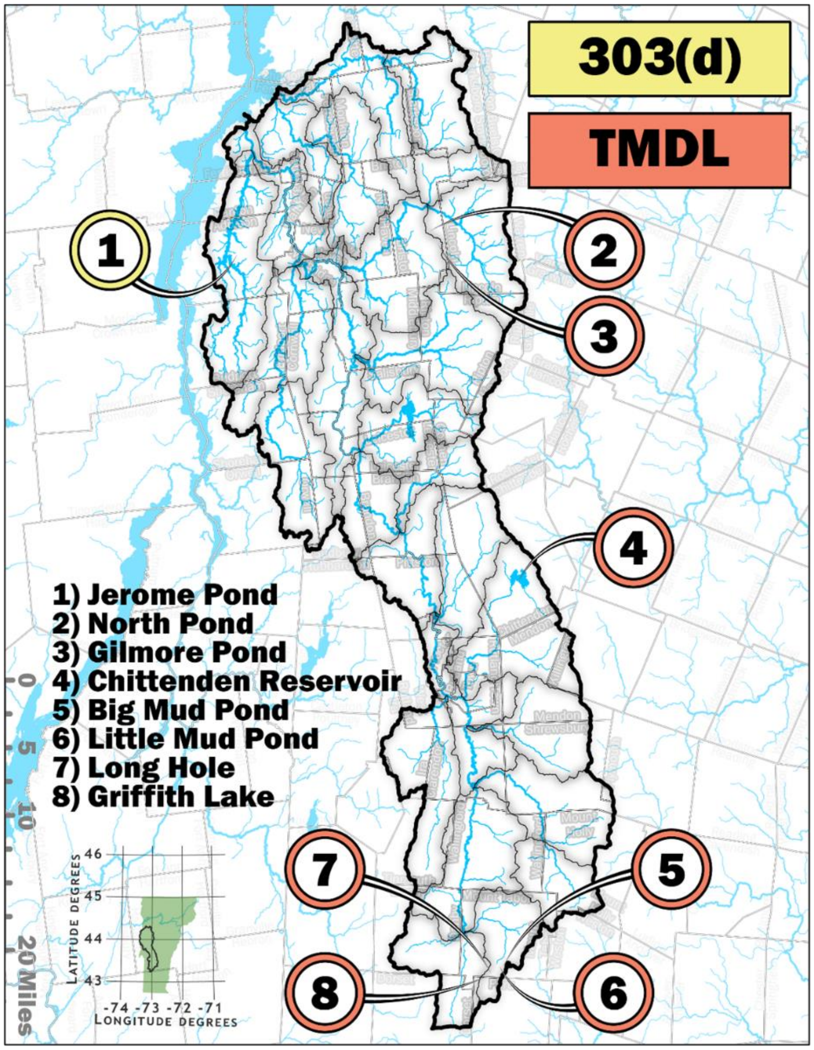

Figure 17. Impaired lakes in the Otter Creek basin. Map number corresponds with Table 6.

Table 6. Impaired lakes in the Otter Creek basin and their pollutants. 'List' indicates the part of the Priority Water list to which the waterbody belongs based on attributes described in Chapter 4 of the 2022 Vermont Surface Water Assessment and Listing Methodology.

Map #	Name	Problem	Pollutant	List
1	Jerome Pond	Excessive Phosphorus; reduced clarity	Total Phosphorus	A
2	North Pond (Bristol)	Atmospheric deposition: critically acidified; chronic acidification	Acidification	D
3	Gilmore Pond (Bristol)	Atmospheric deposition: extremely sensitive to acidification; episodic acidification	Acidification	D

Map #	Name	Problem	Pollutant	List
4	Chittenden Reservoir (Chittenden)	Elevated levels of mercury in walleye	Mercury in fish tissue	D
5	Big Mud Pond (Mt. Tabor)	Atmospheric deposition: extremely sensitive to acidification; episodic acidification	Acidification	D
6	Little Mud (Mt. Tabor)	Atmospheric deposition: extremely sensitive to acidification; episodic acidification	Acidification	D
7	Long Hole (Mt. Tabor)	Atmospheric deposition: critically acidified; chronic acidification	Acidification	D
8	Griffith Lake (Peru)	Atmospheric deposition: extremely sensitive to acidification; episodic acidification	Acidification	D

Impaired Rivers and Streams

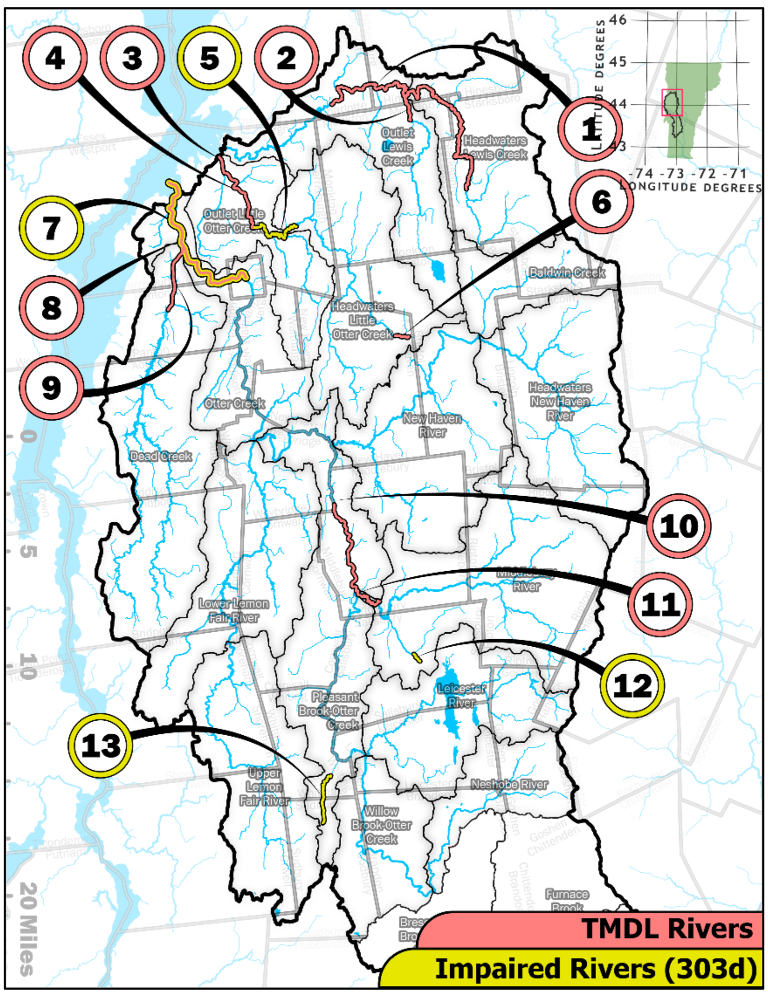

Figure 18. a) Impaired rivers in the lower Otter Creek basin. Map number corresponds with Table 7.

Table 7. Impaired rivers in the lower Otter Creek basin and their pollutants. 'List' indicates the part of the Priority Water list to which the waterbody belongs based on attributes described in Chapter 4 of the 2022 Vermont Surface Water Assessment and Listing Methodology. 'rm' = river mile.

Map #	Name	Pollutant	Problem	Impaired Use	List
1	Lewis Creek, Parsonage Bridge Rd to Covered Bridge	E. coli	Agricultural runoff	CR	D
2	Pond Brook, from Lewis Creek Confluence Upstream 1.5 miles	E. coli	Agricultural runoff	CR	D
3	Little Otter Creek, Mouth to rm 1.0	Mercury in fish tissue	Elevated levels of Hg in walleye; fish present only seasonally; extremely low numbers	FC	D
4	Little Otter Creek, rm 1.0 to 4.2	*E. coli*	Elevated *E. coli* monitoring results	CR	D
5	Little Otter Creek, rm 4.2 to 7.0	Sediment, Phosphorus	Agricultural land uses as sources of nutrient and sediment, lack of riparian buffer as contributing stressor	ALS	A
6	Little Otter Creek, rm 15.4 to 16.4	*E. coli*	Agricultural runoff	CR	D
7	Lower Otter Creek, mouth upstream to Vergennes Dam (7.6 miles)	*E. coli*	Periodic & recurring overflows at pump stations within the collection system	CR	A
8	Lower Otter Creek, mouth upstream to Vergennes Dam (7.6 miles)	Mercury in fish tissue	Elevated levels of Hg in walleye	FC	D
9	Lower Dead Creek, mouth upstream 3.0 miles	Mercury in fish tissue	Elevated levels of Hg in walleye	FC	D
10	Otter Creek, mouth of Middlebury River up to Pulp Mill Bridge (1.5 miles)	*E. coli*	Agricultural runoff, possible failed septic systems, Middlebury CSOs	CR	D
11	Middlebury River, from mouth upstream 2 miles	*E. coli*	Agricultural runoff, livestock, possible failed septic systems	CR	D
12	Halnon Brook, Tributary #10	Nutrients	Elevated nutrients affect aquatic biota	ALS	A

Map #	Name	Pollutant	Problem	Impaired Use	List
13	Pleasant Brook from Leicester-Whiting Rd upstream to VT Route 73e (2.2 miles)	Nutrients	Runoff from agricultural lands	ALS	A

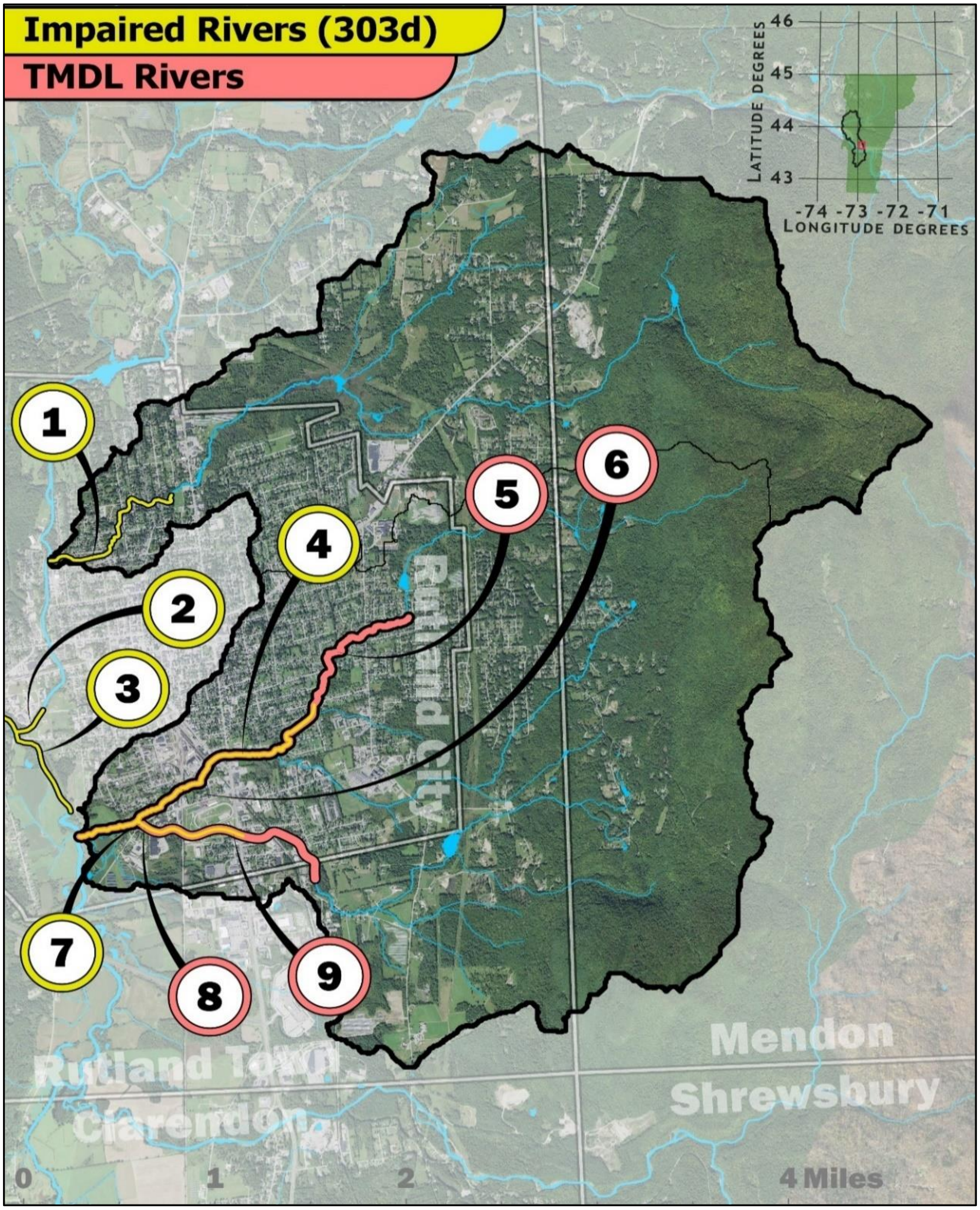

Figure 18. b) Impaired rivers in the Rutland area of the Otter Creek basin. Map number corresponds with Table 8.

Table 8. Impaired rivers in the Rutland area of the Otter Creek Basin and their pollutants.

Map #	Name	Pollutant	Problem	Impaired Use	List
1	Tenney Brook, Mouth to rm 1.0	Cause unknown	Failed biological criteria; stressors include elevated temperature, nutrients and developed land runoff	ALS	A
2	East Creek, Mouth to 0.2 Mi (Below CSO Discharge Pts #2, 3, 4, & 5)	Organic enrichment, E. coli	Rutland City collection system CSO	AES, CR	A
3	Otter Creek, Vicinity of Rutland City WWTF	Organic enrichment, E. coli	Rutland City collection system CSO	AES, CR	A
4	Moon Brook, mouth to 1.8	*E. coli*	Consistently elevated E. coli	CR	A
5	Moon Brook, mouth to rm 2.9	*Pollutants in urban stormwater, Temperature*	Elevated instream temperatures; impoundments and lack of shading	ALS	D
6	Moon Brook mouth to rm 1.8	*Pollutants in urban stormwater*	Runoff from impervious surface	ALS	D
7	Mussey Brook, mouth to rm 0.5	*E. coli*	Consistently elevated E. coli	CR	A
8	Mussey Brook, mouth to rm 0.1	*Pollutants in urban stormwater*	Runoff from impervious surface	ALS	D
9	Mussey Brook, 0.1 to rm 1.2	Temperature; Pollutants in urban stormwater	Lack of riparian cover, Runoff from impervious surface	CR, ALS	D

Altered Lakes and Ponds

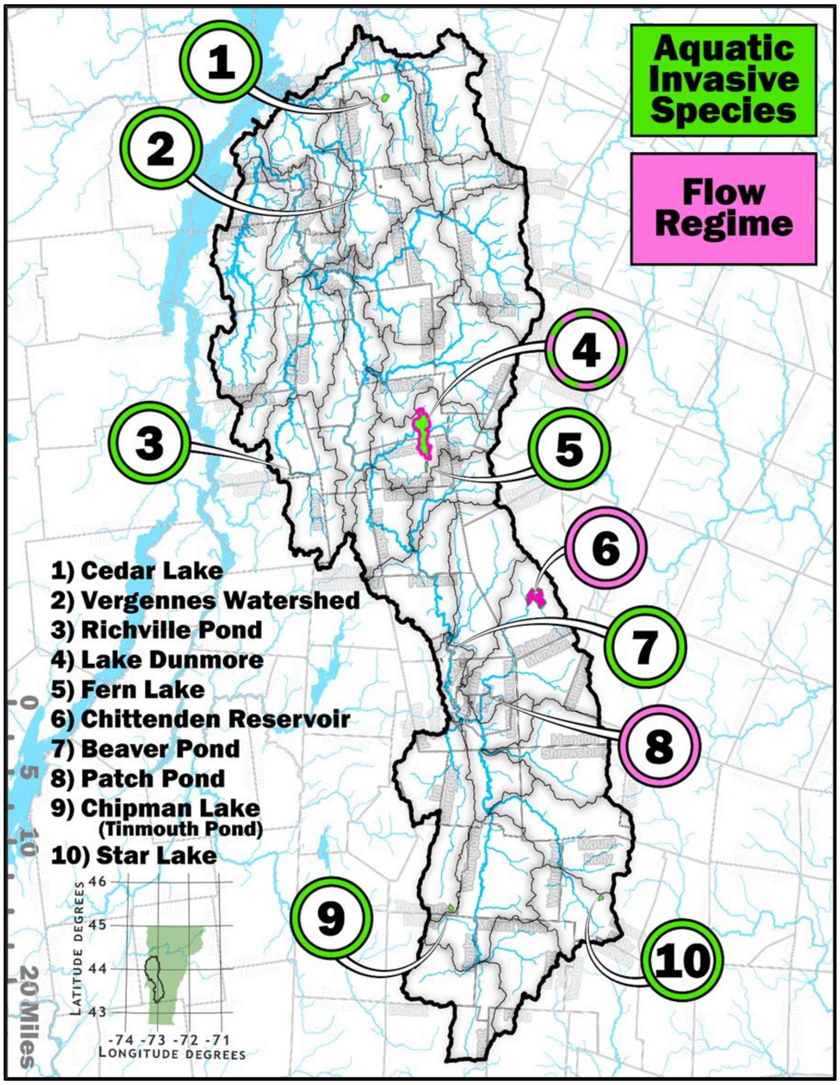

Figure 19. Altered lakes in the Otter Creek basin. Map number corresponds with Table 9.

Table 9. Altered lakes in the Otter Creek basin, from Figure 19.

Map #	Name	Problem	Status	List
1	Cedar Lake	Abundant Eurasian watermilfoil (EWM) growth.	Ongoing management plan that includes DOSH, benthic barriers, and hand-pulling	E
2	Vergennes Watershed	Abundant EWM growth.	No active management.	E
3	Richville Pond	Abundant EWM growth.	No active management.	E
4	Lake Dunmore (Salisbury)	Locally abundant EWM growth.	Ongoing management plan that includes mechanical harvesting,	E

Map #	Name	Problem	Status	List
			DOSH, benthic barriers, and hand-pulling.	
4	Lake Dunmore (Salisbury)	Water level management by hydro alters aquatic biota	GMP needs 404 ACOE to complete work on the dam; DEC trigger section 401 to address flow and water level issue; Project currently delayed	F
5	Fern Lake	Locally abundant EWM growth.	Ongoing management plan that includes mechanical harvesting, DOSH, benthic barriers, and hand-pulling.	E
6	Chittenden Reservoir (Chittenden)	Water level fluctuation by hydro alters biological community & wetlands	Unlicensed facility	F
7	Beaver Pond	Abundant EWM growth.	No active management.	E
8	Patch Pond (Rutland)	Water level fluctuations alter biological community		F
9	Chipman Lake	Locally abundant EWM growth.	Ongoing management plan that includes DOSH, benthic barriers, and hand-pulling.	E
10	Star Lake	Locally abundant EWM growth.	No active management.	E

Altered Rivers

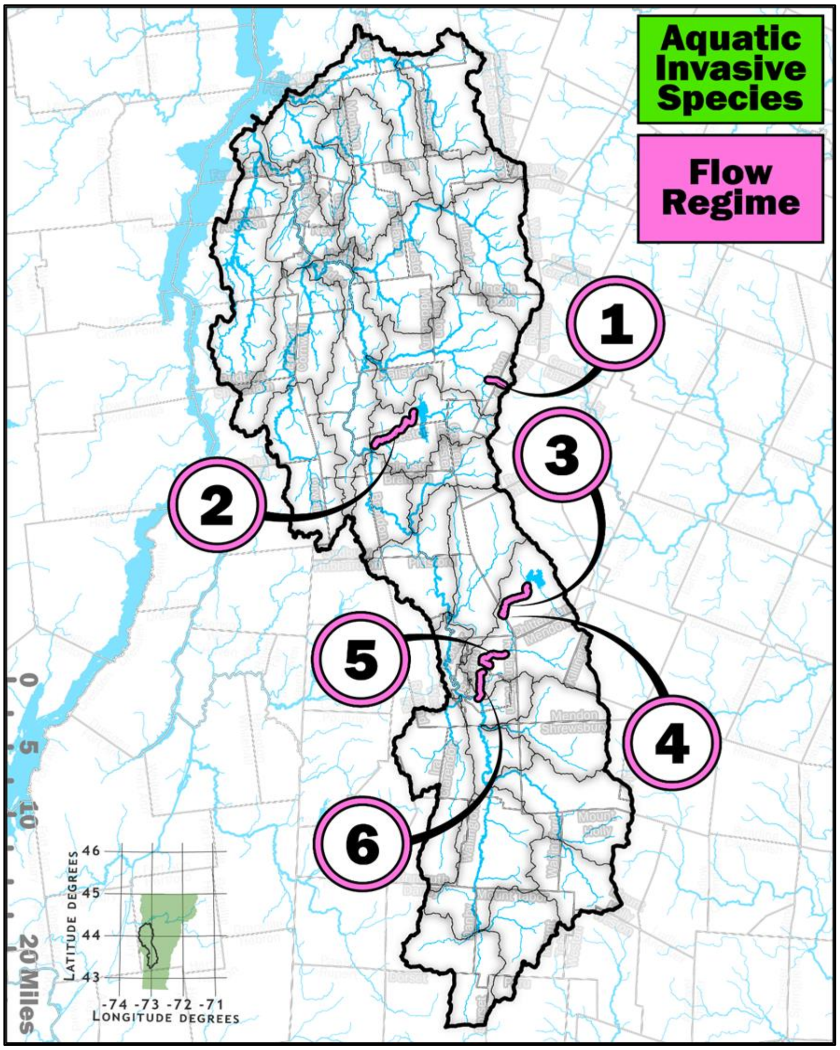

Figure 20. Altered rivers in the Otter Creek basin. Map number corresponds with Table 10.

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Table 10. Altered rivers in the Otter Creek basin, from Figure 20.

Map #	Name	Problem	Status	List
1	South Branch, Middlebury River (1.4 miles)	Artificial flow condition, insufficient flow below Snow Bowl snowmaking water withdrawal	Partial support 1.4 mi (6.0 mi total length)	F
2	Leicester River, from Lake Dunmore Dam down 6 miles	Artificial flow regulation & condition by hydroelectric dam	GMP needs 404 ACOE to complete work on the dam; DEC trigger section 401 to address flow and water level issue; Project currently delayed	F

Map #	Name	Problem	Status	List
3	East Creek Below Chittenden Reservoir	Artificial flow regulation & condition by dam; only local drainage below; possible fish passage problem at dam (threat)	Unlicensed facility	F
4	Trib to East Creek	Low dissolved oxygen downstream of hydro facility	Unlicensed facility	F
5	East Creek Below Glen Dam	Artificial flow regulation & condition by dam; only local drainage below; possible fish passage problem at dam (threat)	Unlicensed facility	F
6	East Creek Below Patch Dam	Artificial flow regulation & condition by hydro; possible downstream fish passage problem at dam (threat)	Unlicensed facility	F

Monitoring Priorities for Further Impairment Evaluation

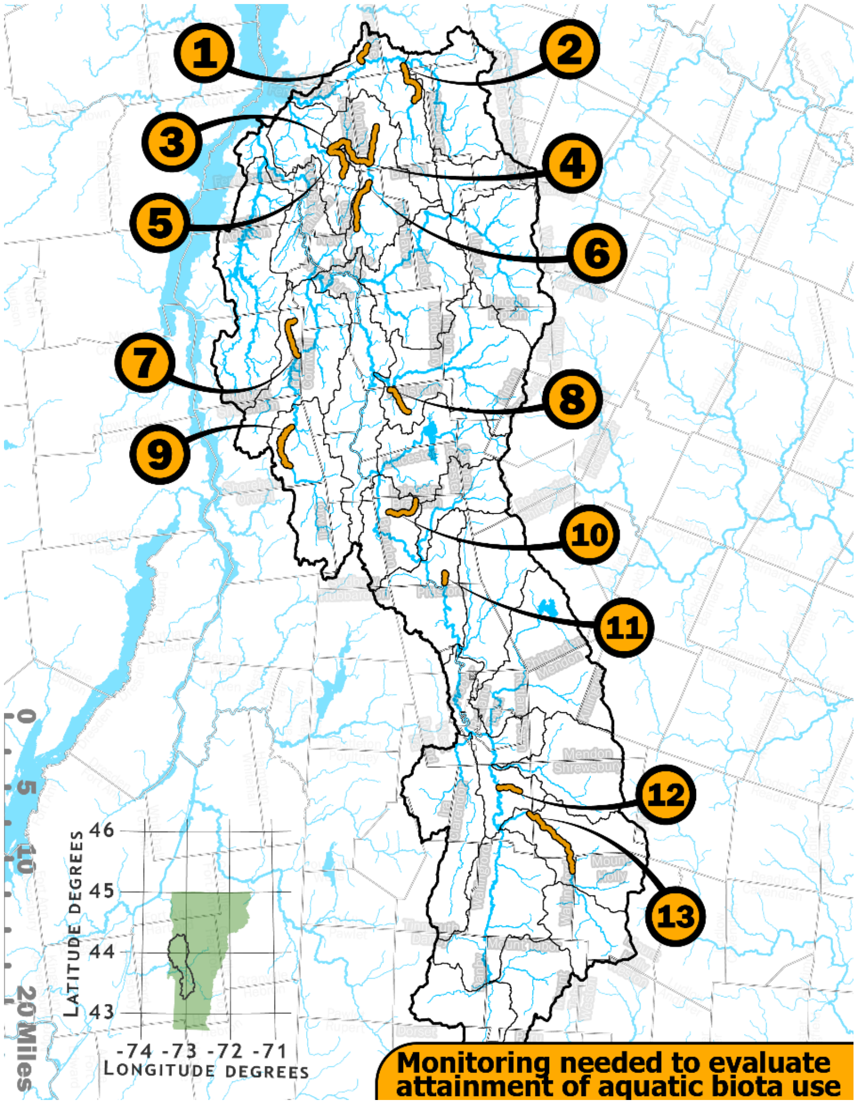

Figure 21. Monitoring needs to determine potential river segment impairment. Map IDs correspond with information in Table 11. Biomonitoring data indicate fair or poor conditions at these sites, but additional data must be collected to fully evaluate rivers that require more monitoring to evaluate attainment of Aquatic Biota use.

Table 11. Rivers that require more monitoring to evaluate attainment of Aquatic Biota use from Figure 21.

Map ID	Name	Problem	Pollutant
1	Prindle Brook	Nutrients	Fish community not meeting criteria, potential agricultural sources

Map ID	Name	Problem	Pollutant
2	Pond Brook	Phosphorus	Fish community barely meeting criteria, elevated biotic index, potential agricultural sources
3	Little Otter Creek (mid-section)	Sediment, Phosphorus	Agricultural land uses as sources of nutrient and sediment, lack of riparian buffer as contributing stressor
4	Mount Florona Brook	Phosphorus	Macroinvertebrate community not fully meeting criteria, high TP
5	Mud Creek	Phosphorus	Macroinvertebrate community not fully meeting criteria, high TP
6	Little Otter Creek Trib #15	Nutrients, turbidity, metals	Macroinvertebrate community not meeting criteria, potential agricultural sources
7	Lemon Fair River Trib 7	Nutrients	Macroinvertebrate community barely meeting criteria, potential agricultural sources
8	Halnon Brook	Phosphorus	Macroinvertebrate community barely meeting criteria, potential agricultural sources, and Hatchery impacts
9	Lemon Fair River	Nutrients	Macroinvertebrate community barely meeting criteria, potential agricultural sources
10	Arnold Brook	Unknown	Macroinvertebrate community not fully meeting criteria
11	Otter Creek Trib 27	Nutrients	Macroinvertebrate community failing criteria, potential agricultural sources
12	Airport Brook	Unknown	High biotic index, fish community failing criteria
13	Mill River	Unknown	Potential impacts from geomorphic instability

B. Total Maximum Daily Loads (TMDLs)

For waters that are listed as impaired, the federal Clean Water Act requires a plan that identifies the pollutant reductions a waterbody needs to undergo to meet VWQS and it must identify ways to implement those reductions. A Total Maximum Daily Load (TMDL) is the calculated maximum amount of a pollutant that a waterbody can receive and still meet VWQS. TMDLs can be calculated for reducing water pollution from specific point source discharges or for an entire watershed to determine the location and amount of pollution reduction needed.

Tactical Basin Plans are implementation plans guiding the execution of actions necessary to meet TMDL reduction targets specific to each planning basin, see Chapter 4 and the implementation table for associated strategies.

TMDLs in the Otter Creek basin include:

- Lake Champlain Phosphorus TMDL
- Northeast Regional Mercury TMDL
- Moon Brook Stormwater TMDL
- Moon Brook Temperature TMDL
- Mussey Brook Temperature TMDL
- Acid Impaired Lakes
- Statewide Bacterial TMDL (2011)
    - Otter Creek Bacterial TMDL
    - Little Otter Creek Bacterial TMDL
    - Little Otter Creek Headwaters Bacterial TMDL
    - Lewis Creek and Pond Brook Bacterial TMDL
    - Middlebury River Bacterial TMDL

The Mercury TMDL is primarily focused on regional efforts to reduce atmospheric deposition and so is not described in greater detail beyond the link provided above. The Stormwater TMDLs are primarily addressed through a combination of permits issued pursuant to Vermont's federally delegated National Pollutant Discharge Elimination System permitting program. These permits include an enhanced Municipal Separate Stormwater System (MS4) General Permit and the Transportation Separate Storm Sewer System (TS4) General Permit. Included in the reissuance in 2018 of the MS4 permit is the requirement for municipalities to develop Phosphorus Control Plans to comply with the Lake Champlain Phosphorus TMDLs. The bacterial TMDLs will be met in part by regulations and actions that will be implemented to meet the Lake Champlain Phosphorus TMDL targets, see next section.

Lake Champlain Phosphorus TMDL Phase 3 Content

Lake Champlain covers 373 square miles with a watershed that extends across 8,234 square miles, draining nearly half the land area of Vermont, as well as portions of northeastern New York and southern Quebec. The large land to water ratio (20:1) has resulted in significant phosphorus loading from land-use activity in the watershed, a predominant source of the lake's phosphorus impairment (LCBP 2021). The excessive phosphorus in the lake has impaired aquatic life and reduced recreational use due to cyanobacteria blooms, unpleasant odors, and low dissolved oxygen concentrations.

The United States Environmental Protection Agency (EPA) established TMDLs for the 12 Vermont segments of Lake Champlain (Figure 22) to ensure that phosphorus reductions are achieved. To meet requirements of the 2016 Lake Champlain Phosphorus TMDL (LC TMDL), Vermont's implementation plan takes a lake-wide approach in recognition of the interconnectedness of the segments. As required, the plan is a phased approach over a 20-year period and includes an accountability framework to ensure pollution reduction targets are achieved across contributing land-use sectors. This section, along with Chapters 4 and 5, gauges progress as part of the LC TMDL's Phase 3's accountability framework.

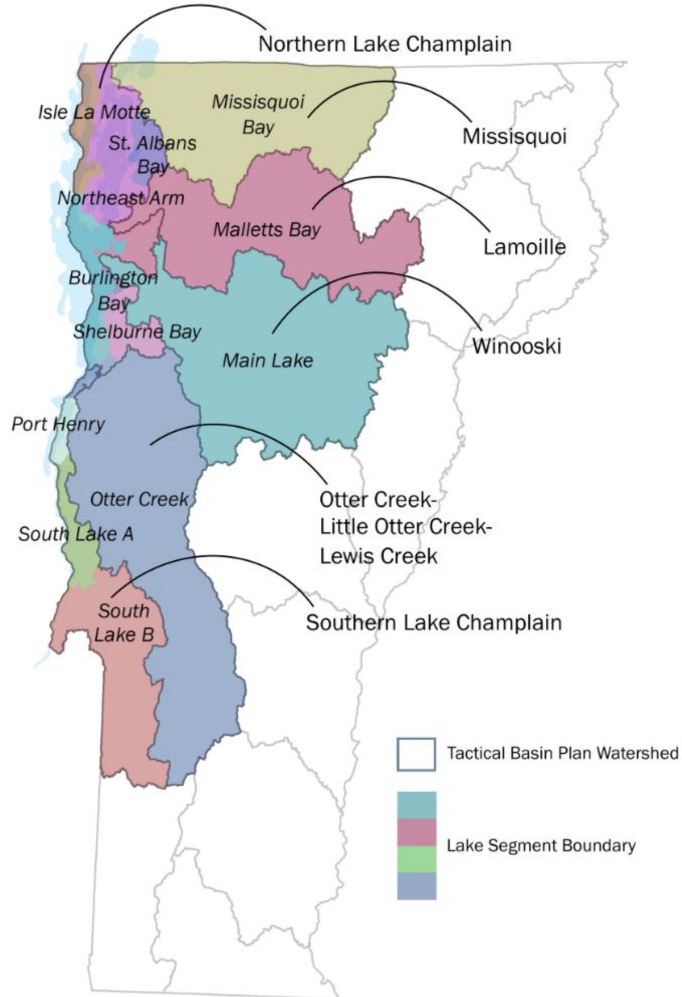

Figure 22. The 12 TMDL lake segments and their watersheds.

Phases 1, 2, & 3 of the Lake Champlain TMDL

The 2016 VT Lake Champlain Phosphorus TMDL Phase 1 Implementation Plan addresses the major Vermont sources of phosphorus to Lake Champlain across all sectors. Vermont's successful completion of the 28 milestones in Phase 1's Accountability Framework[2] in 2020 has resulted in enhanced state regulatory oversight for municipal road and stormwater management, agricultural and silvicultural practices, as well as incentives for landowners to implement water quality best management practices. In addition, the state established a long-term funding source, the Clean

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[2]see Progress Report on Lake Champlain TMDL Implementation Plan (January 2021)

Water Fund to support clean water projects and a tracking and accounting system to evaluate total phosphorus (TP) reduction progress.

The subsequent two phases of the LC TMDL are embedded in the TBPs associated with the Lake Champlain basin. Along with providing updates on Vermont's progress towards addressing policy commitments, each phase provides the following information:

- Phase 2 in the 2019 Otter Creek TBP downscales phosphorus allocations to the tactical basin level from land-use sectors and prioritizes basin catchments for remediation (critical source areas) based on highest modeled phosphorus load reductions.
- Phase 3 in the 2024 Otter Creek TBP documents phosphorus reductions by sector achieved since the 2019 basin plan and sets projected target reductions for the next five years.

Using outcomes of Phase 2 and 3, the TBP strategies in the 2019 and the current 2024 plan direct technical and financial resources to critical source areas to facilitate regulatory compliance and voluntary adoption of BMPs across all land-use sectors. Specific projects to address strategies are included in the ANR's Watershed Projects Database.

The following Phase 3 content describes Vermont's progress towards achieving maximum phosphorus reduction and, along with information in Chapters 4 and 5, updates the approach for reducing phosphorus loading from each land-use sector. Five-year targets are also assigned in Phase 3. As the wastewater targets identified in Phase 1 are achieved through the wastewater treatment facility permitting process, five-year targets are not set, and progress towards these targets is discussed in Chapter 4.

Commitment and Strategy to Meet Targets

To meet the TMDL targets, the state of Vermont has enhanced regulatory program commitments and established a clean water delivery framework with the passage of Act 76 (2019) that will accelerate implementation of natural resource restoration projects to meet non-regulatory target reductions.

Key initiatives include:

- the creation of the state's clean water engagement strategy to develop, maintain, and enhance the Agency's organizational partnerships,
- the passage of Act 76 to support those partnerships and ensure project prioritization and funding,
- tracking and accounting methods in each sector, and
- project reporting systems to obtain an accurate reflection of phosphorus reduction by sector and project type.

These initiatives are described below and in detail in Chapter 4.

Measuring Progress Toward TMDL Targets

Vermont has made a long-term commitment to provide the mechanisms, staffing, and financing necessary to achieve and maintain compliance with the LC TMDLs, along with the Vermont Water Quality Standards. To achieve this, the Vermont Department of Environmental Conservation's Clean Water Initiative Program and the Watershed Planning Program coordinate with committed state and federal agencies and local partners to fund, develop, implement, and track clean water projects that protect and restore water quality. The Clean Water Initiative Program's work includes the development and application of tracking and accounting methods as well as standard operating procedures (SOPs) for phosphorus reduction estimation and reporting (see Tracking and Accounting methodology here.)

The Clean Water Initiative Program tracks practices implemented by state fiscal year (SFY) in the Clean Water Reporting Framework (CWRF) database and annually documents progress towards statewide pollution reduction goals annually in the Vermont Clean Water Initiative Performance Report. The ANR Clean Water Portal's Clean Water Interactive Dashboard, an online tool, provides a link to the year's report and allows users to interact with data on investments, project outputs, estimated pollutant load reductions and project cost effectiveness.

For the Phase 3 content, the Watershed Planning Program uses project reporting outputs generated from the CWRF database in development of the SFY TP reduction estimates by land-use sector for each basin, along with the overall LC TMDL sector reduction targets. At the beginning of the subsequent five-year planning cycle, the Watershed Planning Program will evaluate and document progress against the five-year reduction targets (described in this section) with a goal of meeting phosphorus reduction targets and in-lake water quality standards over the projected LC TMDL lifespan.

The Watershed Planning Program also reports on the state's progress in each basin towards implementing and supporting regulatory and non-regulatory programs that address the LC TMDL commitments. While this Phase 3 includes an overview of progress between TBPs, more specificity relating to completion of strategies in each TBP implementation table is assessed in the interim and final basin report cards, completed at two and a half year intervals with the final report coinciding with the completion of the TBP (Chapter 5). The report cards are published concurrent to the Vermont Clean Water Initiative's Annual Performance Reports.

The ANR uses an adaptive management approach for meeting targets and any revisions to accounting and target setting will be documented in subsequent TBPs and the Vermont Clean Water Initiative's Annual Performance Reports.

DEC also works with the Lake Champlain Basin Program and the New York State Department of Environmental Conservation to implement the Lake Champlain Long-Term Water Quality and

Biological Monitoring Project. Field data from the project, collected annually since 1992, are used to assess the attainment of annual mean TP criteria for Lake Champlain and annual TP loading as well as trends for major tributaries, in addition to other monitoring goals.

State Programs to Meet Regulatory Targets

The regulatory programs that support the attainment of annual TMDL reduction targets in each sector were identified in Phase 1. The state's progress towards program promulgation is described in Table 12. Chapters 4 and 5 describe how the Agency supports delivery of outreach and technical assistance to facilitate compliance.

Table 12. Regulatory programs supporting attainment of TMDL phosphorus reductions.

Source Sector*	Permit Program	Reporting Scale	Efficiency	Spatial Scale of TP Loading	Implementation Timeline
Agriculture	Required Agricultural Practices/ Large Farm Operation & Medium Farm Operation Rules and Permits	HUC12	Reduction efficiencies vary. Calculated using Standard Operating Procedures (SOP)	Implemented and tracked at HUC12 scale	Estimates completed at HUC12 scale per farm size inspection cycle. Certified Small Farm Operations at least once every 7 years, Medium Farm Operations at least once every 3 years, and Large Farm Operations annually.
Developed Lands: Stormwater	Operational 3-acre Permit	HUC12	35% reduction	Can estimate once 3-acre GIS layer is finalized	Stormwater Program has a list of when each parcel is due for permitting; once issued, site will have five-year period to implement. Early adoption is incentivized.
	Municipal Separate Sewer System (MS4) General Permit	MS4 jurisdiction	SOP	Determined by MS4	DEC updated the MS4 permit in September 2023. All MS4s have updated their phosphorus control plans and flow restoration plans and are in compliance.
Developed Lands: Roads	Municipal Roads General Permit (MRGP)	Town, but have access to GIS road segments; should be possible to aggregate at	SOP	Stormwater Program provided estimates of what regulatory programs are expected to achieve over life of TMDL	DEC reissued MRGP in 2023. Towns must update road erosion inventories (REI) by Fall 2027 and upgrade 7.5% of their non-compliant road segments annually,

Source Sector*	Permit Program	Reporting Scale	Efficiency	Spatial Scale of TP Loading	Implementation Timeline
		HUC12 scale			including 20% of Very High Priority segments annually once the REI is updated, and complete all work by 12/31/2036.
	Transportation Separate Storm Sewer System (TS4) Permit	Lake Segment	TBD	TBD	Stormwater Program issued the TS4 permit to VTrans in 2023.
Forests	Acceptable Management Practices (AMPs)	HUC12	See Forestry SOPs	Completed at HUC12 scale	Assumed that lake segments with 5% forest reduction will be achieved via AMP compliance.

*While no river state regulatory programs have been promulgated to achieve TMDL targets, municipal River Corridor Bylaw adoption is encouraged for towns without existing bylaws identified in the Municipal Protectiveness Table (Appendix B).

Act 76 Framework to Meet Non-Regulatory Targets

The state recognizes the valuable role of community partners in facilitating the community's adoption of non-regulatory practices. The 2019 Vermont Clean Water Service Delivery Act (Act 76) provides a funding and project delivery framework to facilitate partner implementation of non-regulatory projects to achieve Vermont's clean water and TMDL goals by:

- providing long-term funding through general fund revenue;
- supporting non-regulatory projects such as conservation easements, wetland and floodplain restoration, and riparian tree and shrub plantings;
- establishing Basin Water Quality Councils led by regional Clean Water Service Providers (CWSPs) to identify, implement, operate, and maintain non-regulatory projects to meet TMDL reduction targets; and
- distributing funds for non-regulatory projects based on interim phosphorus reduction targets and a standard cost per unit phosphorus reduced, consistent with "pay for performance" models.

The Addison County Regional Planning Commission (ACRPC) is the Otter Creek basin CWSP and in SFY 2023 contracted with DEC to achieve an annual phosphorus reduction target of 83.3 kg for $1,094,817; and in FY 2024 a reduction of 83.3 kg for $1,152,517 through the identification, development, design, and implementation of clean water projects. Additional funding and phosphorus reduction targets will be provided each year of this initial CWSP assignment term through June 30, 2025. With DEC guidance, the ACRPC will be developing an operation and maintenance program to ensure the functioning of installed phosphorus reduction projects.

Engagement Strategy

In addition to Act 76 funding framework, the Watershed Planning Program engages partners using strategies that strengthen the partners' sense of ownership and therefore participation in the planning process and implementation. The desired outcomes of the state's engagement strategy follow:

- Multi-partner collaboration across sectors and localities to assist with developing, writing, and implementing TBPs;
- Strategic inclusion and engagement with different sectors and localities throughout the TMDL Phase 3 planning process to ensure that concerns, needs, and goals are addressed;
- Strategic communication efforts to ensure understanding of and support for the plan among key stakeholders as well as throughout the watershed; and
- Needs assessment to support financial and technical assistance to partners and develop programs to expand capacity in our stakeholder networks.

The DEC's accomplishments to date include:

- Establishing the CWSPs as a function of Act 76 program delivery. The DEC's statutory partners are now serving as CWSPs as well as members of recently established Basin Water Quality Councils. These groups enhance community outreach and engagement for clean water project delivery efforts.
- Development of a Watershed Planning Program Communication Plan.
- Creating web-based resources that support the work of partners and the Basin Water Quality Council (e.g., guidance and Standard Operating Procedures), the Watershed Planning Program Communications plan, and the Engagement and Training resources on the Watershed Planning Program website.
- Completing a partners' needs assessment and addressing an identified need for financial support to build partner capacity through the Clean Water Workforce Capacity Development Initiative.

These efforts will continue to improve understanding of the requirements for TMDL implementation efforts, support diverse and sustained collaboration, and will help build new partnerships. As a result, the TMDL implementation efforts will continue to enhance shared ownership and be well informed by those working on the ground, which will enhance reasonable assurance that Vermont will achieve improvements in local water quality and the Lake Champlain TMDL reduction targets.

Otter Creek Basin TMDL Targets

Each of the 12 Lake Champlain segments has individual TP load estimates and reduction goals under the Lake Champlain TMDL. Information on how phosphorus loading was projected in the Lake Champlain basin can be found in Chapter 5 of the Phosphorus TMDLs for Vermont Segments of Lake Champlain (LC TMDL). Phosphorus reductions will be realized by reducing phosphorus loading from the associated Vermont basins draining into each of these lake segments. The Otter Creek drains into the Otter Creek segment of Lake Champlain (Fig. 20). The US Environmental Protection Agency, DEC, and Tetra Tech used the best available modeling to also develop TP reduction goals at the smaller basin scale. In the Otter Creek basin, an estimated 35.4% or 71,630 kg reduction in annual TP loading is required across all land-use sectors to meet TMDL targets (Table 13, and also in an online report).

Table 13. Summary table of total phosphorus watershed annual loading, total annual reduction targets, and required reductions for the Otter Creek basin.

Source	Category	Allocation Category	Total Load (kg/yr.)	Estimated Target Reduction (kg/yr.)	Reduction Required for Basin (%)
Agriculture	Fields[1]/pastures	Load	103,149	48,390	46.9
	Barnyard Production Areas	Wasteload	3,137	2,510	80.0
Developed Lands	Stormwater	Wasteload	19,159	2,874	15.0
	Roads	Wasteload	14,740	2,211	15.0
Wastewater[2]	WWTF discharges	Wasteload	11,980	0	0
Rivers	All streams	Load	35,695	14,314	40.1
Forests	All lands	Load	26,627	1,331	5.0
		Total	***202,507***	***71,630***	***35.4***

[1]Fields include cultivated crops and hay
[2]WWTF numbers are based on permitted loads and exclude WWTF loading

In SFY 2022 about 17.8% of the overall TMDL reduction goal for the basin was met in the basin (Figure 23).

Three interactive online reports are included in this Phase 3 section to further illustrate loading and reduction estimates for the TMDL within the basin and the agricultural sector where an ample tracking information allows for more detailed estimations. Each of these reports is provided below and within the text of the following sections.

- Estimated TMDL TP Loading and Reduction online report
- Otter Creek Basin Agricultural Phosphorus Loading & Reduction online report
  Otter Creek Basin Agricultural Tracking & Target Setting online report

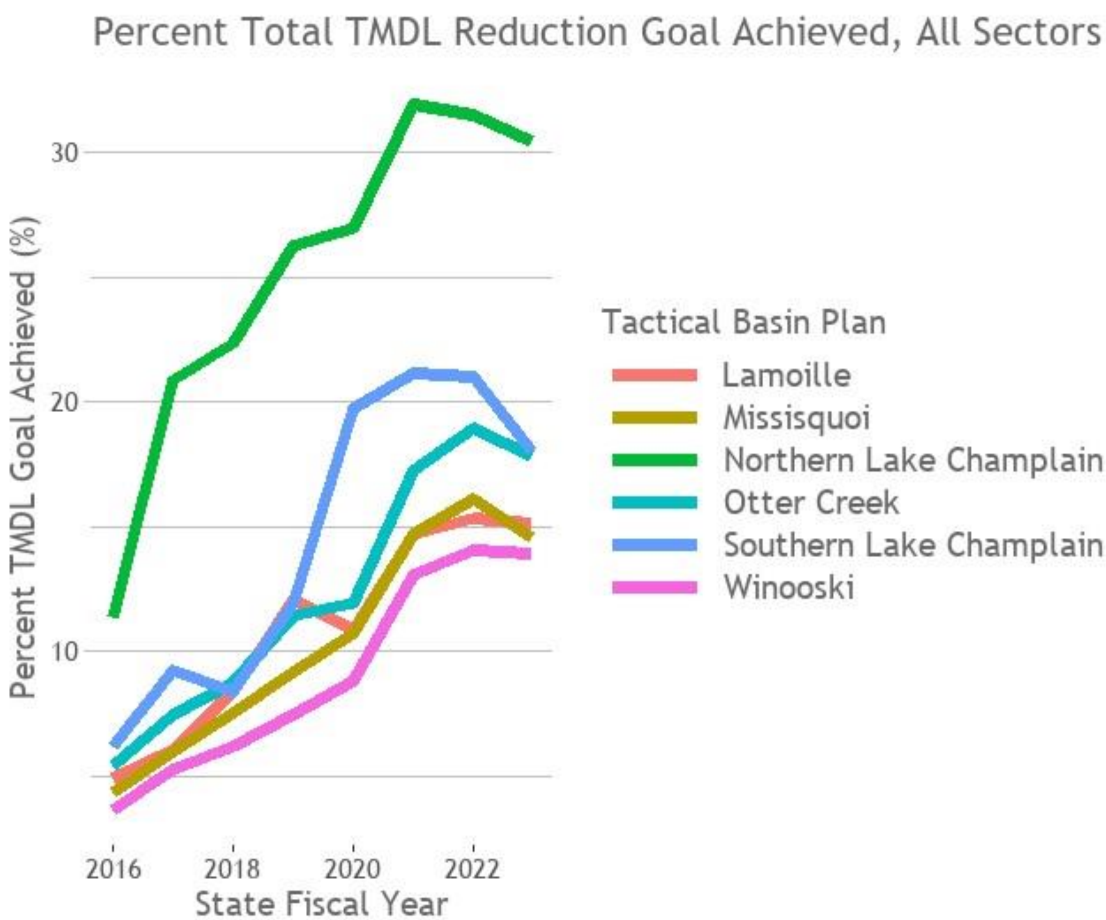

Figure 23. Percent TMDL reduction goal achieved by tactical basin and state fiscal year.

Sub-tactical basin scale phosphorus loading and reduction estimates for HUC12 watersheds within the Otter Creek basin and the other Vermont basins is summarized in the first report, Estimated TMDL TP Loading and Reduction, which displays estimates for all land-use sectors and HUC12 watersheds in the Lake Champlain basin. The first page of the report summarizes estimated phosphorus loading by HUC12 watershed; the second page of the report summarizes estimated TMDL reductions by HUC12 watershed. Although reductions are reported at the basin scale, for tracking and target setting purposes these reduction targets have been downscaled to a HUC12 watershed scale. These HUC12-scale targets can be compared to reported reductions to assess progress, identify new strategies, and prioritize future funding and management actions.

Summary of P reductions 2016-2023 by sector

The TMDL mandates TP reduction targets from specific land-use sectors by 2036 (Table 13). Annual totals are not cumulative, and the same volume of reductions must be achieved every year to meet the 2036 target. Between 2016 and 2022, the annual calculated phosphorus reductions in the Otter Creek basin have generally increased every year (Figure 24). From 2021-2023, the forest lands sector declined, but each year the sector is still well above the 5% reduction target that is based on AMP compliance alone. The roads sector showed the second highest percent of final TMDL target achieved, meeting 21.2% of the target (Figure 24). The agricultural sector has decreased slightly since 2022, which is explained below. The targets in this sector can still be achieved if the rate is increased. Stormwater and River sectors have shown limited TP reductions state-wide in the Annual Clean Water Performance Reports for the reasons described earlier.

The Agency expects increases in reductions across all sectors in the next five years and beyond as regulatory compliance continues, additional phosphorus accounting tools are developed, as well as the infusion of ARPA funds and assistance from the CWSP through increased project implementation and project adoption.

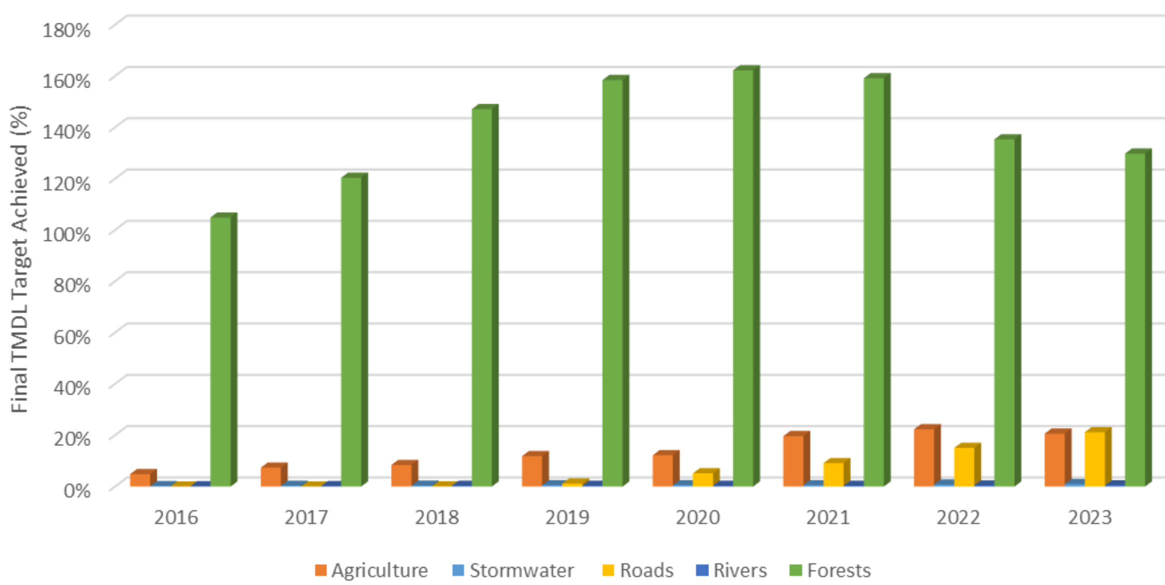

Figure 24. Percent TMDL TP reduction goal achieved in the Otter Creek basin by land-use sector by state fiscal year. Note that SFY estimates are not cumulative. No non-regulatory forestland reductions have been credited in any fiscal year to date.

The following section addresses progress in all land-use sectors, five-year targets, and planned improvements to facilitate meeting those targets.

TMDL Sector Targets: Otter Creek Basin

A goal of Phase 3 and subsequent phases is to refine pollution reductions targets to achieve the load allocations of the TMDL through non-regulatory actions identified in the TBP. This Phase 3 establishes the five-year targets (Table 14). Subsequent phases will report on TP reduction progress towards non-regulatory sources in five-year increments.

In addition to meeting 2036 targets, the Lake Champlain TMDL also requires reporting on TP reduction progress towards non-regulatory sources in five-year increments.

Table 14. The Otter Creek basin five-year TP targets and final targets for each land-use sector. The final TMDL target for forest lands is fully met by regulatory compliance; therefore, no five-year non-regulatory target is provided.

Sector and Category	2028 Target (kg TP/year)	2036 Target (kg TP/year)
Agriculture: Fields/Pastures	15,500	48,390
Agriculture: Barnyard Production Areas	505	2,510
Developed Lands: Stormwater [5]	970	2,874
Developed Lands: Roads	288	2,211
Rivers	0	14,314
Forests	0	1,331

The five-year target setting is obtained by subtracting current-year reduction estimates and any anticipated reductions from regulatory programs from the overall TMDL sector goal and dividing into five-year segments:

$$[5\ year\ target = \frac{TMDL\ target - (current\ SFY\ reduction + regulatory\ reduction\ estimates)}{remaining\ TMDL\ years} * 5] \qquad Eqn\ 1$$

The five-year targets represent a linear estimate that describes how much additional TP should be reduced over the next five years to reach the 2036 TMDL target, given the amount of TP reduction achieved in SFY 2023. The estimate does not include SFY 2024 data but assumes a 14-year period stretching between 2024 and 2036.

The river and forest sectors are not assigned five-year targets in Phase 3. The forest targets have been met through Acceptable Management Practice compliance where forest management is occurring. The rivers are expected to meet targets over a longer time frame than the other sectors (see below for additional explanation).

The following provides the results from the tracking and accounting efforts as a measure of progress towards meeting phosphorus reduction goals as well as supporting information for developing the five-year targets for agricultural and developed land-use sectors. Data shown include up to SFY 2023, so actual achievements as of the publication of this plan may be higher.

Agricultural Sector

The LC TMDL agricultural reduction goal for the Otter Creek basin is 48,390 kg TP, for non-point agricultural field sources and 2,510 kg TP for barnyard production area sources (see Table 13 and The Lake Champlain TMDL[3]). The reductions to meet the 2036 goals will be achieved through Required Agricultural Practices (RAP) compliance (see Table 12) and non-regulatory Best Management Practice (BMP) adoption.

The agricultural community has made substantial progress towards meeting agricultural TMDL targets. Basin-wide in SFY 2023, 48.5% of the total barnyard management goal and 19.7% of the field practice reduction goal were met, though some field practices like cover cropping must be maintained annually to sustain these reductions.

Lake Champlain Agricultural Mitigation, Tracking, and Accounting Efforts

State and federal agencies and partner groups are supporting programs and funding sources to assist the agricultural community's compliance with RAPs or adoption of non-regulatory BMPs (see Chapter 4). Since the 2019 tactical basin plan, two significant contributions include additional funding through the USDA Regional Conservation Partnership Program that has funded AAFM's Pay for Performance program as well as additional agricultural and forestry BMP funding through DEC, and the additional involvement by partners through the CWSP framework to address 10% of the agricultural phosphorus not met by existing regulatory programs.

To keep track of the work by multiple partners, the Vermont Agency of Agricultural, Food and Markets manages the Multi-Partner Agricultural Conservation Practice Tracking and Planning Geospatial Database (Partner Database) to support phosphorus reduction tracking and accounting efforts by state and federal agencies.

Otter Creek Agricultural Tracking and Accounting Results

A summary of agricultural tracking and accounting work in the Otter Creek basin is available in this multi-page interactive online report, which details agricultural land use, phosphorus loading estimates, BMP implementation, and estimated phosphorus reductions. The data reporting starts in 2016, which represents the start of the 20-year TMDL implementation period. Key data include:

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[3] The report breaks the agricultural sector into three classes – field crops (hay and cultivated crops), pasture, and barnyard production practices.

- In SFY 2023, over 16,800 acres were enrolled in at least one agricultural BMPs in the basin. This acreage represents a decrease from 24,900 enrolled acres in SFY 2022. Cover cropping, manure injection, and nutrient management were the most common practices in SFY 2023.

- Approximately 10,400 kg of agricultural phosphorus were estimated to have been reduced by BMP management actions in the basin in SFY 2023 (Figure 25). This number represents a slight decrease of about 800 kg TP over reductions achieved in SFY 2022. Cover cropping was responsible for the most reductions, followed by conservation crop rotation, and conservation tillage. Overall, about 20.6% of the TMDL agricultural reduction goal was met in SFY 2023.

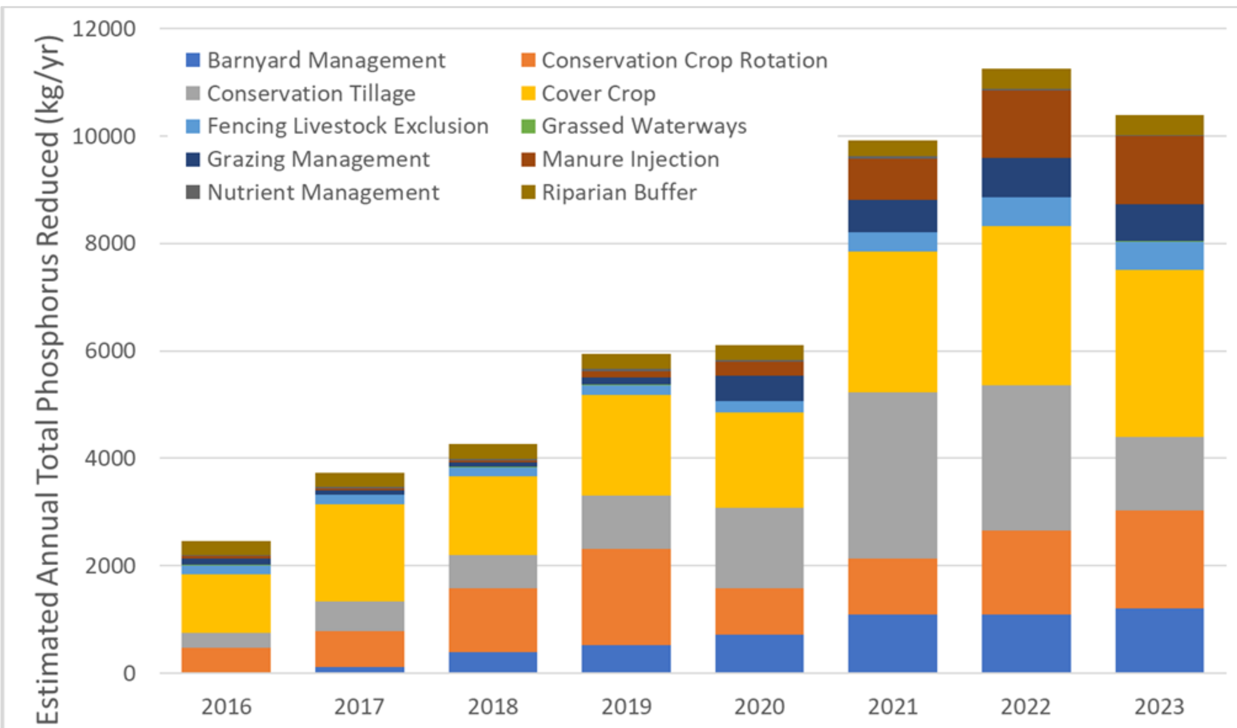


Figure 25. Estimated total phosphorus reductions by agricultural practice and state fiscal year.

Agricultural Target Setting

Progress on agricultural reductions in the Otter Creek basin is summarized in the Agricultural Practice Accounting online report. This report displays estimated reductions and remaining target reductions by HUC12 watershed, as well as the percentage of the TMDL target achieved at the tactical basin scale. This information supports the development of strategies to enhance compliance and BMP adoption (Chapter 5.)

Key accounting highlights:

- Basin-wide in SFY 2023, 48.5% of the total barnyard management reduction goal was met, and 19.7% of the field practice reduction goal was met. The TMDL mandates that 100% of these goals are met by the year 2036.
- Dead Creek and Otter Creek HUC12 watersheds have the largest remaining agricultural reductions.

In the 2028 tactical basin plan, progress against the first five-year target will be assessed. The incremental five-year agricultural targets and the information supporting the calculation of the targets (see eqn. 1) follows:

- Based on SFY 2023 data, the remaining agricultural field practices TMDL goal is 40,000 kg TP. An annual cumulative reduction of approximately 3,100 kg of phosphorus from agricultural field practices is required each year from SFY 2024-2036 to meet the TMDL. The five-year reduction target for SFY 2028 is therefore 15,500 kg of phosphorus.
- Based on SFY 2023 data, the remaining production area TMDL goal is 1,311 kg TP. An annual cumulative reduction of approximately 100 kg of phosphorus from production areas is required each year from SFY 2024-2036 to meet the TMDL. The five-year reduction target for SFY 2028 is therefore 505 kg of phosphorus.

Assessment of Progress

From 2016-2023, the basin achieved roughly 35-40% of the agricultural goal, but there was a slight decrease over the last year. In the 13 years left in the TMDL, the goal should be achievable if the rate increases. This is not necessarily due to lack of interest from the agricultural community and may be attributed to the following:

- Some practices can only be implemented for a limited number of years to be eligible for cost share. Many programs are also subject to funding caps, which may limit the reported acres of practice implementation.

- Many farms implement agricultural conservation practices without the support of cost share programs. The State is limited in its ability to capture the water quality benefits of practices implemented outside cost share programs, and only some of these data are presented in this report.

- The multi-year federal Farm Bill governs much of the funding available to support agricultural practice implementation. Funds are often limited near the end of a Farm Bill cycle. The most recent Farm Bill was passed in 2018 and is set to expire at the end of the calendar year 2023.

- Agricultural water quality programs have recently expanded in focus and emphasis to include holistic planning and implementation on farms, the results of which may not be fully reflected in available data

Vermont will continue to support and improve on programs described in Chapter 4 to increase rates of BMP adoption and RAP compliance activity by the agricultural community. The state expects to meet the target by working with partners to direct resources and funding delivery based on agricultural activity and P loading potential as well P loading achieved identified in the interactive online report of estimated P loading and reductions.

Developed Lands/Stormwater

Developed lands encompass multiple general land use classes, including urban, residential, and industrial areas, as well as paved and unpaved roads. TMDL phosphorus reduction goals for developed lands are broken down by these general land use classes.

The TMDL reduction target for non-road developed lands in the Otter Creek basin is 2,874 kg and is 2,211 kg for roads (see The Lake Champlain TMDL interactive online report). Vermont expects that regulatory compliance will achieve significant TP reduction with community adoption of non-regulatory practices meeting the remainder. Reductions from MRGP and 3-acre permit programs are estimated to mitigate about 35% of the TMDL target for developed lands. SFY 2023 reductions in developed lands in the basin were 495 kg TP. Achieved reductions have been accelerating in recent years and additional reductions are expected over the life of the TMDL as regulatory programs in these sectors get underway (Figure 26).

Lake Champlain Basin Stormwater Mitigation, Tracking, and Accounting Efforts

Vermont has developed expectations for TP reduction from developed lands based on the Municipal Road General Permit (MRGP) and Operational three-acre permit compliance (Table 12). The Transportation Separate Storm Sewer System Permit (TS4) and the MRGP; Municipal Separate Storm Sewer Permit multisector (MS4) in addition to other regulatory and non-regulatory phosphorus mitigation efforts not currently suitable for modeling P reduction expectations will also contribute to the target (see Chapter 4).

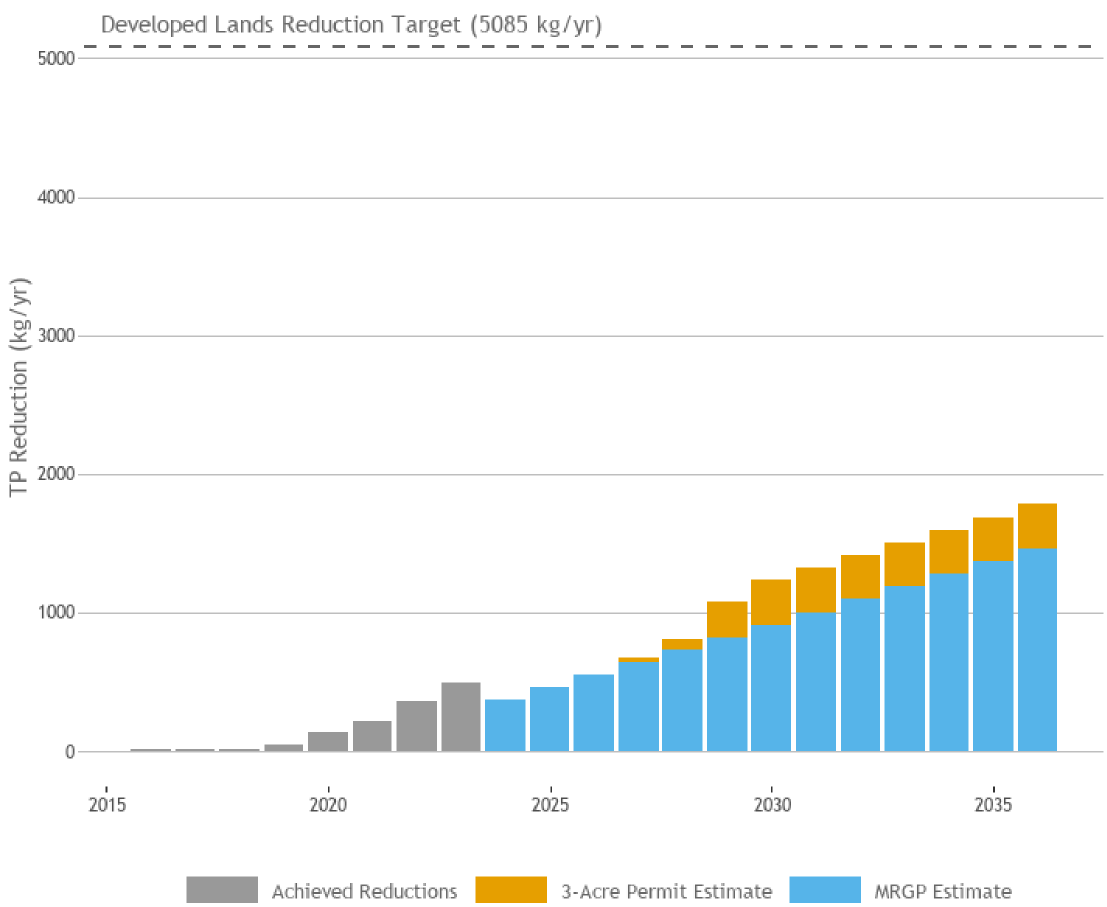


Figure 26. Achieved developed lands TP reductions and anticipated reductions from regulatory stormwater programs. The developed lands target reduction target for the Otter Creek basin is approximately 5,085 kg/yr.

Total Phosphorus from developed lands that is not addressed by regulatory programs is assigned as a non-regulatory P reduction target to Clean Water Service Providers.

Otter Creek Basin Stormwater Tracking and Accounting Results and Target Setting

ANR expects that through the MRGP and 3-acre permits, TP mitigation from both roads and developed lands will achieve roughly 35% of the TMDL reduction goal for these sectors by 2036, leaving the remainder to be address through other regulatory programs and non-regulatory efforts.

The currently modeled regulatory program P reduction targets under the MS4 and TS4 target are minimal. In the 2028 Otter Creek tactical basin plan, progress against the first five-year target will be assessed.

By 2036, over 1,800 kg of developed lands TP is expected to be mitigated by the MRGP and 3-acre permit regulatory programs in the Otter Creek basin. Using *Equation 1*, the five-year target for non-regulatory stormwater and road reductions in the basin was calculated using the above information as well as the SFY 2023 reductions and anticipated regulatory reductions over the five-year target period of 2024-2028 (Table 15).

Table 15. Five-year developed lands TMDL TP target for the Otter Creek basin.

Sector	Anticipated regulatory reductions (kg TP/yr.)	Remaining five-year target (kg TP/yr.)
Developed Lands: Stormwater	320	970
Developed Lands: Roads	1,460	288

Key accounting highlights:

- The TMDL developed lands reduction goal in the Otter Creek basin is approximately 5,085 kg TP. Reductions from MRGP and 3-acre permit programs are estimated to mitigate about 35% of this amount. SFY 2023 reductions in developed lands in the basin were 495 kg TP.
- The five-year target for total developed lands (stormwater + roads) in the Otter Creek basin is 1,258 kg TP, which is an increase of 763 kg over what was achieved in SFY 2023.

Assessment of Progress

A significant decrease in developed lands phosphorus loading from non-regulatory projects will be needed from current annual reduction to meet the five-year target. While the reductions associated with regulatory compliance will continue to increase as permit holders meet requirements, the remaining 65% is expected to be addressed through non-regulatory BMP adoption.

The Act 76 framework will provide a boost to non-regulatory project implementation by providing community partners with the resources to leverage their community connection and knowledge towards finding and implementing projects. Beginning in 2023, the CWSPs support the implementation of non-regulatory practices needed to meet the interim five-year targets for roads and developed lands and phosphorus reduction achieved through other sector-based regulatory programs. The CWSPs also support operations and maintenance practices to ensure functionality of projects to achieve their expected lifespan.

Additional opportunities to support non-regulatory activity are described in Chapter 4, including stormwater management on private roads.

If the developed lands' P target continues to look challenging, Vermont would consider redirecting P reduction to land-use sectors with less expensive solutions and opportunities for additional project implementation. As the forest sector reductions have been exceeded through regulatory compliance, additional non-regulatory work by the CWSP or other partners could achieve additional P reductions.

It is worth noting that the area attributed to roads in the Lake Champlain TMDL Soil Water Assessment model was based on an older land use/land cover dataset and modeling and exceeds more recent and precise estimates of impervious road area based on newer land use/land cover data published by the Lake Champlain Basin Program in 2011 (LCBP 2011). The original larger TMDL road surface area results in larger estimates of phosphorus loading, and associated load reduction potential than current tracking and stormwater permit reduction estimates, which are based on the smaller areas from the Lake Champlain Basin Program 2011 impervious surface analysis. Further analysis based on the Lake Champlain Basin Program 2016 1-meter resolution land use/land cover dataset is expected to further refine the current road surface areas, associated loading, and load reduction potential through MRGP implementation and may provide more clarity on the magnitude of refinement needed. DEC plans to fully evaluate options for how to refine loading estimates and targets in the near term. Reduced road TP loading estimates, and thus reduced TP reduction potential from roads, may require increased reduction from other sectors to meet the overall TMDL goal. Overall, there's uncertainty in the final target for stormwater, although the overall TP reduction for the Otter Creek basin stays the same.

Rivers Sector

The TMDL target for rivers is associated with the river system's progress towards equilibrium and therefore a more stable condition because highly eroding, unstable stream reaches account for most of the phosphorus inputs from river channels.

Excessive channel erosion as an outcome of river instability and lack of floodplain connectivity accounts for 17.6% of phosphorus loading to the Otter Creek basin. The TMDL reduction target is 14,314 kg TP, requiring a 19.9% load reduction, (see Table 13 and The Lake Champlain TMDL interactive online report).

Vermont expects to achieve TMDL river sector TP reductions in part through active floodplain restoration activities; however, the primary focus continues to be the protection of river corridors to allow for ongoing channel evolution processes, stream equilibrium, and natural floodplain function through the natural channel forming processes that occur during floods. Much of this will happen because of regulatory compliance. For this reason and the assumption that the progress towards stream equilibrium will take decades, this Phase 3 will not include a five-year reduction target for non-regulatory river restoration.

Lake Champlain Basin River Mitigation, Tracking, and Accounting Efforts

In contrast to the other sectors, ANR expects streambank source loads to decrease over time due to natural stream evolution processes. Therefore, the ANR is focused on actions designed to support and enhance these natural processes rather than on actions essential to achieving the reductions.

Passive restoration achieved through regulation is the primary mechanism to address phosphorous loading due to stream instability. The Rivers Program has estimated that two-thirds of future stream reductions will be achieved through implementation of regulatory programs aimed at restoring stream equilibrium conditions over time. Specifically, regulatory programs that limit new encroachments and channelization practices facilitate larger scale passive restoration as rivers reconnect to floodplains and achieve a stable slope through the channel evolution process. These programs include the stream alteration permit program and flood hazard area/river corridor regulations implemented at the state and local levels.

The potential for regulatory and non-regulatory phosphorus reduction allocation and tracking will be refined with Functioning Floodplains Initiative tools, described below, additional geospatial analysis, and considerations for strengthened regulations that further support the restoration of equilibrium conditions. The remaining 33% of the stream reduction targets were attributed to the CWSP for the implementation of stream restoration and protection projects annually, until such time that the estimates can be refined.

The DEC recently obtained a methodology for attributing phosphorus reduction credits to river-sector projects because of the 2023 the Functioning Floodplain Initiative (FFI). In addition, the WID's 2022 Natural Resource Standard Operation Practices and associated Interim Phosphorus Reduction Calculator provide the opportunity to calculate P reductions for river and floodplain restoration and protection projects.

The FFI team, including DEC staff and hired consultants, has developed and continues to improve a web-based system for planning and tracking implementation, effectiveness, and value of river and floodplain/wetland restoration and conservation projects. This system allows users to readily access information and visualize maps developed in prior efforts and is designed to track implementation of projects to understand how progress is being made at different scales towards restoring stream equilibrium, floodplain functionality and flood resilience. The tracking interface will be used to update and display implemented projects at the site, reach, HUC12 sub-watershed, and basin scales, and provide updated calculations of benefits.

The FFI project establishes a relationship between connectivity score and phosphorus allocation, whereby the higher the connectivity score, the more the phosphorus reduction target is achieved. This relationship demonstrates that repairing the most disconnected reaches may achieve larger phosphorus reduction. In other words, the size of the connectivity credit awarded to a project is commensurate with the degree to which geomorphic equilibrium is restored (see Chapter 4 for additional information).

As a result, DEC is now able to attribute phosphorus credit to river projects associated with stream's progress towards geomorphic equilibrium. This ability to track and prioritize projects will also allow DEC and partners to target resources towards projects where there is the greatest opportunity to achieve improved stream equilibrium conditions and expected phosphorus reductions. More information on the Functioning Floodplain Initiative website.

Otter Creek Basin River Tracking and Accounting Results and Target Setting

The ANR views river equilibrium as a long-term (multiple decades) process that will be achieved primarily through regulatory compliance and therefore has not projected incremental targets for non-regulatory actions. Although the FFI can now be used to attribute phosphorus reduction as well as progress towards equilibrium to river restoration projects, only River Corridor Bylaw regulations are counted in the FFI toward regulatory reductions. No method exists to assign a load reduction to other river regulations.

Assessment of Progress

In addition to state regulations that support natural processes, the TBP river corridor protection strategies that enhance natural processes include supporting municipalities in adopting and implementing floodplain protection regulations. In addition, TBP strategies support river corridor easement and riparian buffer enhancement and protection opportunities as well as restoration activities identified in River Corridor Plans and through the FFI tool.

The flooding that occurred in 2023 has galvanized community interest and partner collaboration and will continue to increase implementation of River sector projects during the next five-years. Through continued education by ANR and partners about the benefits of floodplain access towards flood resilience, the community has embraced conservation and other nature-based solutions towards flood resilience. In addition, FEMA has increased available funding (e.g., CWF contributes the cost-share for buy outs that result in floodplain enhancements).

Progress in other sectors will also contribute to natural stream evolution processes, such as the agricultural sector's riparian buffer protection and animal exclusion activities through RAP compliance.

Funding to support active as well as passive restoration for phosphorus reduction, will now benefit from the FFI's ability to assign TP reductions for existing standard project types, expand phosphorus crediting capabilities for certain rivers projects that don't currently receive phosphorus credit (e.g., river corridor easements and large wood additions), and may retroactively attribute TP reductions to projects already implemented but not fully credited.

From SFY 2016-2023, partners in the Otter Creek basin restored 12 acres of floodplain, reforested 36 acres of riparian buffer, conserved 83 acres of riparian corridor and 818 acres of wetlands through easements, and improved 4 undersized stream crossings (see Vermont's Clean Water Dashboard Project Output Measures report). However, only a portion of these projects were credited with P reductions (see Fig. 22) as many partners are just gaining access to the new FFI tool. The FFI tool will therefore provide both a re-accounting of past work and an incentivizing of TP-efficient rivers projects for formula grant consideration. As part of the engagement strategy, the FFI project team and Agency trained partners on learning and using the tool in spring 2023.

Forestland Sector

Forestlands phosphorus loading is attributed to forest management activities, where loading can be minimized through forest management practices that maintain water quality and minimize erosion.

The TMDL reduction target for the forest sector in the Otter Creek basin is 1,331 kg TP, requiring a 5% load reduction, (see The Lake Champlain TMDL interactive online report). The ANR expects that reductions will be achieved primarily through compliance with Acceptable Management Practices (AMPs). Although the Agency will continue to support additional forest BMP (non-regulatory) implementation that are supplemental to Acceptable Management Practices compliance, this iteration of the Phase 3 will not include any projected forestland BMP reduction estimates or forestland BMP five-year targets.

Lake Champlain Basin Forestland Mitigation, Tracking, and Accounting Efforts

The Otter Creek basin's forest target will be met through regulatory compliance as Vermont assumes that lake segments with 5% forest reduction will be achieved via compliance with the 2017 updated Acceptable Management Practices. The regulatory programs and support towards Acceptable Management Practice compliance are described in Chapter 4.

In calculating the forest sector reduction, regulatory compliance was associated with enrollment of a forest parcel in the Vermont's Use Value Appraisal (UVA) Program. The program enables eligible private landowners who practice long-term forestry to have their land appraised based on the property's value of production of wood rather than its residential or commercial development value. To qualify, parcels must contain at least 25 acres that will be enrolled and be managed according to a forest management plan approved by the Vermont Department of Forests, Parks and Recreation (FPR). Parcels enrolled in the UVA Program require application of the Acceptable Management Practices (AMPs) for Maintaining Water Quality on Logging Jobs in Vermont to the maximum practical extent possible. Forestland parcels enrolled in the UVA Program are eligible for phosphorus credit if the 10-year forest management plan and compliance work began after the TMDL modeling periods. For the Lake Champlain basin, this refers to UVA enrollment only after 2010. Previous Phase 3's did not include UVA acreage as part of the P reduction calculation, resulting in minimal reduction estimates. The ANR is still evaluating the results of the UVA analysis, and this review may result in changes in the estimates for forest sector reductions related to UVA enrollment in the future.

The ANR is currently developing the calibration of the phosphorus and sediment accounting methods to estimate load reductions associated with forestland BMP implementation. The completed Phase I of the project included identifying and mapping critical source areas of forestland and establishing a method to estimate the potential for phosphorus and sediment reductions associated with forestland BMPs and Acceptable Management Practices. Phase II of the project will calibrate models and expand on forestry BMP accounting methodologies. With the Phase II Quality Assurance Project Plan just recently approved by the Environmental Protection Agency, the field verification and ground-truthing was completed during the 2023 field season.

Otter Creek Basin Forestland Tracking and Accounting Results

The Natural Resources Tracking & Accounting Standard Operating Procedures (based on above methodology) is now available to support tracking of Acceptable Management Practices compliance and accounting for forest sector reductions. Although no additional BMP work is presently required in the basin to meet the forest sector target, the Standard Operating Procedures will also allow DEC to start tracking and crediting associated phosphorus reductions towards the forestland target or support any future redistribution of phosphorus reductions among the sectors.

Assessment of Progress

The Agency has undertaken the development of forestlands assessment and planning tools to address phosphorus reductions stemming from forest management activities. Currently, the Agency is coordinating with natural resource consultants, professional foresters, and researchers with the University of Vermont's Spatial Analysis Lab to deploy a basin-wide forest landscape assessment tool to identify critical source areas and erosional features to inform the prioritization framework that will be used to design and implement forestry BMPs.

Phase II of this assessment and prioritization project will be used to:

- Develop a framework to field verify and calibrate the Spatial Analysis Lab model's identification of erosion features in critical source areas on forested lands;
- Refine the framework for project prioritization in high priority Lake Champlain basins (Missisquoi and South Lake, Vermont) to achieve target load allocations for lake segments that won't meet reduction targets through VT Acceptable Management Practices compliance alone; and
- Pilot the project prioritization framework in a representative geographic area.

While the Forestlands Critical Source Area mapping project is currently underway, the Agency has been actively conducting Road Erosion Inventories on state forest roads and will soon be piloting a Trail Erosion Inventory later this year. These assessment tools will then be applicable to private forest road assessments akin to the development of private roads Road Erosion Inventories discussed above and in Chapter 4. With these new tools, the Agency will be better able to support Acceptable Management Practices compliance and forestry BMP implementation within the basin. Additional resources to support non-regulatory activity are described in Chapter 4.

Chapter 4 – Strategies to Address Pollution by Sector

ANR's approach to remediation of degraded surface waters and protection of high-quality waters includes the use of both regulatory and non-regulatory tools with associated technical and financial

Figure 27. Land use sector framework with practices used to enhance, maintain, protect, and restore water quality.

assistance to incentivize implementation. Tactical basin plans address water quality by land use sector (Figure 27). Ongoing protection and restoration efforts and recommendations to meet water quality objectives are developed for each sector. These recommendations support the development of the strategies in the Chapter 5 Implementation Table.

A. Agriculture

Agricultural land use makes up approximately 21 percent of the Otter Creek basin. The highest concentrations of agricultural land are found in Dead Creek, Little Otter Creek, Lower Otter Creek, and the Upper and Lower Lemon Fair (Figures 28). Pasture and hay cultivation is most

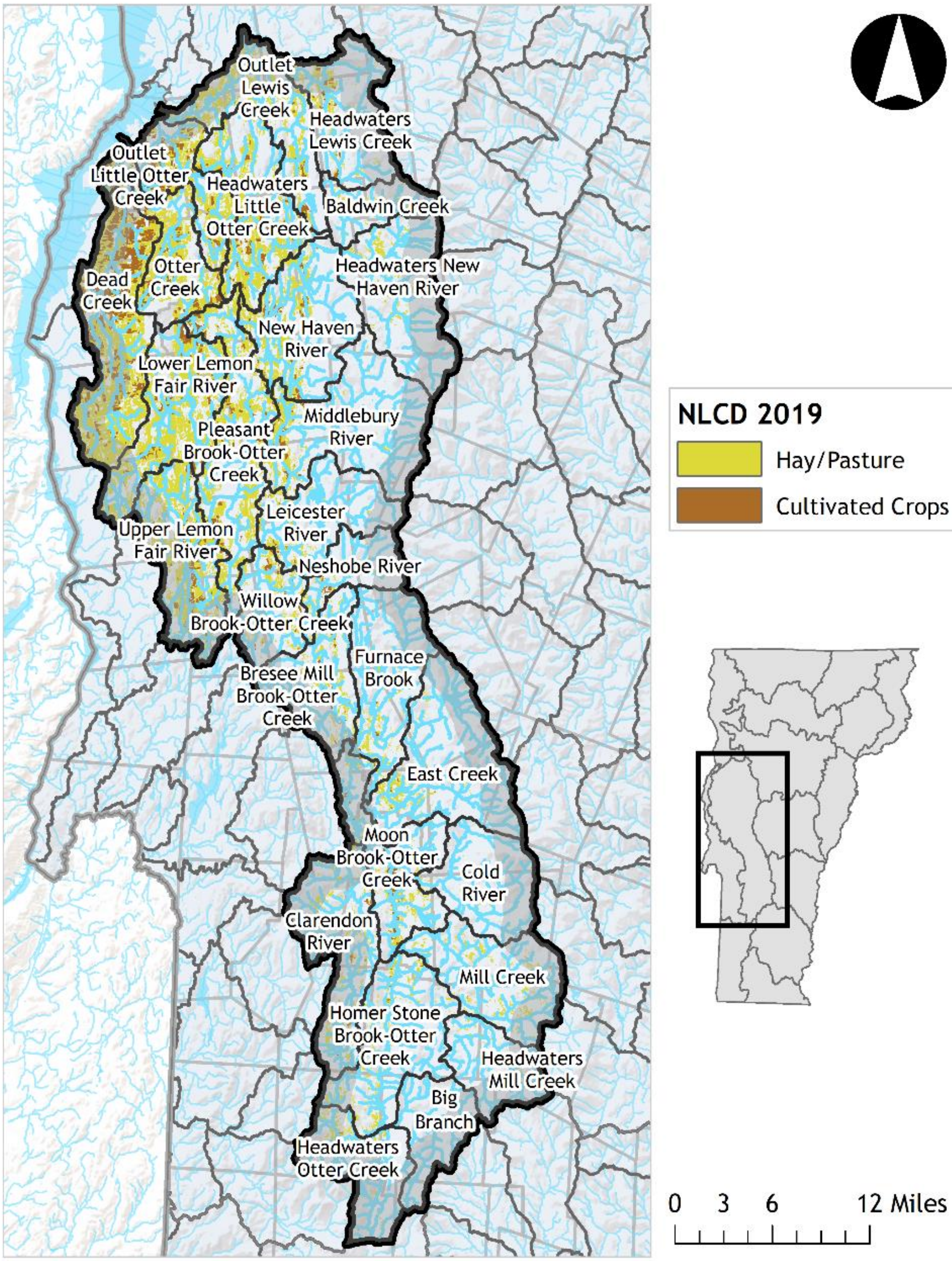


Figure 28. Agricultural land use in the Otter Creek basin.

widespread, though cultivated crops make up a notable portion of the Dead Creek, Outlet of Little Otter Creek sub-watershed, Otter Creek, and a few other sub-watersheds (Figure 29).

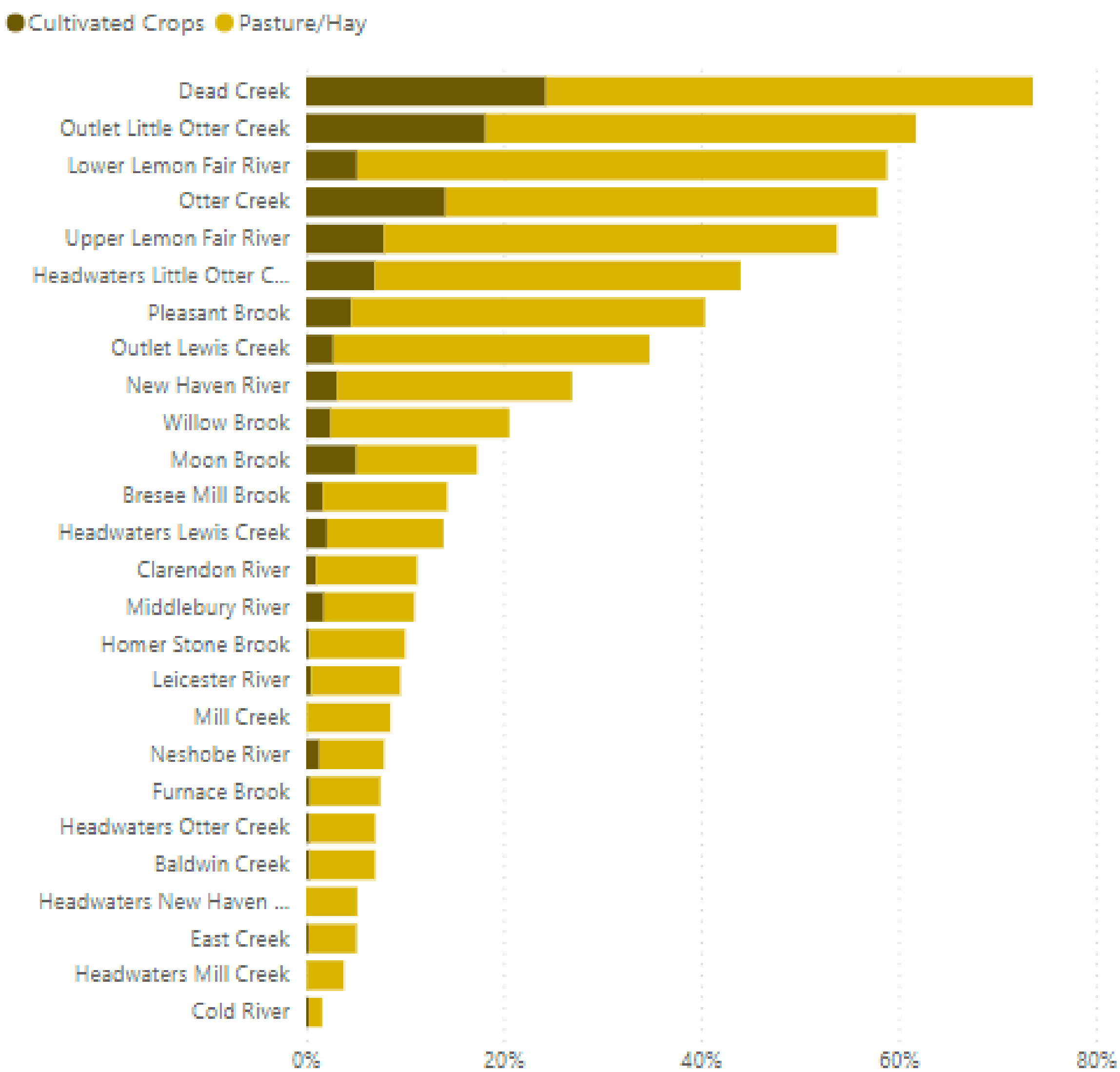


Figure 29. Agricultural land use in the Otter Creek basin by HUC 12 watershed.

Agricultural runoff constitutes 49% of the Otter Creek basin's estimated TMDL baseline total phosphorus (TP) loading (kg/yr.) to Lake Champlain. Agricultural runoff also contributes to *E. coli* impairments in Lewis Creek (Parsonage Bridge Rd. to Covered Bridge), Pond Brook (from Lewis Creek Confluence Upstream 1.5 miles), Otter Creek (mouth of Middlebury River up to Pulp Mill

Bridge (1.5 miles)), and Little Otter Creek (rm 15.4 to 16.4), as well as sediment and phosphorus impairments in Little Otter Creek (rm 4.2 to 7.0).

This section presents basin specific strategies to address agricultural water resource impairments through regulatory programs, BMP implementation, funding sources, outreach efforts, and partnerships. When appropriate, agricultural partner efforts will target several sub-basins in which

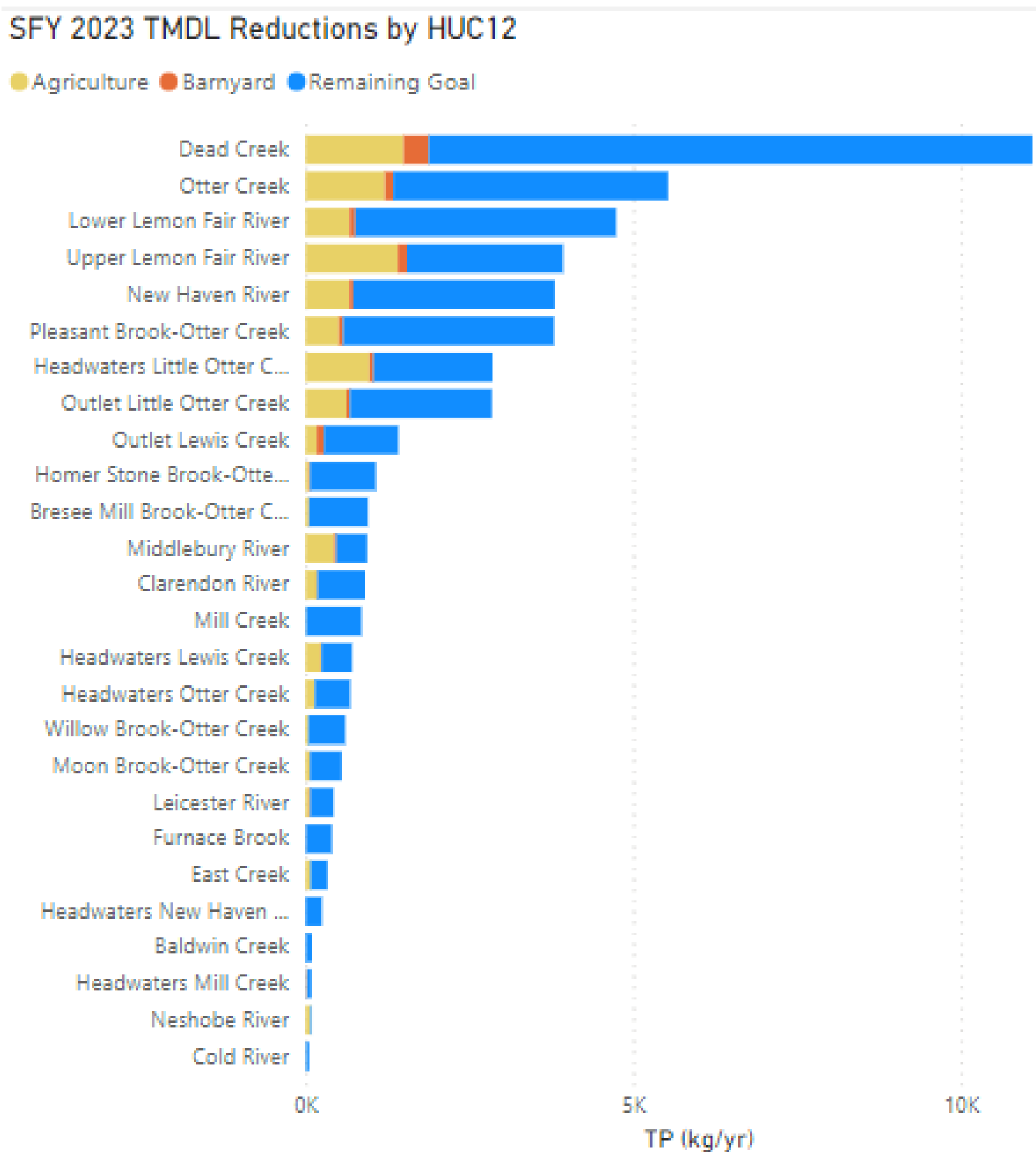


Figure 30. Agricultural total phosphorus (TP) reductions compared to TMDL targets. Each bar is the total TP reduction target for a HUC12. Yellow and orange bar sections are the TP reduction achieved in SFY2023 and blue sections are the remaining TP reduction needed to reach the total reduction goal.

remaining TMDL TP reduction goals are large such as Dead Creek, Otter Creek, Lower Lemon Fair River, New Haven River, and Pleasant Brook (Figure 30).

Regulatory programs

Vermont Agency of Agriculture, Food, and Markets (AAFM) regulatory programs work towards protecting surface waters by requiring baseline farm management practices to ensure environmental stewardship. The Required Agricultural Practices (RAPs) aim to reduce nutrients such as TP and nitrogen entering state waterways. The RAPs apply to different types of farms, farm sizes and farming activities. In addition to the RAPs, Vermont farms are regulated by additional sets of rules promulgated by the AAFM based on farm animal numbers into large, medium, certified small and small farms.

There are currently 11 permitted Large Farm Operation and 19 Medium Farm Operations in the basin. Large farms are inspected annually and medium farms are inspected once every three years by AAFM. These farms must comply with the Required Agricultural Practices (RAPs), Large Farm Operation Rule and Medium Farm Operation permitting program requirements as applicable, and the VWQS.

An estimated 50 Certified Small Farm Operations, that are required to certify annually with the Agency, will be inspected at least once every seven years, and need to comply with the RAPs. The AAFM estimates there are 163 Small Farm Operations in the basin that do not meet the thresholds of a certified small farm and are not required to receive a routine inspection by AAFM, but still need to comply with the RAPs. Outreach will continue to help landowners understand where they fall within the RAP farm categories and the RAP requirements.

AAFM regulatory programs support farmers to ensure their clear understanding of the RAPs and program rules, while helping assess, plan, and implement any conservation and management practices necessary to meet water quality goals. Inspections by AAFM include assessments of farm nutrient management plans, production area assessments of all facilities associated with the permitted or certified operation, and cropland management assessments in accordance with RAPs and permit rules as applicable. As a result of regulatory farm inspections and technical assistance provided to farms in counties overlapping the basin, in SFY 2022 and 2023 approximately 69% and 68% of production areas at farm facilities inspected in the basin were compliant with the RAPs, respectively. Information regarding farm inspections, compliance, and enforcement actions can be reviewed on AAFM's Water Quality Interactive Data Report.

Technical and Financial Assistance

The AAFM and agricultural partners provide technical and financial assistance to facilitate compliance with water quality regulations as well as the voluntary adoption of conservation practices throughout the basin. In the Otter Creek basin, partners include Rutland NRCD, Otter Creek

NRCD, UVM Extension, and the Natural Resources Conservation Service (NRCS). In addition, the Addison County River Watch Collaborative and the Champlain Valley Farmer Coalition support farmer-led discussions and collaboration that address gaps in funding and technical assistance.

The AAFM and NRCS programs financially support farmers to implement Best Management Practices (BMPs) including field practices such as cover cropping, crop rotation, and reduced tillage practices, and farmstead practices, such as waste storage facilities or clean water diversion practices. Between SFY 2019-2023, AAFM provided $4.4 million in state agricultural water quality program investments.

Between SFY 2019-2023, 76,444 acres of agricultural conservation practices were implemented in the Otter Creek basin with state program assistance. Cover cropping and conservation tillage were the most common practices in the Otter Creek basin, while grazing management and nutrient management were more annually variable (Figure 31). Agricultural partners suggested that a lack of access to capital equipment (e.g., drag lines for manure injection, no till drills for cover cropping and crop to pasture/hay conversion) and a lack of understanding of what is fundable (e.g., whole-pasture fencing vs. riparian-only fencing) are some major current barriers to BMP implementation, especially for smaller farms. UVM extension has a rental equipment program in Addison County and they

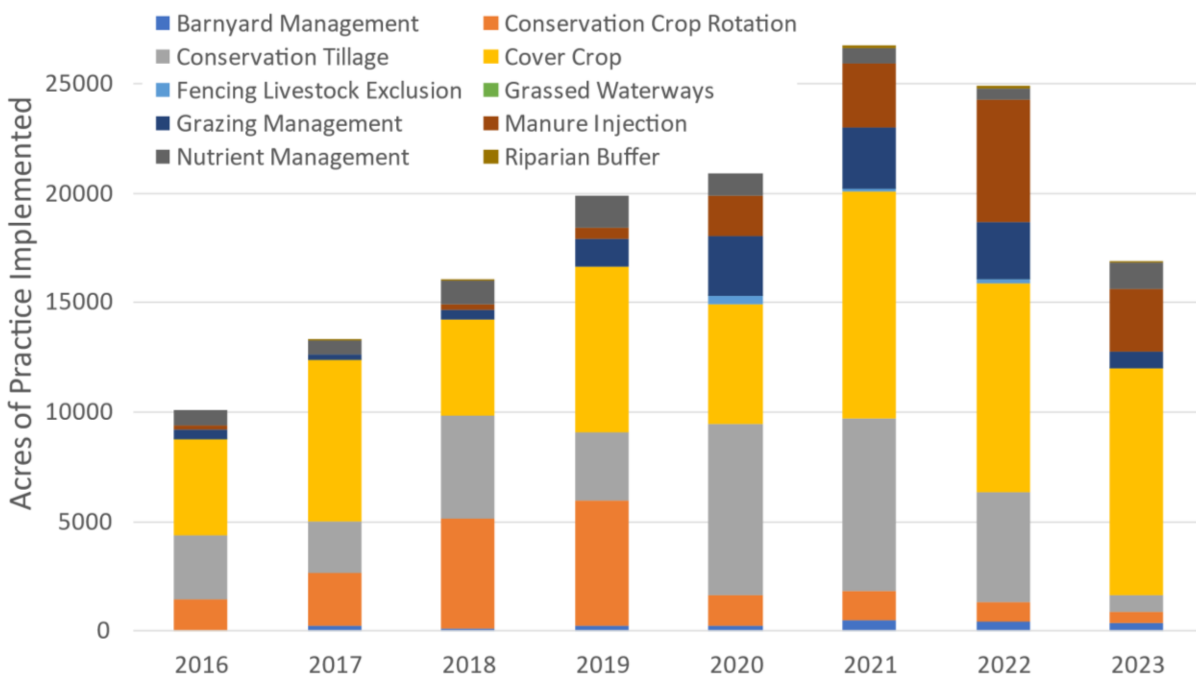


Figure 31. Implemented agricultural practices in the Otter Creek basin by state fiscal year.

provide technical assistance to farmers. In addition, the Southwest Regional Partnership (RNRCD, BCCD, and PMNRCD) with support from the VAAFM Agricultural Clean Water Initiative Program (ACWIP) serves farmers and producers in Bennington and Rutland Counties and employs two agricultural outreach specialists to provide a variety of services, education, and outreach to farmers with support from the district managers. Services currently offered include equipment rental, soil and manure sampling, manure cart weights, NMP development, consultations on BMPs to address water quality issues, and referrals to funding programs or agencies. The partnership also provides education and outreach through on-farm visits, mailers, workshops, and articles in publications like AgriView. Sustaining and coordinating with these groups is an important strategy in this plan to effectively target agricultural BMP implementation to improve water quality.

In addition to traditional agricultural funding, Act 76 formula grants can fund agricultural practices on non-RAP farms in the watershed. These farms are very small in scale but there may be significant TP loading if best management practices are not in place and costs for practices to reduce TP loading may be lower than stormwater treatment type practices. Identification of these smaller farms that may need BMPs to address water quality issues is needed along with capacity to complete outreach to these smaller farms and the development of practices and a way to support operations and maintenance required for formula grant funding are all needed to support this work in the basin.

The AAFM and partners provide education and outreach opportunities and technical assistance to farmers to promote and assist with conservation practice adoption. Between 2019-2023, AAFM and the AAFM funded partners supported 99 outreach events with 2,641 attendees in the Otter Creek basin. Between 2020-2023, UVM Extension, Conservation Districts, the Champlain Valley Farmer Coalition, and AAFM conducted 766 on-farm technical assistance visits in the basin.

The Vermont Agricultural Water Quality Partnership (VAWQP) is a coalition of state and federal organizations dedicated to improving agricultural water quality in Vermont by coordinating partner efforts to provide education, technical and financial assistance to the farming community. The Partnership collaborates to strategically leverage unique resources, funding mechanisms, technical expertise, outreach techniques, and more.

Partners are also developing resources for new farmers, small-scale farmers, and under-served and marginalized farmers to improve equity in agricultural funding opportunities in the basin. The challenge is identifying and targeting them for outreach on available programs. A capacity building project to support diverse and new farming audiences, spearheaded by UVM Extension's New Farmer Project and the Women's Agricultural Network, is an example effort addressing this need via the participation of 24 agricultural service providers.

B. Developed Lands

Stormwater runoff from developed lands, including the road network, is a significant threat to water quality in Vermont. Stormwater runoff is any form of precipitation that flows over the land during or after a storm event or snowmelt. On undeveloped lands, such as forests and meadows, a portion of this runoff is absorbed into the ground through infiltration while the rest takes a relatively slow path to nearby rivers, lakes, and ponds. On developed lands, however, infiltration is reduced by impervious surfaces such as roads, rooftops, and driveways, which increase the velocity and volume of runoff into rivers and lakes. Along this route stormwater carries pollutants with it to the waterbodies it enters. This leads to an increased frequency and intensity of flooding as well as a greater likelihood that runoff will become contaminated with pollutants. The result is increased erosion and property damage, degraded aquatic and terrestrial habitats, and threats to public health via recreation sports and contaminated drinking water.

Developed lands make up about 2% of the land cover in the basin, with locally higher concentrations in the Moon Brook-Otter Creek (7.2%), East Creek (3.6%), Pleasant Brook-Otter Creek (3.4%), and Otter Creek (2.7%) sub-watersheds. These lands include the general land use classes of urban, residential, and industrial areas, as well as paved and unpaved roads. Phosphorus loading from developed lands accounts for approximately 16.7% of all phosphorus loading from the basin to Lake Champlain. The Phase 3 TMDL portion of Chapter 3 above provides additional detail on the quantitative TMDL TP reduction targets, tracking and accounting methods, and progress towards these TP targets since 2016. Stormwater runoff is also a partial cause of 40% of the 22 stream impairments identified in the basin, contributing excess sediment, chloride, nutrients, bacteria, temperature, and other pollutants to surface waters. The following sections describe regulatory programs and non-regulatory tools to address agricultural runoff to surface waters during this plan cycle.

Stormwater

Tactical basin planning engages local, regional, and federal partners in the development of strategies needed to accelerate the adoption and monitoring of stormwater-related Best Management Practices (BMPs) to meet the state's clean water goals and TMDL targets. Basin stakeholders implement priority projects and municipalities are working on meeting regulatory requirements and to remediate identified discharges.

Stormwater mapping, Indirect Discharge Detection and Elimination studies, and Stormwater Master Plans are used to identify stormwater actions needed to address stormwater-related water resource impairments.

Regulatory requirements ensure proper design and construction of stormwater treatment and control practices as well as construction-related erosion prevention and sediment control practices, necessary to minimize the adverse impacts of stormwater runoff to surface waters throughout Vermont. Stormwater permits for developed lands include:

- Operational Stormwater Permits
- Construction Stormwater Discharge Permits
- Municipal Separate Storm Sewer System (MS4) General Permits
- Multi-Sector General Permit (Industrial)

Municipal Separate Storm Sewer System (MS4) General Permit

Designated municipalities that discharge to stormwater impaired waters must manage stormwater runoff from municipally owned or controlled impervious surfaces through the Municipal Separate Storm Sewer System (MS4) General permit. MS4 permittees develop stormwater management programs to comply with the six Minimum Control Measures. They develop 1) public education and outreach plans, 2) public involvement and participation activities, 3) illicit discharge and elimination programs, 4) regulations for construction site stormwater runoff, 5) regulations for post-construction stormwater management, and 6) good housekeeping programs. In addition to the six Minimum Control Measures, the MS4 General Permit also requires compliance with the Stormwater Impaired Waters TMDLs and the Lake Champlain Phosphorus (LC P) TMDL. DEC has developed initial estimated TP load reductions to the Otter Creek basin expected through MS4 General Permit compliance from MS4 communities to Lake Champlain segments as reported in Chapter 3 Phase 3 LC TMDL content.

The City of Rutland and the Town of Rutland are MS4 permittees and have developed Flow Restoration Plans to achieve the Stormwater TMDLs, and/or Phosphorus Control Plans to achieve the LC TMDL phosphorus reduction targets. The Phosphorus Control Plans include both town-wide retrofits to stormwater systems to enhance phosphorus removal and the implementation of municipal road upgrades and stabilization to meet the requirements of the Municipal Road General Permit standards within the MS4 permits.

In MS4 communities where a chloride- impaired waterbody has been documented (i.e., City of Rutland and Rutland Town) the communities and VTrans are required to develop and implement Chloride Response Plans as part of permit requirements. These typically include strategies to reduce the amounts of road salt applied by utilizing well maintained and calibrated spreading equipment and focusing applications at temperatures when road salt is most effective.

Together, Phosphorus Control Plans, Flow Restoration Plans, and Chloride Response Plans are integrated into each MS4 community's Stormwater Management Program Plan and progress made on each are reported annually. As of the writing of this plan, all MS4 communities are in compliance.

Stormwater General Permit 3-9050 (Three-Acre General Permit)

General Permit 3-9050 addresses runoff from impervious surfaces. This permit covers all operational stormwater permitting, including new development, redevelopment, and permit renewal. It serves as the statutorily required "Three-Acre General Permit" under the Vermont Clean Water Act. Parcels in the Lake Champlain watershed, including the Otter Creek basin, were required to apply for permit coverage by 2023. Vermont's Stormwater Program maintains a list of three-acre properties identified as of September 2020. The towns of Middlebury, Rutland City, and Rutland Town have the highest estimated acreage of three-acre sites, and about 49 sites covering about 547 acres exist basin-wide (Table 16). The Agency is presently making available grant funding in the form of rebates for individual landowners. In addition, the MS4 Community Formula Grant program is designed to assist MS4 communities with permit compliance. The funding will help reduce negative water quality impacts through the design and implementation of stormwater and roads projects and make progress toward phosphorus reduction targets outlined within the grantees' phosphorus control plans. The appropriation has been fully allocated and there will be no call for future awards. Most of the MS4 grants are made of a combination of American Rescue Plan Act, ARPA dollars, and VT clean water fund dollars, with the grantee contributing leverage equal to 20% of their total award amount. The projects must be completed by August 2026, when ARPA funding will run out. The Green Schools Initiative was also developed specifically to address public three-acre sites.

As of July 1, 2022, projects that expand or redevelop one half-acre (0.5 acres) or more of impervious surface are required to apply for stormwater operational permit coverage. Additional information on the ½ acre threshold can be found on the stormwater program website.

Table 16. Estimated three-acre parcels and associated impervious cover for Otter Creek basin towns.

Town	Estimated # of Parcels	Estimated Acreage	Town	Estimated # of Parcels	Estimated Acreage
Brandon	5	25.6	**New Haven**	5	47.1
Charlotte	2	10.6	**Pittsford**	4	98.6
Chittenden	1	8.1	**Rutland**	10	45.7
Clarendon	3	22.3	**Rutland City**	17	136.3
Danby	2	11.1	**Rutland Town**	11	136.0
Ferrisburgh	2	14.7	**Shoreham**	1	4.2
Hancock	1	4.3	**Vergennes**	8	56.7

Hartford	1	7.0	**Wallingford**	1	9.3
Killington	1	21.1	**West Rutland**	1	8.3
Mendon	2	9.2	**Williston**	1	6.6
Middlebury	22	274.3			

Green Schools Block Grant

DEC is funding a Green Schools Block Grant administered through GreenPrint Partners to have stormwater design and permitting work completed on behalf of schools in the Lake Champlain basin. Public schools and colleges in the Lake Champlain basin that are required to obtain three-acre general permit coverage (3-9050) will be able to sign up to receive technical and financial assistance for stormwater design and permit obtainment. The 10 three-acre school sites in the Otter Creek basin are here.

The Green School Initiative will also partner with Lake Champlain Sea Grant to provide stormwater education and outreach to school communities. Lake Champlain Sea Grant will provideschools with watershed and stormwater lesson plans as well as training for students and teachers. In addition, Lake Champlain Sea Grant will help schools identify ways to maximize the additional benefits of green stormwater projects, such as creating pollinator habitat and outdoor classrooms. Most schools in the basin are enrolled in Phase 2 of the Green Schools initiative for 3-acre permit obtainment.

Stormwater Mapping and Master Planning

Stormwater infrastructure mapping projects are completed for municipalities by the Clean Water Initiative Program to supplement any existing drainage data collected by towns and with the intention of providing a tool for planning, maintenance, and inspection of the stormwater infrastructure. Town reports can be found by clicking on the town on the left side of the municipal stormwater website. As of spring 2024, all municipalities in the basin have been mapped except for Cornwall, Goshen, Leicester, Monkton, Mount Tabor, Panton, Ripton, Salisbury, Sudbury, Tinmouth, Waltham, Weybridge, and Whiting.

The town reports and maps provide an understanding of the connectivity of the storm drainage systems on public and private properties to raise the awareness of the need for regular maintenance and to identify stormwater retrofit opportunities. These reports identify potential priority projects and provide information necessary to develop a stormwater master plan. Stormwater Master Plans are developed with municipal and public involvement and further prioritize projects identified in initial mapping efforts, offering a strategic approach to address stormwater runoff in the plan focus area. Stormwater master planning has been completed for 30 of 44 municipalities in the basin (Table 17) and reports are available at DEC's Stormwater Infrastructure Mapping Directory. The ANR will make recommendations or support proposals as appropriate for additional SWMPs.

Projects identified as high priority in the stormwater mapping reports and master plans may be implemented by towns with the aid of watershed partners. Most towns in the basin with significant development adjacent to surface waters have developed a stormwater master plan and the priority projects in those plans should be pursued. For those towns with less development, a singular project identified by a stormwater mapping report can be developed. Stormwater Master Planning and projects in the Lake Champlain basin are currently funded through CWSP Formula Grants.

Table 17. Towns with completed stormwater assessments. Visit the Stormwater Infrastructure Mapping Directory to access town-specific stormwater mapping reports and master plans.

Town	Year(s) SW Mapped	SW Master Plan(s) Completed
Addison	2021	SW Infrastructure Mapping Project (SWIR)
Brandon	2017, 2020, 2020	Brandon SWMP, Forestdale SWIR, Brandon SWIR
Bridport	2021	Bridport SWIR
Bristol	2019	Bristol SWMP
Buels Gore	NA	
Charlotte	2022	Charlotte SWIR
Chittenden	2024	Chittenden SWMP in progress
Clarendon	2020	Clarendon SWIR
Cornwall	NA	
Danby	2017	Danby SWIR
Dorset	2018	Dorset SWIR
Ferrisburgh	2021	Village of Ferrisburgh SWIR
Goshen	NA	
Hinesburg	2015	Hinesburg SWIR
Hubbardton		Lake Bomoseen SWMP (covered in Basin 2&4 TBP)
Ira		Castleton Headwaters SWMP (covered in Basin 2&4 TBP)
Killington	2016	Killington SWIR
Leicester	NA	
Lincoln	2018	Lincoln SWIR
Mendon	2021	Mendon SWIR
Middlebury	2020, 2012, 2016	Middlebury SWMP, Middlebury College S Campus SWIR, Downtown Middlebury East SWMP
Mount Holly	2017	Mount Holly SWIR
Mount Tabor	NA	
Monkton	NA	
New Haven	2022	New Haven SWIR
Orwell	2015	Orwell SWIR
Panton	NA	
Pittsford	2012	Pittsford SWIR, Pittsford SWMP in progress

Town	Year(s) SW Mapped	SW Master Plan(s) Completed
Proctor	2012	Proctor SWIR
Ripton	NA	
Rutland Town	2014, 2016, 2012	Tenney Brook East Creek SWMP, MS4-Moon Brook Flow Restoration Plan, Rutland Town SWIR
Rutland City	2019, 2012, 2014, 2016	MS4—Moon Brook SWMP, Rutland City SWIR, Tenney Brook East Creek SWMP, Moon Brook Flow Restoration Plan
Salisbury	NA	
Shrewsbury	2020	Shrewsbury SWIR
Shoreham	2015	Shoreham SWIR
Starksboro	2018	Starksboro SWIR
Sudbury	NA	
Tinmouth	NA	
Vergennes	2018, 2012	Vergennes SWMP, Vergennes SWIR
Wallingford	2019, 2012, 2017	Wallingford SWMP, Wallingford SWIR, Village of East Wallingford
Waltham	NA	
Weybridge	NA	
Whiting	NA	
West Rutland	2022	West Rutland SWIR

Illicit Discharge Detection & Elimination (IDDE) Studies

Illicit discharges are discharges of wastewater or industrial process water into a stormwater-only drainage system. A 2014 IDDE study was completed for the following 7 towns in Rutland County: Benson, Castleton, Fair Haven, Poultney, Proctor, Wallingford, and West Rutland. The goal of the project was to improve water quality by identifying and eliminating contaminated, non-stormwater discharges entering stormwater drainage systems and discharging to the Otter Creek, the Poultney River, and their tributaries. The geographic scope included the entirety of the municipal closed drainage systems in these towns. The final reports are available at: https://bit.ly/2QQH4Un and https://bit.ly/2ydaDHe.

A second IDDE study was also completed in 2014 for the following 6 towns in the Otter Creek basin: Brandon, Middlebury, Pittsford, Rutland City, Rutland Town, and Vergennes. The goal of the project was to improve water quality by identifying and eliminating contaminated, non-stormwater discharges entering stormwater drainage systems and discharging to the Otter Creek and its tributaries. The project encompassed the entirety of the municipal closed drainage systems in the six towns.

Through these studies several sewage and industrial wastewater discharges were detected and eliminated in the communities of Wallingford, Rutland City and Rutland Town, Proctor, Brandon, Middlebury, and Vergennes. These studies also produced comprehensive developed land stormwater infrastructure maps for each municipality (https://bit.ly/2YbZrFh).

Most of these illicit discharges have been identified and eliminated. Where sources were difficult to locate, compliance was difficult, or the infrastructure was no longer in use follow-up actions are identified in the reports.

Stormwater Outreach and Education

Many of the stormwater issues associated with developed lands can be prevented or mitigated using Low Impact Development and Green Stormwater Infrastructure systems and practices. These concepts strive to manage stormwater and pollutants by restoring and maintaining the natural hydrology of a watershed. Rather than funneling stormwater off site through pipes and infrastructure, these systems (gardens or permeable materials) focus on infiltration, evapotranspiration, and storage as close to the source as possible to capture runoff before it gets to surface waters.

The Vermont Green Infrastructure Toolkit is a project of the ten Regional Planning Commissions of the Vermont Association for Planning and Development Agencies and the Agency of Natural Resources' Water Investment Division. The toolkit is a clearinghouse of information useful to municipalities to explore how to promote the adoption of Green Infrastructure policies and practices to combat the problems caused by urban, suburban, and rural stormwater runoff.

Simple voluntary actions by individual landowners and residents can also reduce local stormwater runoff issues if adopted at scale. Several outreach campaigns have been developed and implemented regionally to encourage practices like reducing lawn mowing and fertilizing, using permeable pavers, redirecting downspouts, picking up pet waste, lessening salt application, and installing rain barrels. Nationwide, the Environmental Protection Agency provides general Stormwater Smart Outreach Tools to promote sound stormwater management.

Lawn to Lake is a collaborative program promoting healthy lawn and landscape practices to protect water resources in the Lake Champlain basin. To date, their campaigns have included efforts to reduce phosphorus runoff from lawns ("Don't 'P' on Your Lawn) and improve the soil health and stormwater infiltration by increasing grass height on lawns ("Raise the Blade").

Likewise, Rethink Runoff is an ongoing awareness and public outreach effort to reduce sediment and pollutants in stormwater runoff in the Lake Champlain basin. Rethink Runoff offers online stormwater education materials, hosts workshops on residential stormwater topics, and manages volunteer programs for storm drain cleaning, stream clean ups, rain garden maintenance, and water quality monitoring (the Stream Team).

This plan encourages the continued promotion of these outreach campaigns. Where appropriate, campaigns may look to coordinate efforts to streamline outreach to residents, integrate materials from related campaigns to attract broader audiences (e.g., campaigns with a fish, wildlife, or pollinator habitat focus), employ social marketing techniques to promote adoption of stewardship techniques, or collaborate to develop messaging unique to Otter Creek basin residents.

Roads

It is estimated that more than 75% of Vermont roads were constructed prior to any requirements for managing stormwater runoff (ANR, 2012). Where road networks intersect stream networks, roads and their ditches effectively serve as an extension of the stream network. Roads can increase stormwater runoff and unpaved roads are an important source of sediment and phosphorus to receiving waterbodies in this basin. In the Lake Champlain P TMDL, unpaved roads are estimated to contribute 29.6% of the phosphorus loading across developed lands. Road runoff also contributes other pollutants, such as chlorides and sediment, that can impair streams and lakes. Roads can impinge on stream floodplains and be a barrier to aquatic organism passage due to undersized or perched culverts.

Tactical basin planning engages local, regional, and federal partners to accelerate the implementation of transportation-related practices to meet the state's clean water goals. Two regulatory programs, the Municipal Roads General Permit (MRGP) and the Transportation Separate Storm Sewer System Permit (TS4) are driving road water quality implementation efforts in the basin.

Municipal Roads General Permit

Road Erosion Inventories (REI) are used by Vermont municipalities to:

- identify local road segments in need of sediment and erosion control,
- determine individual road segment compliance with MRGP required practices,
- prioritize road segments that pose the highest risks to surface waters, and
- estimate costs to remediate those sites using Best Management Practices.

REIs are required by the Municipal Roads General Permit. The MRGP is intended to achieve significant reductions in stormwater-related erosion from municipal roads, both paved and unpaved. The permit is required by the Vermont Clean Water Act (Act 64) and the Lake Champlain Phase 1 TMDL. As of 2023, road segments are surveyed and scored according to either open drainage REI or closed drainage REI methods.

The implementation of REI priorities will reduce sediment, nutrients, and other pollutants associated with stormwater-related erosion generated from unpaved municipal roads that contribute to water quality degradation. A secondary benefit of upgrading roads to MRGP standards is improving the flood resilience of the municipal transportation system from the increased frequency of localized high intensity rain events associated with climate change. The inventories are conducted for hydrologically connected roads. Hydrologically connected roads that are open drainage are those municipal roads within 100' of or that bisect a wetland, lake, pond, perennial or intermittent stream or municipal roads that drain to one of these water resources. For closed drainage roads that collect stormwater in catchbasins connected to outlet pipes, a hydrologically connected road has an outlet that is within 500 feet of a surface water. These road segments can be viewed using the Stormwater - Road Segment Priority layer onthe ANR Natural Resource Atlas and REI results by town can be viewed in the MRGP Implementation Table.

Based on protocols developed by DEC with the assistance of the Regional Planning Commissions, all the towns in the basin have completed initial REIs as of 2023. Towns were required to bring 15% of connected segments scoring *Partially Meeting* or *Not Meeting* to the MRGP standards or *Fully Meeting* status by December 31, 2022. *Very High Priority* connected segments will have to meet standards by December 31, 2025, for all road types, except for Class 4 roads, which will have to meet standards by December 31, 2028. Towns will report and manage their progress annually via the MRGP Implementation Table Portal database. For additional information see the DEC Municipal Roads Program.

The DEC reissued the MRGP in January 2023. The new permit continues the implementation requirements of the previously issued permit, requiring towns to upgrade at least 7.5% of their non-compliant segments to meet MRGP standards annually. The re-issued permit requires a second, town-wide reassessment of all hydrologically connected segments by the Fall of 2027. After the updated REI is completed, 20% of total *Very High Priority* segments will be required to be upgraded to meet MRGP standards each year, as part of the 7.5% annual requirement mentioned above. One change in the reissued MRGP is that the active channel width is now required for new intermittent stream crossings, as well as replacements to existing non-compliant intermittent structures.

This plan recommends that technical and financial assistance be provided to towns to complete the new, required REIs and for towns interested in implementing road projects with water quality benefits. Priority projects for water quality are those projects that are "*very high priority*" and are in sub-basins with phosphorus impairments or with lakes that have increasing nutrient trends related to road stormwater runoff (Figure 32). Resources available from the Clean Water Fund (e.g., VTrans Municipal Grants-in-Aid, VTrans Better Roads grants) assist with development of designs, capital budgets, cost estimates, and implementation of road projects. Completion of these projects may be counted towards meeting the requirements of the MRGP.

Rutland City, Lincoln, Wallingford, Starksboro, Brandon, and Middlebury are priority towns for funding because they have the highest number of non-compliant roads to be improved (Figure 32). Priorities for funding road assessments or improvements may also include lakes with impaired or increasing nutrient trends (Danby and Dunmore), priority road-related projects identified in Stormwater Master Plans (Table 17) or Lake Watershed Action Plans (see the Lakes section), or lake watersheds with municipal or private road erosion adjacent to waterways. Private and forest roads can be significant sources of runoff but are not yet fully mapped at the basin scale. Strategies to address these non-regulatory roads are discussed in the Forestlands section. Clean Water Fund formula and enhancement grants support private road stormwater remediation.

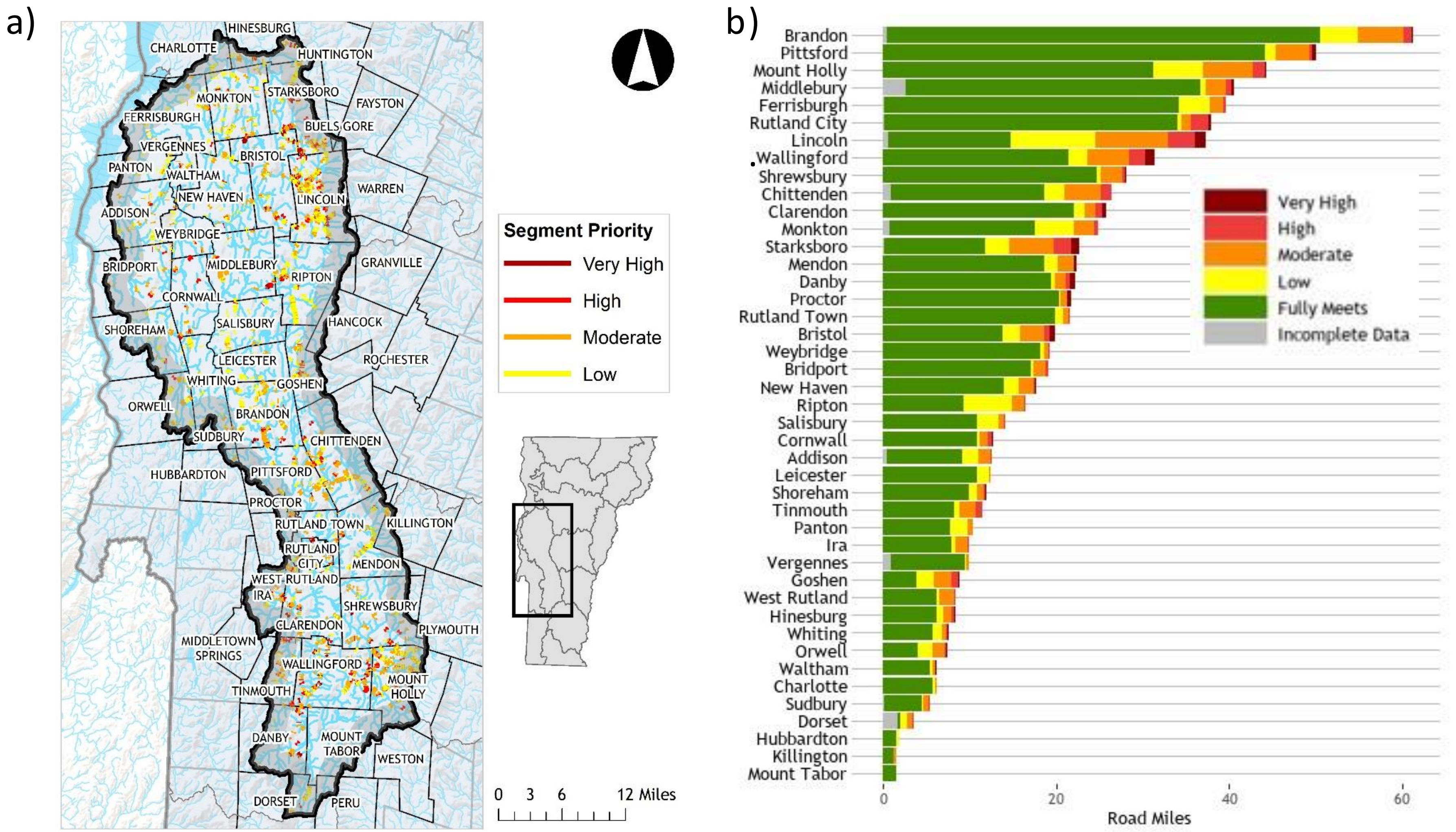


Figure 32. a) Map of road segment priorities based on REIs not including fully meeting or incomplete segment data. B) Town road improvement priorities including fully meeting and incomplete segment data.

VTrans Municipal Grants in Aid & Vermont Local Roads

The VTrans Municipal Grants In Aid Program provides technical support and grant funding to municipalities to promote the use of erosion control and maintenance techniques that save money while ensuring best management practices are completed in accordance with the MRGP. The Vermont Local Roads team provides training, technical assistance, communication tools, and opportunities for information exchange to assist municipalities with improving their road networks. These programs help implement the strategies described here and listed in Chapter 5.

Transportation Separate Storm Sewer System General Permit – TS4

The Transportation Separate Storm Sewer System General Permit (TS4) covers stormwater discharges from all Vermont Agency of Transportation (VTrans) owned or controlled impervious surfaces. The TS4 general permit combines the stormwater requirements for VTrans associated with its designated regulated small MS4s; industrial activities, commonly regulated under the Multi-Sector General Permit; and previously permitted, new, redeveloped, and expanded impervious surface, commonly regulated under State Operational Stormwater permits.

As required by the permit, VTrans has an approved Phosphorus Control Plan (PCP) for each Lake segment within the Vermont portion of the Lake Champlain basin. The PCPs, developed in phases, identify and document a suite of best management practices that should collectively achieve the required LC TMDL reductions in phosphorus loading from VTrans stormwater discharges. The practices on VTrans roads, rights-of-way, and facilities will be prioritized to include highly hydrologically connected road segments, existing road drainage deficiency, or localized erosion.

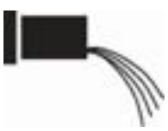
The Phosphorus Control Plan meets the requirements of the Lake Champlain Phosphorus TMDL and will result in the reduction of phosphorus loading from roads, rights-of-way, and facilities under the Agency's control by over 20% in the Main Lake segment within the next 20 years (by June 17, 2036). The highest loading totals for paved roads in the Otter Creek drainage are those with high hydro-connectivity with a low slope and moderate hydro-connectivity with a low slope.

A VTrans Lake Champlain Basin Phosphorus Control Plan Story Map outlines the agency's process towards developing and implementing the Phosphorus Control Plans and this VTrans factsheet provides additional information. VTrans submits annual progress reports to ANR. VTrans has also developed the Vermont Transportation Resilience Planning Tool as a web-based application that assesses the risk to bridges, culverts, and road segments based on their vulnerability to damage from floods and the criticality of their location in the roadway network, and then identifies potential mitigation measures based on the factors driving the vulnerability.

Vermont Road and Bridge Standards

In addition to the MRGP, towns can voluntarily adopt the most current version of the Vermont Town Road and Bridge Standards. These standards are administered by VTrans and go above and beyond MRGP standards. For example, municipalities may adopt MRGP standards for non-hydrologically connected roads. Towns adopting the Vermont Road and Bridge Standards may be entitled to higher cost share rates in federally declared flood event reimbursements. DEC will coordinate with VTrans District Offices to gather up to date information on adopted Road and Bridge Standards, coordinate outreach to municipalities, and update the Vermont Flood Ready website.

Managing road runoff in the upper watershed catchments will lessen the pressure on the downstream areas receiving larger contributions of runoff. Waters being impacted or impaired lower in the watershed does not negate the need for action high up in the watershed. Lack of good management in the upper parts of the sub-basins can often be the cause of water quality issues further downstream due to cumulative impacts. For this reason, road BMPs for water quality are recommended basin wide on public and private roads particularly on steep slopes.



C. Wastewater

Wastewater discharges to surface or ground waters represent a regulated, measurable, and controlled source of pollutants, including pathogens and Phosphorus. The State of Vermont addresses these discharges primarily through implementation of the National Pollutant Discharge Elimination System and Indirect Discharge (NPDES) permit program as well as state permit programs. The DEC provides financial assistance and technical assistance to municipalities and other permittees to repair, refurbish, and upgrade wastewater treatment infrastructure and along with partners supports the development of community onsite wastewater disposal systems and maintenance of residential onsite wastewater disposal systems.

Direct Discharges from Wastewater Treatment Facilities

In the Otter Creek basin, 9 municipal wastewater treatment facilities treat wastewater to established standards identified in NPDES permits before discharging it into a receiving water (Table 18). Municipal wastewater treatment facilities (WWTFs) receive wastewater originating from a combination of domestic, commercial, and industrial activities. An overarching consideration for the Agency's issuance of NPDES permits is the 2016 Lake Champlain Phosphorus TMDL (LC TMDL). The LC TMDL did not alter the allowable phosphorus discharge loads from wastewater treatment facilities that discharge to the Otter Creek segment of Lake Champlain. However, when renewing the Otter Valley Union High School permit in 2023, the discharge had reasonable potential to violate Vermont Water Quality Standards in the Unnamed Tributary to Otter Creek for phosphorus. A new phosphorus load limit was included in the permit, reducing from 381 lbs./year to 33.8 lbs./year, with a compliance schedule to optimize the facility and make any upgrades necessary to comply with the new load as soon as possible, but no later than March 31, 2027.

Since 2021, DEC has reissued 7 of 9 municipal wastewater discharge permits in Basin 3. The municipal wastewater discharge permits in place in the basin are in Table 18. To ensure that facilities have time to implement any needed construction of upgraded phosphorus treatment facilities to continue to meet the TMDL allocations, discharge permits require that municipalities develop plans to maximize phosphorus reductions and meet limits. All permittees must develop a Phosphorus Optimization Plan to identify opportunities to implement optimization techniques that achieve phosphorus reductions primarily using existing infrastructure and equipment.

After completion and implementation of the Phosphorus Optimization Plan, all permits require the facilities' phosphorus discharge to be evaluated by the Agency Secretary relative to 80% of the facilities' allowable load threshold of the permit. If a facility is at, or reaches, 80% of its effluent phosphorus concentration or annual mass limit, the permittee must develop a Phosphorus Elimination/Reduction Plan to ensure compliance with the permit's annual mass limit. See Wastewater Management Program fact sheet for additional information. None of the Otter Creek municipal WWTFs have exceeded 80% of their LC TMDL limit. The Otter Valley Union High School is optimizing their process to see if they can achieve the new permit limit unrelated to the LC TMDL or will need an upgrade.

Before issuing the permit, the DEC WSMD also conducts a reasonable potential analysis to ensure all water quality criteria in receiving streams are met. The Wastewater Management Program is working with the Monitoring and Assessment Program to increase the frequency of instream sample collection upstream of WWTFs prior to permit renewal. The upstream data is used during the reasonable potential analysis, described below, to calculate the resulting downstream concentration once mixed with the WWTF effluent under critical conditions to determine if there is reasonable potential to violate VWQS. The increased instream sampling as well as increased effluent sampling requirements being incorporated into WWTF permits contribute to more statistically accurate, data-based determinations for WWTF permit effluent limits.

Permit limitations must control all pollutants or pollutant parameters (either conventional, nonconventional, or toxic pollutants) which are or may be discharged at a level that will cause, have the reasonable potential to cause, or contribute to an excursion above any state water quality standard, including state narrative criteria for water quality. At each renewal, permit writers use this "reasonable potential analysis" to determine whether a discharge, alone or in combination with other sources of pollutants to a waterbody and under a set of conditions arrived at by making a series of reasonable assumptions, could lead to an excursion above an applicable water quality standard. If the expected receiving water concentration determined exceeds the applicable VWQS at critical conditions, limits are included in the permit. A permit writer conducts a reasonable potential analysis using effluent and receiving water data, and the findings are included in the permit issuance documentation, which can be viewed on the Wastewater Program's discharge permit database.

The Agency is also actively working with Middlebury, Rutland, and Vergennes on minimizing overflows from combined sewer systems (CSS), an additional source of nutrients and pathogens to surface waters. A CSS collects sewage and stormwater in the same pipe and directs it to the wastewater treatment facility. Although the systems work well in dry weather, the runoff from strong storms or snowmelt overwhelms the combined system causing a Combined Sewer Overflow (CSO) event. To prevent sewage backups into basements or onto roadways, some of the untreated wastewater is diverted into lakes and rivers via outfall pipes. After issuing a 1272 order, DEC works cooperatively with the communities to ensure that comprehensive plans with a high probability of success will be created. After these Long-Term Control Plans are finalized, DEC issues a new 1272 order with the schedule of activities planned to eliminate or abate CSOs and annual reports to summarize Long-Term Control Plan activities completed each year.

The Wastewater Management Program website includes additional information regarding specific 1272 orders, Long-Term Control Plans, and CSO annual reports. A summary of work completed by facilities and expected upgrades to meet WWTF permits is located at the end of this section. Permit issuance documentation can be viewed on the Wastewater Program's discharge permit database.

In addition to the improved WWTF functioning achieved through Phosphorus Optimization Plans, Phosphorus Elimination/Reduction Plans and CSO Long-Term Control Plans, large contributions of commercial discharges to facilities now receive pretreatment. The Wastewater Management Program issues permits under the Federal Pretreatment Permit program for certain industrial and commercial discharges to municipal WWTFs. The conditions of the DEC pretreatment permit help minimize the potential that industrial or commercial discharges will interfere with the operation of the treatment facility, resulting in the release of untreated wastewater to the environment. The list of 9 operations with pretreatment permits that discharge to Otter Creek basin WWTFs can be viewed on DEC's Wastewater Pretreatment Permit webpage.

Financial and Technical Assistance

The DEC and partners assist municipalities in discharge permit compliance by providing access to funding and technical assistance. Vermont provides loans and grants to supports municipal WWTF and associated infrastructure upgrades through the Clean Water State Revolving Fund, Vermont Pollution Control State Revolving Fund, and the Vermont Engineering Planning Advance Program; and grants via the Vermont Pollution Control Grants , Vermont Healthy Homes grants, the Clean Water Fund (created via Act 64: the Vermont Clean Water Act), and certain grants through Vermont's Agency of Commerce and Community Development. Federal assistance is provided by the US Department of Agriculture via USDA Rural Development Water and Environmental Loans and Grants and Northern Boarders Regional Commission grants.

The DEC Wastewater Management Program works cooperatively with local organizations, such as Vermont Rural Water Association and Vermont Energy Investment Corporation, to facilitate technical assistance related to optimization of nutrient removal and energy efficiency at WWTF.

The DEC and partners are also available to assist municipalities with asset management planning, which includes identifying needed upgrades, timelines, and funding sources. Without a plan, facilities tend to delay upgrades and therefore Clean Water State Revolving Fund funding requests until required by permits. As permit reauthorization occurs at the same time for all facilities within the same basin, they may end up competing for a set amount of annual funding. This planning is especially important in this basin, which has a high number of WWTF. With an asset management plan in place, municipalities could plan over a longer time-period taking advantage of Clean Water State Revolving Fund cycles.

Table 18. Summary of permit requirements for the wastewater treatment facilities in the Otter Creek basin. To view the permits, see the Vermont's Wastewater National Pollutant Discharge Elimination System Permit webpage.

Facility Name	Permit Expiration	Permitted Flow (MGD[1])	Current Percent of Flow[2]	TMDL Allocated Wasteload (MT P/yr.)[3]	Treatment Type	*CSOs (#)*	Receiving Water
Brandon	03/31/2027	0.700	56%	0.580	Extended aeration	0	Neshobe River
Middlebury	9/30/2013[4]	2.200	54%	1.823	Sequential batch reactor	4	Otter Creek
Otter Valley Union High School	3/31/2028	0.025	12%	0.173[5]	Aerated lagoons	0	Otter Creek
Pittsford	3/31/2027	0.085	46%	0.483	Extended aeration	0	Furnace Brook
Proctor	12/31/2027	0.325	76%	0.359	Aerated lagoons	0	Otter Creek
Rutland	3/31/2027	8.100	72%	5.634	Extended aeration	5	Otter Creek
Vergennes	12/31/2009[4]	0.750	54%	0.621	Aerated lagoons	1	Otter Creek
Wallingford FD 1	3/31/2027	0.120	44%	0.829	Extended aeration	0	Otter Creek

West Rutland	9/30/2027	0.450	59%	0.364	Sequential batch reactor	0	Clarendon River

[1]MGD = Million gallons per day

[2]Percentage was calculated using the average monthly flows (Effluent Gross Value) for the period 5/1/2022 to 5/1/2023.

[3]The TMDL Waste Load Allocation (metric tons P/yr.) is the same as the current permitted load.

[4]Permit under Title 3 administrative continuance until renewed.

[5]The renewed permit reduced the phosphorus load to 0.015 MT P/yr. with a compliance schedule based on the receiving water of the Unnamed Tributary to Otter Creek.

Facility-specific information

The WWTF upgrades and associated projects described below, as well as those in the Priority List of Vermont Waters, will provide water quality benefits by addressing the Lake Champlain and/or Bacterial TMDLs and associated implementation plans. In addition, any WWTF and infrastructure upgrades or other wastewater management projects within a DEC-specified distance upstream of a swimming hole identified as an existing use would also benefit water quality. The projects are also required to uphold Vermont's Anti-Degradation Policy.

The Water Investment Division will consider each of the wastewater treatment facilities and associated infrastructure upgrades listed below that have municipal support for future drafts of the Project Priority List articulated in the DEC's Intended Use Plan. Please see the Intended Use Plan for the list of Otter Creek basin municipalities with projects currently on the Project Priority List.

Brandon

The Town of Brandon owns and operates the Brandon Wastewater Treatment Facility, an activated sludge extended aeration process that provides phosphorus removal. Dechlorination follows the addition of liquid chlorine for disinfection. Solids are trucked to the City of Rutland WWTF for dewatering. The collection system consists of seven pump stations.

The facility is currently undergoing an upgrade to replace aging infrastructure. The upgrade includes a new mechanical fine screen, improved grit removal, clarifier and oxidation dich refurbishment, new secondary clarifier, chemical storage treatment and upgrade, electrical and control upgrades and renovation of the primary control building.

Middlebury

The Town of Middlebury owns and operates the Middlebury Wastewater Treatment Facility, a sequencing batch reactor (SBR) activated sludge process with chemical addition for phosphorus removal and ultraviolet light disinfection. The facility receives domestic sewage from the Town, as well as industrial process wastewater from the Agri-Mark dairy processing facility, Vermont Hard Cider, Middlebury Resource Recovery Center, Whistle Pig and other industrial sources.

A 20-year engineering evaluation was done as part of the Phase 2 Interim Preliminary Engineering Report (PER) in 2020 and the Town is working through the Clean Water State Revolving Fund process to upgrade the facility based on the PER.

Otter Valley Union High School

Otter Valley Union High School owns and operates a wastewater treatment facility consisting of two in series concrete aeration lagoons, a clarifier, and sand filter, followed by chlorine disinfection.

The renewed permit, effective June 1, 2023, included a reduced annual phosphorus mass limit based on reasonable potential for the discharge to violate Vermont Water Quality Standards for total phosphorus in the small receiving water, the Unnamed Tributary to Otter Creek. The facility may not be capable of achieving the limit currently, so a compliance schedule was included in the permit for the facility to comply with this new total phosphorus limit as soon as possible, but no later than March 31, 2027. The facility submitted a Phosphorus Optimization Plan December 18, 2023, and is implementing optimization techniques and assessing if an upgrade will be needed to meet the new limit.

Pittsford

The facility consists of the headworks, the Aero-Mod Technology extended aeration treatment system and a separate chlorine disinfection tank followed by de-chlorination. Effluent is discharged into Furnace Brook, a tributary of the Otter Creek. No major upgrades have occurred at the WWTF in the past five years.

Proctor

The treatment system at this facility consists of two aerated lagoons. Ultraviolet light is used for disinfection and then the wastewater is discharged to Otter Creek. Proctor is currently planning a refurbishment project. No major upgrades have occurred at the WWTF in the past five years.

Rutland

The City of Rutland operates the Rutland Wastewater Treatment Facility which is an extended air activated sludge treatment system. The facility currently receives and treats wastewater from the City of Rutland and some areas of the Towns of Rutland, Mendon, Killington, and Clarendon.

The city has four active CSOs. On May 8, 2018, a 1272 Order was issued requiring the City to implement the 9 Minimum Controls for CSOs as well as the create Long-Term Control Plan

(LTCP). On January 11, 2022, the CSO LTCP was presented at a public meeting, and it was submitted to the State on July 26, 2022.

A continuation of the Northwest Neighborhood Sewer Separation Project was completed in Spring 2021. Additionally, the East Creek Forcemain Replacement project was completed in 2021, the telemetry devises of the ultrasonic level sensors in all CSO overflow structures were upgraded and eight area-velocity meters were purchased for the Hydraulic and Hydrologic Model of the City's combined sewer system.

Preliminary design was completed in March 2023 for the Connor Park CSO Storage project, which consists of constructing a 1-million-gallon CSO storage facility beneath Connor Park. Contracts were established in summer 2023 for design of the Meadow Street Separation project and the CSO Check Valves project.

Vergennes

The WWTF consists of an influent pump station with grinder pumps, two equally sized super primary aerated lagoons, and a chlorine contact tank. There is no specific treatment technology used for phosphorus removal at the facility, but it does remove approximately 20% to 30% of influent phosphorus and nitrogen via the normal lagoon treatment process.

The bond vote for upgrading the WWTF passed in 2022 and the City is working through the Clean Water State Revolving Fund process to upgrade the facility based on the final design.

Wallingford FD 1

The Wallington Fire District #1 owns and operates the Wallington Fire District #1 Wastewater Treatment Facility. The facility provides secondary treatment consisting of extended aeration in an oxidation canal. Chlorination is provided for disinfection. No major upgrades have occurred at the WWTF in the past five years.

West Rutland

The Town of West Rutland owns and operates the West Rutland Wastewater Treatment Facility, a secondary treatment facility that utilizes sequential batch reactor (SBR) technology and UV light disinfection. The facility was upgraded and expanded in 2000 when the design flow increased from 0.325 to 0.450 MGD. The facility has completed a 20-year evaluation and is moving forward with the design of a refurbishment project.

PFAS Monitoring

As part of a statewide investigation of potential conveyors of PFAS, DEC is supporting a sampling program for wastewater treatment facilities. As part of implementing the DEC 2023 PFAS Road Map, $1.25 million dollars of American Rescue Plan Act funding has been dedicated for a two-phased project to (1) quantify PFAS in municipal wastewater discharges across the State and (2) focus resources on identifying and reducing or eliminating PFAS sources in select communities. DEC is partnered with Weston and Sampson to conduct quarterly influent and effluent sample collection at each of Vermont's 94 municipal WWTFs and analysis for PFAS utilizing current analytical methods. The first phase of the project started fall 2023 and is expected to take place over one year. Upon completion of phase 1, the information obtained will be used to select municipalities for additional PFAS investigation. The second phase will involve collaboration with DEC and municipal officials to plan and conduct targeted collection system sampling for PFAS analysis to identify sources and mass loading to municipal WWTFs.

Soil-Based Wastewater Disposal Systems (Septic Systems)

In Vermont's mostly rural landscape, the majority of wastewater is treated through soil-based wastewater disposal systems. If not installed appropriately, wastewater may reach groundwater or be discharged to surface waters without proper treatment.

Since 2007, the State of Vermont has had regulatory jurisdiction over the design, permitting, and installation of all new wastewater systems and potable water supplies including septic systems. All new wastewater systems and potable water supplies under 6,499 gallons per day must obtain a Wastewater System and Potable Water Supply Permit

Larger systems of 6,500 gallons per day and over are permitted through Vermont's Indirect Discharge Program, a NPDES permit. Indirect discharge systems are soil-based disposal systems, which also include primary treatment, and may include additional secondary or tertiary treatment levels depending on discharge requirements. Water quality related indirect discharges are monitored by testing water quality in nearby surface waters. Systems can be municipally or privately owned.

Financial and Technical Assistance

For residential systems under 6,440 gallons, state financial assistance is available to qualifying homeowners for system upgrades and until 2024 includes Vermont Healthy Homes grants provided by American Rescue Plan Act funding. Technical assistance and education are provided by Town Health Officers, including investigating citizen concerns about failed septic systems.

The WSMD Lakes and Ponds Management and Protection Program and the Drinking Water and Groundwater Protection Division support outreach to homeowners during neighborhood gatherings organized by partners. At these wastewater workshops, homeowners learn about the options for a well-functioning onsite wastewater system and good maintenance practices for wastewater systems on lakeshores. Lakes in the basin that would benefit from wastewater workshops are larger populated lakes like Lake Dunmore, Tinmouth Lake, Star Lake, and Fern Lake. Communities adjacent to *E. coli* impaired stream segments with possible septic sources or where residential development is dense and adjacent to waterways may also benefit from these workshops, and other interested river and lake communities are encouraged to participate. More information can be found at the Wastewater Workshop website.

Village Wastewater Solutions

Many historic villages do not have municipal treatment facilities. Closely spaced on-site septic systems adjacent to waterways can be the source of elevated levels of contamination. Failed or poorly functioning systems can contribute *E. coli*, phosphorus, or nitrogen to surface waters. Additionally, failed systems can cause cross-contamination of nearby drinking water wells. Momentum has been growing in rural villages to explore options to deal with concerns about pollution from septic systems and the need for economic growth in village centers that is limited by the lack of centralized shared wastewater systems.

DEC provides direct funding and technical assistance to small communities without existing municipal wastewater systems to help evaluate and plan for wastewater needs within designated village centers. It is anticipated there will be a steady demand by small communities for wastewater evaluations and planning in the coming years. Small lots and older on-site sewage systems, without municipal treatment infrastructure, re-development or the re-sale of property may require expensive upgrades. Another factor is the economic viability of small communities which cannot support commercial or residential growth due to the lack of wastewater treatment options. Alternative treatment systems are available to communities not wishing to build large waste treatment facilities, including several advanced technologies for small community scale systems that have been approved for use in Vermont.

Resources available for assisting municipalities include the Clean Water State Revolving Fund, as well as Village Water and Wastewater Initiative American Rescue Plan Act grant funding. Basin 3 towns included in the Clean Water State Revolving Fund Project Priority List are articulated in the FFY22/FFY23 DEC's "Intended Use Plan" as developed by the Water Investment Division.

Assistance in planning for on-site systems as well as connections to existing sewer is also available through the Vermont Engineering Planning Advance Program. The loan program is available to municipalities without existing municipal water or sewer systems for conducting a feasibility study for community-based drinking water and/or wastewater solutions. Consulting engineers assess the town's needs and goals offering treatment options.

To support towns with limited staff for supporting wastewater studies, Vermont has formed an interagency Village Wastewater Solutions Initiative. The program offers the following resources:

- Organizing Village Wastewater Solutions

- Wastewater Solutions for Vermont Communities

In the Otter Creek basin, the historic village centers and lake communities with their dense, septic-based development would benefit from alternative wastewater solutions.

D. Natural Resources

Forests, lakes, ponds, rivers, floodplains, and wetlands are all examples of natural systems that provide continuing benefits both socially and ecologically. Natural resource restoration and protection projects help to prevent and reduce nutrient and sediment pollution, improve flood resiliency by mitigating flood hazards, enhance habitat function, and support Vermont's outdoor recreational opportunities. These projects are also the most economical and have a long-term benefit with little to no maintenance requirements. Restoration and protection of natural systems offer a cost-effective, long-term means to mitigate water quality and the effects of climate change and enhance the ecosystem services - flood control, wildlife habitat, filtration of pollutants - these natural resources provide.

While Agency regulatory programs protect natural resources, the Agency's also works to support landowner interest in natural resource protection and restoration and depends on partners to provide some of this assistance.

Rivers

In response to historic intensive channel management, floodplain and riparian corridor encroachments, and land use changes, most Vermont rivers are actively adjusting their shape, size, and course as they seek to re-establish equilibrium. Human activities can prevent or disrupt equilibrium by changing flow inputs to the channel (e.g., deforestation, increasing impervious surfaces and runoff, or water withdrawals) or by changing the sediment regime (e.g., dams, dredging). Legacy and present-day impacts, such as development within riparian corridors, channel straightening, berming, damming, removal of riparian vegetation, and construction of undersized crossing structures, have contributed to stream instability state-wide. A key consequence of these activities is the loss of resilience, and the ecosystem services provided by rivers that fully achieve dynamic equilibrium. In the Otter Creek basin, loss of river equilibrium is the major contributor of TP loading to Lake Champlain (17.6% of the total load, see Chapter 3). Therefore, the plurality of the TMDL reduction goal for this basin (19.9%) is expected to be met through river regulatory reductions and voluntary projects.

Fluvial geomorphic equilibrium is the condition in which a persistent stream and floodplain morphology is created by the dynamic fluvial processes associated with the inputs of water, sediment, and woody debris from the watershed. The stream and floodplain morphology are derived within a consistent climate; and influenced by topographic and geologic boundary conditions. When achieved at a watershed scale, equilibrium conditions are associated with minimal erosion, watershed storage of organic material and nutrients, and aquatic and riparian habitat diversity.

Improving all forms of connectivity, upstream-to-downstream and river-to-floodplain, encourages river equilibrium. Dynamic equilibrium is essential for good water quality, healthy aquatic habitat, and flood resilience in the basin and will help to mitigate impacts of increased runoff and streamflow described in the Climate Change section. Tactical basin planning engages local, regional, and federal partners in the development of strategies needed to accelerate practices to move toward equilibrium and increase river connectivity to meet the state's clean water goals. River corridor plans, planting projects, strategic wood additions, aquatic organism passage restoration, and community efforts to regulate floodplain and river corridor development, are examples of some of the tools used to increase river connectivity.

The Functioning Floodplains Initiative Tool

Assessing stream and floodplain function supports the valuation of ecosystem services and the potential for natural resource restoration opportunities. Societal benefits such as safe swimming, fish and wildlife, public safety and property protection may be categorized under the general ecosystem services of water quality, ecological integrity, and flood resilience.

The Functioning Floodplains Initiative (FFI) tool was developed to provide practitioners, program managers, and policymakers with the maps and data to identify potential, wetlands, riparian areas, and floodplains restoration opportunities in the Lake Champlain basin. The FFI project team has developed a methodology for a project credit scoring system that rewards phosphorus load reducing practices, as derived from the TMDL baseload allocations. The stream network itself is estimated to be the second largest source of phosphorus baseload in the Otter Creek basin (17.6%), with required reductions of 20% during the TMDL lifetime. The FFI tool will result in a phosphorus crediting tracking system that quantifies the gains made towards river system equilibrium and resultant water quality improvement.

There are two types of river and floodplain load reduction credit types for river instability. They are:

- Stream stability reconnection credits for projects at reach and watershed scales.
- Storage attenuation credits for projects that reconnect floodplains and wetlands.

Stream stability and storage may be restored through projects, such as active in-stream restoration, the removal of constraints, the protection of the natural processes through easements, floodplain restoration to reduce channel incision, dam removals and other efforts that move the river and floodplain toward equilibrium conditions. A given restoration project may include one or more of these components. This connectivity-based framework for TP base load allocation and crediting is predicated on the understanding that restoring stream and floodplain connectivity will increase stream equilibrium and therefore reduce net TP loading to Lake Champlain.

Generally, repairing the most disconnected reaches will achieve the most phosphorus reduction. From a target-setting perspective, project implementers should target those reaches that will address the highest pollution reductions, are necessary in the area where they are located, and are feasible with the resources available.

The FFI tool is only one step in determining if a project is a priority project to pursue for implementation and crediting considerations. Other resources, such as River Corridor Plans, stream geomorphic assessment data, field evaluations, project location, and other information about the site and project alternatives will be needed to determine the full needs, priorities, and options for pursuing a given project. This crediting system will consider "stacked" practices (e.g., protection + riparian buffers). DEC will devise how this will be quantified and reported on in the tracking and accounting systems.

River Corridor Plans

A River Corridor Plan (RCP) is a synthesis of the physical data collected during Phase I and II Stream Geomorphic Assessments (SGAs) based on protocols and guidelines developed by the River Management Program. These plans identify causes of channel instability and make recommendations for restoration and protection projects. All SGAs and RCPs can be found at: Stream Geomorphic Assessment - Final Reports and those in the Otter Creek basin are shown in Table 19.

While overall water quality in the basin is satisfactory, degraded geomorphic condition of the basin's streams (Figure 9) may impact:

- wildlife and fish habitat (e.g., riparian buffer removal increases water temperature, reduces shading and habitat for insects that feed fish, and channel alteration destroys aquatic habitat);
- public safety (e.g., loss of floodplains that store floodwaters, accelerated streambank erosion which results in infrastructure damage, and channel straightening that increases flow velocity during rain events);
- water quality (e.g., higher phosphorus loading from bank soil erosion stormwater runoff from encroachment of impervious surfaces and agricultural land).

Rivers are in a constant balancing act between the energy they produce from the slope of the channel, and the volume and weight of the moving water and the energy they expend to carry the water, sediment, and debris produced in their watersheds downstream. A change in any one of these factors will trigger adjustments of the other variables until the river system comes back into equilibrium. These changes can be caused by natural events such as storms and by human activity such as channel manipulation. The impact of these changes may be seen immediately and for decades after the activity occurred.

The legacy from Tropical Storm Irene in 2011 and large flood events like those in 2023 and 2024 will be felt for years to come. While flooding impacts are unlikely to be fully mitigated, the goal of managing toward protecting and restoring the equilibrium condition of Vermont rivers is to lessen or avoid conflicts between human investments and river dynamics in a manner that is technically sound, and both economically and ecologically sustainable. In addition, it will help to mitigate impacts of increased runoff and streamflow from climate change.

Where funding, local support, and interest exists, priority projects and objectives identified in RCPs and SGAs should be pursued. The FFI tool provides a method for calculating whether proposed projects stand to restore one or more dimensions of river connectivity and what the phosphorus-reduction credit of such projects will be. Within the Act 76 framework, cost-efficient priority projects that have effective phosphorus reduction credits and selected by Basin Water Quality Councils could be implemented using Water Quality Restoration Formula Grant funding or other funding sources. This plan recommends partners work with the Planner, the Vermont Rivers Program, the Otter Creek Clean Water Service Provider, and possibly outside consultants to seek cost-efficient, P-reducing stream restoration projects within existing RCPs and SGAs and develop projects where landowners are supportive. Priority sub-watersheds include Cold River, Mill River, Moon Brook, Neshobe River, Lewis Creek, and Upper Otter Creek.

The SGAs or RCPs on some stream segments may be outdated and require updated field assessments because of substantial probability of geomorphic change (e.g., for plans developed before Tropical Storm Irene or the July 2023 flooding). However, limited resources require that SGA/RCPs are evaluated and prioritized with respect to their need for collecting current data.

Table 19. Stream Geomorphic Assessments and River Corridor Plans are available for many of the Otter Creek basin's major river segments and sub-watersheds.

River	SGA Phase 1 Completed	SGA Phase 2 Completed	RCP Completed	Other
Lemon Fair	Lemon Fair Phase 1 SGA (2006)			

River	SGA Phase 1 Completed	SGA Phase 2 Completed	RCP Completed	Other
Lewis Creek	Lewis Creek tributaries Draft Phase 1 SGA (2007)	Lewis Creek Phase 1 and 2 SGA Updates (2004)	Lewis Creek M14-M18 Corridor Plan (2008), Lewis Creek River Corridor Conservation and Management Plan (2010)	Pilot Project-SGA (2004)
Little Otter Creek	Little Otter Creek and Mud Creek Phase 1 SGA (2006)			
Lower Otter Creek	Lower Otter Creek Phase 1 (2006)			
Middlebury River	Middlebury Watershed Phase 1 SGA (2006)	Middlebury River Phase 1 and 2 SGA (2003)	Middlebury River Corridor Conservation Plan (2008)	
Mill River	Mill River Phase 1 SGA (2007)	Mill River Phase 2 SGA (2007)	Mill River Corridor Plan (2009)	
Neshobe River	Neshobe River Phase 1 SGA (2004)		Neshobe River Corridor Plan (2011)	
New Haven River	New Haven River Phase 1 SGA (2003), New Haven tributaries Phase 1 SGA (2008)	New Haven River Phase 2 SGA (2004), New Haven River Phase 2 Addendum (2008), New Haven tributaries Phase 2 SGA (2007)	New Haven River Corridor Plan Draft (2006)	
Otter Creek-Cold River		Cold River Phase 2 SGA (2008)	Cold River Corridor Plan (2014)	
Otter Creek - East Creek Trib		East Creek Watershed Phase 2 SGA (2007)		
Otter Creek - Moon Brook		Moon Brook Watershed Phase 1 and 2 SGA (2006)	Moon Brook Watershed Corridor Plan (2008)	
Otter Creek Tributaries	Otter Creek tributaries Phase 1 SGA (2007), Otter Creek Watershed tributaries Phase 1 SGA (2009)			

River	SGA Phase 1 Completed	SGA Phase 2 Completed	RCP Completed	Other
Upper Otter Creek	Upper Otter Creek Phase 1 (2005)	Upper Otter Creek Phase 2 (2006), Upper Otter Creek Phase 2 (2009)		

River Restoration and Conservation

Active river restoration can include, but not limited to, the reconnection of floodplains through berm removal, dam removals, woody buffer plantings, in-stream wood additions, head-cut stabilization, encroachment removal, and upgrading structure size. Since the 2019 plan, Otter Creek partners have restored and conserved 73 acres of river corridor through easements and restored 12 acres of floodplain.

Scientific research strongly supports the value of planting trees and shrubs along stream and lake shorelines for both water quality and wildlife habitat. Shoreline vegetation filters and cleans polluted runoff from uphill land uses, provides shoreland and shallow water habitat, stabilizes banks, and increases lake and river aesthetics. Since 2019, partners have planted 23 acres of forested buffer and are actively developing and implementing buffer projects. However, regional tree stock shortages as well as difficulties in funding and implementing invasive species management in the riparian zone can hamper buffer implementation. Organizations like the Lake Champlain Basin Program are supporting efforts to increase available tree inventory. As efforts to increase inventory ramp up, this plan recommends partners continue to evaluate and implement innovative buffer solutions in coordination with AAFM, DEC, FWD, US Fish and Wildlife Service, and other agencies active in this area. Appropriate methods are context-dependent but might include riparian agroforestry, hydroseeding, passive restoration, and invasive species mapping and on-site management techniques. The Franklin County Natural Resource Conservation District's Northwestern Vermont Riparian Planting Guide further details many of the Vermont-specific challenges and opportunities in riparian restoration.

In addition, ANR prioritizes river reaches that are identified as high priority sediment and nutrient storage areas for conservation. One option for protection, outside of land acquisition, is purchasing river corridor easements to avoid future encroachment and flood damage as well as to restrict channel management activities. River Corridor Easements protect rivers from channel management that can degrade the river and functions of a river corridor. This practice is now creditable for phosphorus reductions via the FFI tool which may accelerate its implementation, although near term limitations in capacity to implement them may require prioritization of easement projects. If capacity limitations on River Corridor Easement implementation constrains these efforts, this may be an area to invest in increasing capacity.

Since the last TBP, the Lake Champlain Basin Program and NEIWPCC have developed Stream Wise, a program that engages streamside property owners in the Lake Champlain basin to enhance and protect vegetated stream buffers. In addition to hosting online education materials, the Stream Wise programs offer free property assessments to provide recommendations on improving streamside management and to award private landowners that maintain wide riparian buffers of native plants. Such a social marketing campaign that helps and awards individual landowners is thought to be a more effective strategy to shifting streamside management behavioral change than education alone. There are currently no Stream Wise awards in the Otter Creek basin.

Process-based Restoration

Process-based restoration is defined by Beechie et al. (2010) as work that "aims to reestablish normative rates and magnitudes of physical, chemical, and biological processes that create and sustain river and floodplain ecosystems (e.g., rates of erosion and deposition, channel migration, growth and succession of riparian vegetation)." One area that process-based restoration has been focused on restoring is the incorporation of wood back into river systems through different formats to help generate those processes that help move a stream toward equilibrium. Large woody material is a critical component of rivers. It improves fish habitat, stream stability, floodplain connection, nutrient processing, and sediment storage, but it is generally lacking in most Vermont streams due to past and present river management practices to accommodate land uses such as logging, agriculture, and urban and residential development.

Likewise, the long-term absence of beaver populations from many stream basins due to past overharvest has likely contributed to many streams becoming single-threaded, flashy, and incised. Strategic wood addition, beaver dam analog (BDA) construction, and post-assisted log structures (PALS) are examples of low tech process-based restoration techniques meant to initiate stream channel evolution toward a more complex, connected, resilient configuration where sited, designed, and implemented appropriately. Process-based restoration should move the stream toward becoming self-sustaining, such that over time additional work to maintain these or other created structures is not needed to achieve the goals of the project.

Process-based restoration has not yet been widely implemented in the Otter Creek basin. Currently, the Vermont Natural Resources Council (VNRC) and partners are working towards the removal of Wainwright Mill Dam (also known as Halnon Pond Dam) in Salisbury, Vermont, which may utilize BDAs and PALs or other woody installations to increase bed resistance is proposed within and near the active restoration area. These woody structures would temporarily set the channel profile and allow sediment trapping and migration, headcutting, and floodplain adjustment to occur over time, like the cycle beaver dams naturally follow. There is a growing interest in process-based restoration work among partners as funding opportunities expand (e.g., Natural Resource Conservation Service, formula grants), regional partners share their expertise (e.g., Vermont Land Trust, The Nature Conservancy, and Trout Unlimited), and successful project examples become more common in

Vermont (e.g., strategic wood addition in brook trout streams of the Memphremagog basin, beaver dam on The Nature Conservancy's Hubbardton River Clayplain Preserve).

This plan does not prioritize process-based restoration at the sub-watershed scale, but when projects are proposed that improve both water quality and habitat and are supported by both FWD and the Rivers Program, funding should be prioritized. In the Otter Creek basin, viable projects could be identified by targeting initial field assessments on streams within conserved public and private lands that adhere to the general stream slope and width recommendations of the Rivers Program or [FWD](#) strategic wood policy. A further layer of prioritization focusing on B(1) fishing candidate streams could add wildlife co-benefits and potentially help leverage other funding sources for this work. For clean water funding consideration, partners should consult early with the Rivers Program and other trained partners to collect appropriate field data to assess whether a project has a high probability of providing water quality benefits.

The DEC Rivers Program and partners will be supporting additional training and workshops to grow the knowledge base required to increase implementation. As partner capacity and expertise grows and project opportunities on conserved lands are exhausted, piloting identification and development work on private lands may be appropriate.

Aquatic Organism Passage

Since the 2019 Otter Creek Basin plan, state and federal funding has supported the improvement of 687 crossings in the basin, reconnecting 13 stream miles for fish habitat use and flow and sediment transport.

Bridges and culverts convey the flow of water under transportation corridors. Transportation corridors include state, local, and private roads, large interstates, logging roads, private driveways, and railroads. Most of this infrastructure was built before engineers and scientists fully understood the balance required for managing sediment and flow to protect stream channels (and adjacent developed lands). The correct sizing and placement of bridges and culverts plays a significant role in protecting water quality in the basin. Correctly sized and installed structures prevent erosion and scouring upstream and downstream, allow for the passage of fish and wildlife, and reduce impacts from flooding. Replacing structures with ones that meet the current geomorphic and connectivity standards allows fish and other aquatic organisms to move among complementary foraging, spawning, thermal refuge, and overwintering habitats. Without access to essential habitat, fish diversity and abundance decline.

In Spring 2024, the US Fish and Wildlife Service organized several partners in the Otter Creek basin (Trout Unlimited, RNRCD, FWD, WUV, LCBP) to identify and map priority projects including culverts for retrofit or replacement to restore aquatic organism passage and improve crossing compatibility with its geomorphic setting. Finding these mutually beneficial projects can be an important strategy given the relatively large expense of crossing projects and cost share opportunities with fish and wildlife-focused or transportation-focused funding programs

Dams and Dam Safety

There are records of 106 dams of different types, sizes, and condition in the basin (Appendix A). While some dams are used to generate energy and support recreational opportunities such as boating, fishing, and swimming, all dams also impede a river's ability to transport flow and sediment; cause streambank erosion and flooding problems; degrade and alter fisheries habitat; create barriers to fish and other aquatic organisms' movement and migration; alter downstream water temperature; degrade water quality; and impede river-based recreational activity.

Of the 106 inventoried dams, 90 are in-service, 2 are fully breached, 2 are partially breached, 6 have been removed, and the status of 2 is unknown. The 92 active in-service and partially breached dams may constrict the stream channel enough to reduce sediment transport, prevent lateral movement, and inhibit aquatic organism passage if mitigating actions have not been taken (e.g., fish ladder).

The Vermont Dam Safety Rules are in place to protect public safety and provide for the public good through the inventory, inspection, and evaluation of dams in the State. The Dam Safety Program administers the rules which apply to all non-power dams (dams that do not relate to the generation of electricity energy for public use) and all non-federal dams (dams that are not owned by the US or are subject to Federal Energy Regulatory Commission license or exemption). The rules set requirements and standards on dam registration, classification, inspection, application, and approval to construct, reconstruct, alter, repair, breach, or remove a dam, as well as related standards including design standards, operation and maintenance standards, inspection standards, and Emergency Action Plans.

All dams, even small dams for backyard ponds, are significant structures that can have major public safety and environmental implications. Fifteen inventoried dams are considered high or significant hazards (Appendix A), indicating that either direct loss of life is probable from an incident, uncontrolled release, or dam failure (high hazard) or that major property losses, disruption of critical services, and environmental losses are probable (significant hazard). The WSMD Dam Safety Program has reached out to dam owners of the high hazard dams with results.

Dam removals are pursued by private and public dam owners, often with the help from watershed groups and partners. The Vermont Dam Task Force is an interdisciplinary team of natural resource professionals that collaborate to share and investigate current dam removal protocols, watershed science, funding, and dam removal opportunities. The group meets bi-monthly to collaborate on projects. In addition, The Nature Conservancy in VT provides useful resources to inform dam removals such as the Vermont Dam Screening Tool for the Lake Champlain basin and the "Scaling Up Dam Removal Guide."

Dam removal is a priority basin-wide where the removal will result in restoration of stream equilibrium and habitat, fish passage, and sediment reduction. Opportunities for dam removal and restoration may exist at other sites upon further discussion with dam owners as the risk to public safety and ownership liability associated with aging and deteriorating dams becomes more evident. Dam owners are encouraged to contact the Vermont Dam Safety Program and their Watershed Planner if they are interested in discussing dam removal.

FEMA Mapping

The Federal Emergency Management Agency (FEMA) is currently updating the Flood Insurance Rate Maps in Vermont for the National Flood Insurance Program. This will be the first map update for many towns since the 1970s or 1980s. This new update will cover the entire state in stages and may become effective in some counties as soon as 2025 as part of FEMA's Risk Mapping, Assessment, and Planning program. During the meetings, stakeholders, including FEMA, state, and community officials, discussed areas of flooding concern and project goals, milestones, and products.

Most high-risk flood hazard areas in the basin will be mapped as Zone A, using a new Baseline Engineering strategy that combines computer modeling and high-resolution ground data (Lidar). Other areas with existing detailed flood studies will be labeled as Zone AE, with the older studies aligned with current topography. The new Flood Insurance Rate Maps will include aerial photographs that show houses and roads.

Flood Insurance Rate Maps are the basis of floodplain regulations and the National Flood Insurance Program. When the new maps go into effect, FEMA requires that town bylaws meet current standards for participation in the National Flood Insurance Program. To support towns in the timely adoption of updated bylaws, DEC provides a model bylaw that meets or exceeds the National Flood Insurance Program requirements, addresses river corridors consistent with Act 250 review, and ensures municipal eligibility for the maximum amount from the Emergency Relief and Assistance Fund. For ease of adoption in the limited time that will be available to the towns, it was designed for use as either a stand-alone bylaw or an appendix to a zoning bylaw.

The regional planning commissions, with financial and technical support coordinated by the DEC regional floodplain managers, are facilitating the planning commissions and selectboard's bylaw adoption. This process also benefits from the participation of other partners in the support of meaningful community engagement in consideration of public safety, equity, and the multiple benefits of functioning river corridors and floodplains. The DEC Rivers Program details the FEMA mapping process in Vermont online. Although DEC supports a town's adoption of enhanced river floodplain protection, the current update to a town's bylaw is a time-sensitive priority. As such this TBP recommends targeted outreach to communities to adopt model flood hazard bylaws as part of the map update process.

In 2024, the Addison County Regional Planning Commission and Rutland Regional Planning Commission completed a review of the municipal protections of their member municipalities (Appendix B). With funding support from ANR, planning commissions will target municipalities needing updates for outreach and technical assistance.

Fish Communities and their Habitat

Barriers, thermal modification, lack of naturally vegetated riparian areas and woody instream habitat threaten fish populations statewide and within the Otter Creek basin. FWD's state-level population and habitat management objectives strategies are available in the 2018 VT Management Plan for Brook, Brown, and Rainbow Trout. Dams along the Otter Creek River and its tributaries are partly responsible for thermal modification, and most are complete barriers to upstream fish movement. Some improvements in operational impacts from hydroelectric facilities are obtained through involvement in the federal relicensing process or for dams not federally licensed through Vermont's Public Utility Commission. Other dams that no longer function as intended in addition to road crossings that block fish movement are being slowly removed through various local partnerships.

Instream fish habitat was severely impacted in some areas following the removal of woody habitat and alteration of stream channels after Tropical Storm Irene. Within the Otter Creek basin, it was estimated that major impact to instream habitat occurred along roughly 31,885 feet of stream following Tropical Storm Irene (Kirn 2012). It is too early to estimate the impacts of July 2023 flooding. Projects to restore fish habitat and protect water quality are currently ongoing and have occurred though various local, State, and federal partnerships. Many of these efforts, including culvert upgrades, dam removal, in-stream habitat improvement, and riparian protection and restoration, are described in previous sub-sections.

Lakes

A lake's water quality is determined by its characteristics (e.g., depth, retention time) and by human activities and the land uses within its watershed. The loss of native vegetation at the shoreline, the locations of roads, the development pressures along the shoreline and into the watershed, and activities such as agriculture and forestry contribute to overall lake and pond health.

Preventing and mitigating water quality degradation, preserving and enhancing lake habitat and shoreline stability, and ensuring recreational uses of lakes and ponds are priorities for the basin. The recommendations below are based on the VT Inland Lakes Scorecard status of lakes and ponds, and feedback from the Lakes and Ponds Management Program and basin stakeholders.

Protecting and Improving Lakeshore Condition

Shoreland disturbance contributes to degraded lake water quality and lakeshore habitat. The Shoreland Protection Act (Chapter 49A of Title 10, §1441 et seq.) regulates shoreland development within 250 feet of a lake's mean water level for all lakes greater than 10 acres in size. The intent of the Act is to prevent degradation of water quality in lakes, preserve habitat and natural stability of shorelines, and maintain the economic benefits of lakes and their shorelands. The Act seeks to balance good shoreland management and shoreland development.

In 2022, the Vermont Lakes and Ponds Program released new guidance to help property owners protect and restore lakeshore properties. The Shoreland Best Management Practices guidance is comprised of multiple Best Management Practice documents. Each document highlights different shoreland management activities to improve water quality and the health of lakeshore habitat. Examples of activities include planting native trees and shrubs, installing rain gardens to absorb runoff, improving driveways and pathways, and creating no-mow zones. Small practices can be implemented by landowners directly, but larger projects may require support from local partners and additional clean water funding.

The Lake Wise Program encourages lakeshore owners to implement best management practices that improve and protect lake water quality conditions and habitat. The program awards lake-friendly shoreland properties including state parks, town beaches, private homes, and businesses. Lake Wise assessments review shoreland practices for their benefit to water quality and wildlife habitat and suggest actions if improvements are needed. Lakes with a Fair or Poor shoreland score will benefit from implementing Lake Wise Program best management practices.

Two lakes in the basin greater than ten acres have a poor shoreland habitat condition rating from the VT Lake Scorecard (Chipman Lake and Richville Pond), and 16 are rated fair. Chipman Lake is identified as a priority for Lake Wise assessments because of the shoreland condition and number of lakeshore residents. If other communities in fair-rated shorelands are interested in pursuing Lake Wise, they can contact the Lake Wise Program. Watershed partners are currently working with some of these lake communities and outreach will be planned for the additional lakes in the next five years.

In addition to in-land lakes, the Lakes and Ponds Program piloted a 2023 project to complete Lake Wise assessments at State Parks and public access areas around Lake Champlain. Areas assessed for potential projects in this basin include Kingsland Bay State Park, Chimney Point Fish and Wildlife access area and boat ramp, Button Bay State Park, D.A.R. State Park, and Ferrisburgh Town Beach. The Lakes and Ponds Program, WPP, FPR, and town staff are coordinating implementation of projects at these sites over the next five years.

Lake users interested in becoming involved in the health of their favorite lake or pond can find information on the VDEC Lakes and Ponds website as a first step to moving toward a healthier lake or pond.

Lake Watershed Action Plans

Lake Watershed Action Plans (LWAPs) are assessments to identify pollution sources in the lake watershed that result in water quality and habitat degradation. Vermont DEC Lakes and Ponds program uses the following metrics to determine priority lakes for Lake Watershed Action Plans: Increasing Phosphorus Trends, Disturbed Shoreline/Watershed, engaged Lake Association or another watershed group. Sources of data for these metrics include data from the VT Lake Scorecard, NGLA's, Lake Wise and AIS program Engagement. The LWAPs result in a prioritized list of projects and strategies to address the sources of pollution and habitat degradation identified in the assessment. The plan may also contain recommendations to preserve natural features and functions, encourage use of low impact green stormwater infrastructure, and maintain the aesthetic and recreational uses of lakes. To date, Lake Dunmore and Fern Lake are the only lakes in the basin that have completed LWAPs or have received funding to develop an LWAP.

Chipman Lake is a possible LWAP candidate in the basin because it has a poor shoreland habitat condition rating and a significant number of lakeshore residents. However, the lake does not have an active lake association, despite a significant number of shoreline residents. Ongoing partner outreach from the Vermont Lakes and Ponds Program and the Rutland Regional Planning Commission is helping to determine local community support for assessment and lake and watershed restoration to slow increasing nutrient trends.

Cyanobacteria

Cyanobacteria, also known as blue-green algae, are naturally found in fresh water in the U.S., and in Lake Champlain and other Vermont waters. Cyanobacteria grow well in water that has high amounts of nutrients like phosphorous and nitrogen. Cyanobacteria can multiply quickly to form surface scum and dense populations known as blooms, especially during the warm days of late summer and early fall. Some types of cyanobacteria can release natural toxins or poisons (called cyanotoxins) into the water, especially when they die and break down.

Since 2003, the Lake Champlain Committee has trained citizen volunteers to monitor for cyanobacteria at lakeshore locations. Volunteer monitors, along with staff from the Vermont Department of Health and LPMPP, file weekly online reports that are then displayed on the Cyanobacteria Tracker Map. The program helps citizens, and health, environmental, and recreational officials, assess the safety of our beaches. It also provides important data to better understand when and why blooms occur. As of 2022, 5 Otter Creek basin lakes were evaluated at least once for cyanobacteria blooms (Lake Dunmore, Fern Lake, Emerald Lake, Spring Lake and Winona Lake).

Annual reports on long-term chemical and biological monitoring including cyanobacteria blooms are available on the LPMPP website.

Preventing Aquatic Invasive Species

Aquatic invasive species can affect water quality by degrading shoreline habitat, generating imbalance in lake food webs, and altering chemical and physical factors important to aquatic systems (e.g., hydrology, nutrient transport, and oxygen concentration). Of the 30 lakes and ponds assessed for AIS in the basin, 12 received poor scores for AIS. They are Beaver Pond (Proctor), Beaver Pond (Mendon), Cedar Lake (Monkton), Chipman Lake (Tinmouth), Lake Dunmore (Salisbury), Fern Lake (Leicester), Porter Lake (Ferrisburgh), Richville Pond (Shoreham), Rutland City (Rutland), Star Lake (Mount Holly), Vergennes Watershed (Bristol), and Winona Lake (Bristol). Eurasian Watermilfoil is the most common AIS in Basin 3 lakes. Active management including mechanical harvesting, DOSH, benthic barriers, and hand-pulling is ongoing at Cedar Lake, Lake Dunmore, Fern Lake, and Chipman Lake.

New AIS introductions occur mainly in waterbodies that have launch sites for motorboat watercraft, are near infested waters, and lack spread prevention programs. Incoming motorboats from AIS infested waters are a high risk for introducing AIS in and on motors, propellers, trailers, and boating equipment. Vermont Fish and Wildlife Department (FWD) manages seventeen lake access areas in the basin. The VT Public Access Greeter Program and the Vermont Invasive Patrollers, and the Vermont Invasive Patrollers for Animals, are spread prevention programs that incorporate AIS identification training, surveying and monitoring, watercraft inspection, and decontamination programs. VT Public Access Greeter Programs are supported by DEC's Aquatic Nuisance Control Grant-in-aid funding. Greeters interact with boaters at boat access areas, inspect watercraft, identify and remove any suspicious matter, and collect and report AIS data. Greeters also distribute educational material. Vermont Invasive Patrollers Program training is offered on an annual basis.

The Aquatic Nuisance Control Grant-in-aid Program and the Lake Champlain Basin Program provide financial assistance to municipalities and agencies of the state for aquatic invasive and nuisance species management programs. Lake Dunmore is the only lake in the basin with an active Greeter program. A map of active greeter and control efforts is available online.

In addition, the Lewis Creek Association is supported by the Lake Champlain Basin Program to implement AIS programs at Cedar Lake and Winona Lake. These efforts provide local information about AIS in these ponds and their boat launch stewards help minimize the spread of AIS to and from these ecologically important areas. Annually, these AIS education and outreach efforts lead to a better informed and educated public.

Wetlands

Wetlands cover about 11% of the basin and are important for safeguarding many of its high-quality surface waters. As recently as the 1950s, wetlands were seen as obstacles to development, agriculture, and transportation, and consequently, were systematically drained and altered. These losses and alterations diminish the important ecosystem services provided by wetlands such as sediment and nutrient attenuation, wildlife habitat, and flood water storage. Protecting the remaining wetland resources is an important strategy in the basin. Additionally, restoring degraded wetlands is essential to improving water quality. Wetland conservation and restoration and identifying sites with the greatest potential for improving water quality are priority recommendations.

Wetland Assessment and Protection

The Wetlands Program regulates wetlands in accordance with the Wetlands Rules which are focused on protecting wetland functions and values. The Program also monitors and assesses wetland conditions. The Program relies on wetland mapping to help preliminarily identify the locations of regulated wetlands (Class II and Class I). Enhanced wetland mapping is being developed by the Program and will eventually cover the entire state. Current maps can be found at Wetland Inventory Map.

Enhanced protection, in the form of a Class I wetland determination, can be afforded to wetlands determined to be exceptional or irreplaceable in their contribution to Vermont's natural heritage, based on their functions and values. One wetland, the Otter Creek wetland complex, has been identified as a Class I candidate. At approximately 15,000 acres, the wetland complex is the largest in the state and occupies a valley along the Otter Creek River providing water storage and water quality functions that are critical in relation to its landscape position. The complex provides an irreplaceable function for storm and flood water storage as evidenced during and after Tropical Strom Irene (2011) and the 2023 flooding.

The 2019 plan recommended evaluating community interest in reclassification for the complex. Wetlands Program staff and Watershed Planning staff supported a series of informal meetings among various stakeholders, but no action was taken to advance a petition for the entire complex at that time. If a smaller portion of the complex was supported by towns, they are encouraged to reach out to their watershed planner and wetlands program staff for technical support to research and submit Class I wetland designation petitions for review, including for additional wetlands not mentioned here which may qualify.

Wetland Restoration

Wetland restoration is the process of returning a degraded wetland to an approximation of its pre-disturbance condition. The United States lost over half of its wetlands through ditching and filling between 1780 and 1980, and Vermont has lost as much as 35 percent. While conservation and protection of wetlands are critical for preventing continued loss of remaining intact wetlands, wetland restoration is essential for rehabilitating those that have historically been degraded or lost. Clean water goals for wetland restoration include assessing areas of degraded and prior converted wetlands and areas of hydric soils for restoration potential and implementing restoration as sites and opportunities are identified. This plan recommends that wetland restoration and conservation be explored where water pollution reduction and flood protection is evident.

Recommendations for wetland restoration can be found in Stream Geomorphic Assessments and River Corridor Plans (Table 19) and the Vermont Regional Conservation Project Partnership (RCPP) Wetlands Project Outreach and Development map created by Arrowwood Environmental. The RCPP prioritization model highlights many wetlands in the Otter Creek sub-basin with a high proportion of agricultural land near surface waters draining clay soils (i.e., in soil hydrologic groups C and D, which are characteristic of these sub-basins). These sites would be appropriate targets for initial wetland restoration efforts. Field surveys are critical for ensuring accuracy as some wetlands may have been missed or misidentified.

Wetlands can also be protected through easements or other conservation programs that restrict certain uses within the eased area. Such conservation programs include the Farm Service Agency's Conservation Reserve Program, Natural Resource Conservation Service's Wetland Reserve Easement program, a 2020-2025 RCPP opportunity administered by the Clean Water Initiative Program that targets smaller privately owned wetlands (10-50 acres), and Vermont's River Corridor Easement program. For the latter, VT Wetlands and Rivers Programs are developing template language so that river corridor easement footprints can be readily expanded to protect wetlands adjacent to the river corridor.

Wetland restoration and protection has the potential to reduce downstream phosphorus loading but there are no simple ways to estimate the magnitude of phosphorus reductions. One need for this basin is to develop phosphorus reduction estimates for wetland restoration projects. Currently, process-based restoration projects lump in-stream improvements with floodplain wetland enhancement to estimate TP reduction credits using the Interim P Calculator Tool. This approach needs to be further explored to devise more accurate estimates of stream versus wetland-based P reduction capacities using the Functioning Floodplain Initiative Tool and empirical data.

Watershed partners have worked on wetlands restoration projects opportunistically in the basin. Better accounting for phosphorus crediting as described above might be one way to accelerate wetlands restoration if the practice's P reduction efficiency appears competitive for formula grant funding through Act 76. The Clean Water Initiative Program's current RCPP wetland easement program allows for limited restoration (e.g., tree planting) on smaller 10 – 50-acre wetlands, while Wetland Reserve Easements allow more intensive active restoration efforts. In small headwater and lowland streams, increasing partner interest in process-based restoration techniques like beaver dam analogues and stage zero floodplain restoration are also likely to enhance wetland restoration in the basin.

Forests

Forest lands cover approximately 59% of the basin. As the dominant land cover, forests are important for safeguarding many high-quality surface waters. Yet, 17% of phosphorus runoff is shown to originate from forestlands. Reducing runoff and erosion from forests is important to meeting the state's clean water goals. Forest management activities offer benefits such as maintaining healthy forest communities, improving wildlife habitat, addressing non-native invasive species, contributing to the working landscape economy, and remediating poor legacy road infrastructure. Improving management and oversight of harvesting activities by following the Acceptable Management Practices (AMPs) and providing educational outreach and technical assistance to forest landowners and land managers are basin priorities. Providing funding to implement improvement practices will grow the practice of good stewardship and water quality protection.

Mapping Critical Source Areas & Identifying Legacy Erosion

As an outcome of the Clean Water Service Delivery Act (Act 76), ANR has contracted a consultant team to identify and map critical source areas of forestland erosion and establish a method to estimate the potential for phosphorus and sediment reductions associated with forestland BMPs and AMPs. This consultant will assist in identifying forestland phosphorus and sediment reduction potential using remote sensing, a GIS-based (LiDAR) landscape analysis of erosion risk potential, and critical source area (CSA) mapping of forest roads, trails, and log landings. These features will be prioritized based on their erosion risk potential. An additional element of this work is to establish forestland BMP phosphorus and sediment accounting methods to estimate load reductions associated with forestland BMP and AMP implementation on lands in the Use Value Appraisal Program.

A second phase of this work will assess forestlands to identify and prioritize legacy erosion associated with the critical source areas and to ground truth and calibrate the analytical and prioritization tools. The ground truthing of the landscape analysis is intended to calibrate the prioritization framework of critical source areas, as well as to develop a prioritization framework to address legacy erosion in high priority basins (i.e., South Lake Champlain and Missisquoi Bay) to achieve target load allocations that will not meet reduction targets through Vermont AMP compliance alone. Vermont ANR anticipates this work will be completed by fall 2025 with training available on the use of the tool by spring 2025.

Forestry AMPs and Skidder Bridge Programs

Acceptable Management Practices for Logging Jobs are scientifically proven methods designed for loggers, foresters, and landowners to prevent soil, petroleum products, and excessive logging slash from entering the waters of the State and to minimize the risks to water quality.

Stream crossings can have a significant negative impact on water quality. These impacts can be minimized by making sure that stream crossing structures are properly sized and installed correctly before crossing streams with logging equipment.[4] The Department of Forests, Parks, and Recreation (FPR) and watershed partners provide portable temporary bridge rental opportunities for use during timber harvests. These "skidder" bridges reduce the occurrence of sedimentation, channeling, and degradation of aquatic habitat, allowing loggers to harvest timber in compliance with AMPs. When properly installed, used, and removed, Skidder bridges provide better protection from stream bank and stream bed disturbance than do culverts or poled fords. These reusable bridges are also economical, easy to install, and can be transported from job to job.

Specifications for building skidder bridges can be found at: Temporary Wooden Skidder Bridges. Information on the bridge rental program is found at: Temporary Bridge Rentals. These bridges should be utilized on logging projects basin-wide especially on steep slopes and areas with erodible soils adjacent to surface waters.

Additional guidance is available from FPR in the Vermont Voluntary Harvesting Guidelines to Protect Forest Health and Sustainability, and through support for local skidder bridge programs, and forest land conservation efforts. FPR is using Clean Water funding to re-launch skidder bridge construction and rental programs in 2023 with the assistance of conservation districts including the Rutland Natural Resource Conservation District.

Enhanced coordination between ANR and the US Department of Agriculture – Natural Resources Conservation Service such as the Regional Conservation Partnership Program (RCPP) has also brought additional technical and financial assistance statewide to forest landowners developing and implementing water quality improvement projects in Vermont, including buffer establishment, stream habitat and stream crossing improvement, forest trail and landings improvement, and forestry easements. After an initial grant of $16 million in 2015, this RCPP grant was extended for five years in 2020 with an additional $10 million in assistance to farmers and forest landowners.

[4] Acceptable Management Practices for Logging Jobs

Importantly, RCPP is a standalone program from the US Department of Agriculture – Environmental Quality Incentives Farm Bill program, allowing separate caps of $450,000 for each program per landowner.

Use Value Appraisal Program & AMPs

Vermont's Use Value Appraisal Program (UVA) enables eligible private landowners who practice long-term forestry or agriculture to have their land appraised for tax purposes based on the property's value for the production of forest or agricultural products rather than on its residential or commercial development value. Compliance with UVA requires that the AMPs be employed to the maximum practicable extent. If AMPs are not employed on the UVA parcel resulting in a discharge, it may affect parcel eligibility in UVA and be a water quality violation. While there is overlap between requirements of the AMPs and UVA, they should be viewed as distinct from each other. In addition, Act 146 creates a new enrollment subcategory in the Managed Forestland category called 'Reserve Forestland,' with enrollments in the subcategory beginning July 1, 2023. This change to UVA accelerates the development of old forest conditions, and it does so in a way that preserves working lands as the primary focus of the Managed Forestland category of the UVA program. More information is available on the UVA Reserve Forestland website. County Foresters are available for consultation when questions arise about UVA, AMPs, and other practices to protect water quality.

About 29% of the basin is enrolled in the UVA program (Figure 3). Another 26% of the basin is protected via federal, state, municipal, or non-profit ownership and management. Federal and state lands include portions of the Green Mountain National Forest and many other state parks, forests, and wilderness management areas.

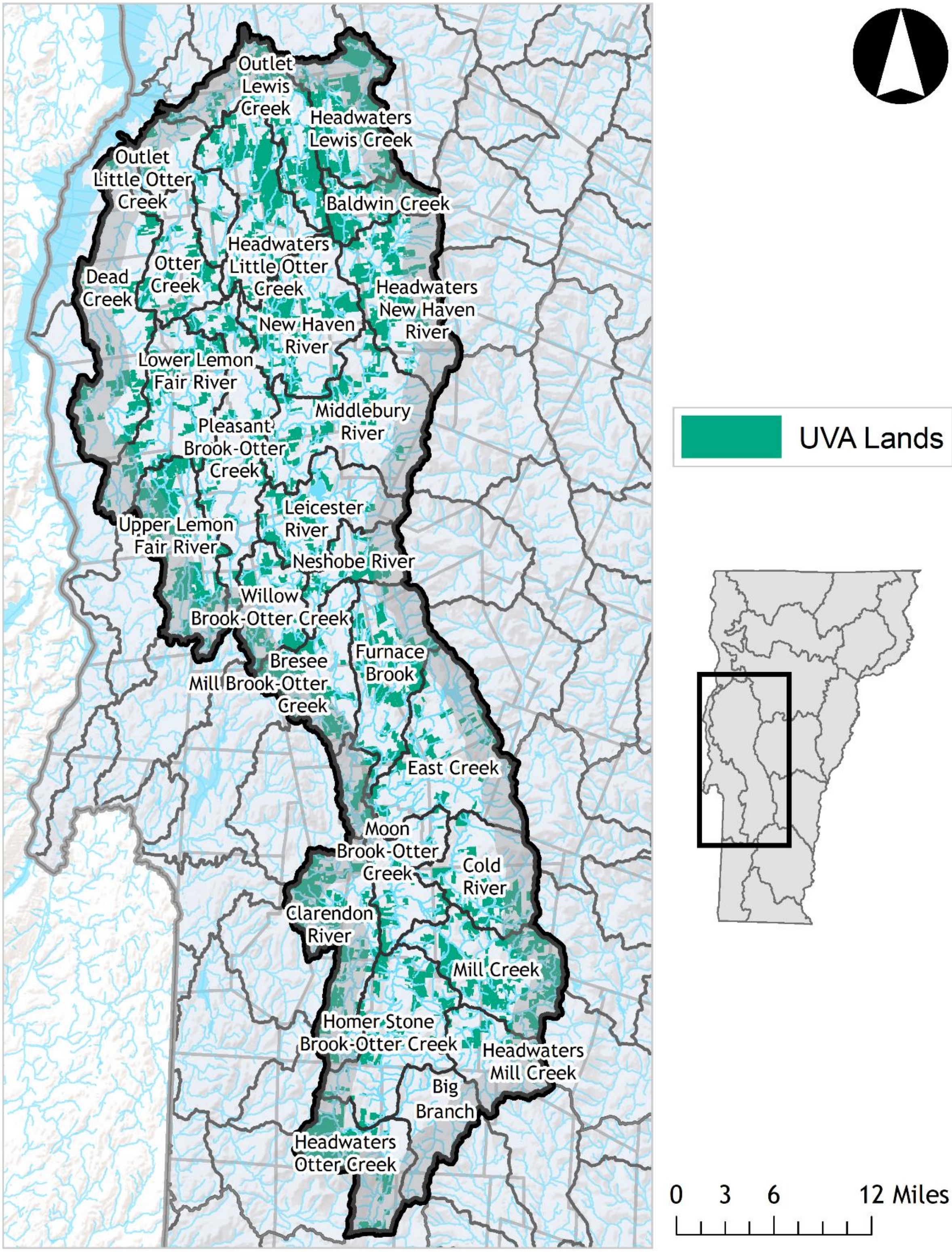


Figure 33. Otter Creek basin parcels enrolled in the Use Value Appraisal program.

Increased enrollment in the UVA program is encouraged wherever landowners express interest, and this plan particularly encourages increased enrollment in Source Protection Areas with substantial remaining UVA-eligible parcels. Major surface water source protection areas with unprotected lands are located within the following sub-watersheds: tributaries to the Little Otter Creek (abandoned Vergennes water source), a tributary to Beaver Meadow Brook (abandoned Bristol water source), Notch Brook (abandoned Middlebury water source), Leicester Hollow Brook (abandoned Brandon water source), tributary to Tenney Brook and Moon Brook (abandoned Gleason Road water system in Mendon), and Young's Brook (abandoned Village of West Rutland water source), whereas unprotected groundwater source protection areas are distributed across the basin. Additional voluntary forestland protections beyond UVA enrollment such as forest easements, deed restrictions, or long-term leases are encouraged in these surface water and groundwater source protection areas in accordance with their Source Protection Plans and via a variety of funding programs. More information is available on the UVA Reserve Forestland website. County Foresters are available for consultation when questions arise about UVA, AMPs, and other practices to protect water quality.

Forest Road Assessments and Management

The ANR is assessing and prioritizing erosion issues along hydrologically connected forest roads on ANR-owned lands. State Forest roads in the basin are primarily found in Kingsland Bay State Park, Button Bay State Park, Chimney Point State Park, DAR State Park, Branbury State Park, West Rutland State Forest, and Aitken State Forest. These inventories will identify potential road projects which can reduce sediment and phosphorus loading to surface waters in the basin.

The ANR Road Erosion Inventory Application (app) will become a resource for contractors and volunteers on other public and private lands in 2024. The downloadable app can be used to assess and prioritize road segments in the field. Landowners may use this app to prioritize forest land projects and for supporting funding requests. This plan recommends piloting these tools, in coordination with Rutland and Addison County Regional Planning Commissions and conservation commissions, on municipal forest lands in association with conservation commissions to encourage increased forest land project implementation and to evaluate the tools' use before engaging private landowners. ANR is also considering ways to identify potential phosphorus and sediment reduction projects on forest trails and to estimate phosphorus reduction potential for this project type.

Watershed Planning and Environmental Justice

Vermont's natural resources are held in trust for everyone and should be a source of inspiration and enjoyment for all. The Agency of Natural Resources is committed to ensuring that everyone living in and visiting Vermont has meaningful access and equal opportunity to participate in Agency programs, services, and activities and that everyone feels safe and welcome on Vermont's public lands. The Agency's Office of Civil Rights and Environmental Justice advances this mission.

ANR is committed to the work needed to engage our state's diverse population in shaping our shared work. As an Agency, we strive to be inclusive, both leading and supporting important work needed around diversity, equity, and inclusion – in our land management practices, in our environmental policies and permitting, and in ensuring our public processes are accessible, equitable and transparent.

Ensuring clean surface water for consumptive and recreational uses, ensuring fish caught in Vermont are safe for consumption, ensuring access to waters for all abilities and in all communities, providing open space availability in more densely populated areas and ensuring clean water projects are equitably implemented in all communities are areas where tactical basin planning can work toward equity and environmental justice.

Focus areas for the basin include:

- Clean surface water for consumptive and recreational uses;
- Safe consumption of fish caught in Vermont for subsistence anglers;
- Access to waters for recreation for all abilities and economic levels in all communities;
- Open space availability and access in more densely populated areas; and
- Equitable implementation of clean water projects in all communities, for example through explicit consideration of environmental justice in formula grant funding decisions.

Chapter 5 – The Otter Creek Basin Implementation Table

A. Progress in the Basin

The 2019 Otter Creek basin plan identified 56 strategies to address protection and restoration of surface waters. Of the 56 strategies identified, 25 are complete, 8 are in progress, 19 are ongoing, and 4 are awaiting action.

The TBP addresses all impaired and altered waters in the basin as well as protection needs for high quality waters. The list of strategies in the Implementation Table (Table 20) and the Monitoring and Assessment Table (Table 21) cover future assessment and monitoring needs, as well as projects that protect or restore waters and related education and outreach.

The process for identifying priority strategies is the result of a comprehensive review and compilation of internal ANR and external watershed partner monitoring and assessment data and reports. The monitoring and assessment reports include Stormwater Master Plans and stormwater mapping reports, Stream Geomorphic Assessments, River Corridor Plans, bridge and culvert assessments, Hazard Mitigation Plans, flood modeling, agricultural modeling and assessments, Road Erosion Inventories, biological and chemical monitoring, lake assessments, wetland assessments, fisheries assessments, and natural communities and biological diversity mapping.

The Water Investment Division's Clean Water Initiative Program funds, tracks, and reports on priority projects to restore Vermont's waters, and communicates progress toward meeting water quality restoration targets outlined in the TMDLs. The Clean Water Initiative Program also coordinates funding, tracking, and reporting of clean water efforts for state partners, including the Agencies of Agriculture, Food and Markets; Commerce and Community Development; Transportation, and other ANR Departments (FWD and FPR), and federal partners including the Natural Resources Conservation Service and the US Fish and Wildlife Service's Partners for Fish and Wildlife Program.

The Division's reporting on financial investments made and phosphorus loads addressed occurs annually. Progress toward the 56 strategies from the 2019 plan will be in the Appendix of the next Clean Water Initiative Performance Report. Progress made in addressing the strategies in the 2024 Otter Creek basin Implementation Table will be reported in the 2029 TBP and the Clean Water Initiative Program 2027 and 2029 Performance Reports.

B. Public Participation

Public input is key to the development of this Plan and the strategies included in the Implementation Table. Public participation is sought throughout the planning process with guidance from the Watershed Planning Program Communication Plan. The planning process for the Otter

Creek basin kicked off in the fall of 2023. With help from Basin 3 partner organizations, the Watershed Planning Program distributed information and requested input through presentations, email distribution lists, Front Porch Forms, and Instagram posts. Provided links to an on-line survey and story map helped to further engage the community, providing alternative educational formats about the basin and the planning process online story map.

The primary goals of the on-line survey and web map are to provide an opportunity for stakeholders to contribute information to the planning process and to educate the community. The survey was distributed through state and partner networks. Twenty-four respondents from 13 in-basin towns offered their input. Contact information was collected to allow respondents to remain engaged in the planning process.

Although not a representative sample of all stakeholders in the basin, public meeting input and survey results can help inform the topics, strategies, and projects addressed in this plan. Survey respondents' top-recommended solutions based on their perceived threats to surface water quality in the basin included agricultural BMP implementation, natural resource restoration (e.g., floodplain restoration and buffer establishment), and land protection and acquisition. Where specific waterbodies and pollutants were identified or interest in clean water project development was expressed, the planner will coordinate with state and watershed partners to further evaluate the concern or project opportunity.

C. Coordination of Watershed Partners

Partnerships are crucial in carrying out non-regulatory actions to improve water quality. There are several active organizations undertaking watershed monitoring, assessment, protection, restoration, and education and outreach projects in the basin in coordination with the ANR. These partners are non-profit, private, state, federal, or other organizations working on both private and public lands. The Addison County Regional Planning Commission, Addison County River Watch Collaborative, Lewis Creek Association, Otter Creek Natural Resource Conservation District, Rutland Regional Planning Commission, Rutland Natural Resource Conservation District, Vermont Natural Resources Council, Vermont Land Trust, The Nature Conservancy, United States Forest Service, Vermont River Conservancy, Vermont Fish and Wildlife, and municipalities are active in:

- providing outreach and education to local stakeholders, private landowners, and municipalities;
- developing stream and floodplain protection and restoration projects (e.g., river corridor easements, tree plantings, culvert and bridge upgrades, dam removals, stream channel habitat restoration);
- developing stormwater projects (e.g., Stormwater Master Plans, road erosion inventories, implementation of town road Best Management Practices);

- working with farms in the basin developing and implementing Best Management Practices for water quality; and
- monitoring water quality (e.g., lay monitoring program on lakes, *E. coli* and nutrient monitoring in rivers).

The work necessary to meet water quality goals in this basin requires collaboration among all these groups to maximize the effectiveness of the watershed partners and the funding investments. Without funding or partners, little of this work would be possible. The Agency is grateful for the active engagement and long-term commitment of so many partner organizations and interested citizens.

D. Implementation Table

The Implementation Table (IT) (Table 20) provides a list of 47 priority strategies created as the go-to implementation guide for watershed action. The IT provides specificity for where each strategy should focus by identifying priority sub-basins and towns. A list ofrelated individual project entries is found in the online Watershed Projects Database. Projects in the Database vary in level of priority based on the strategies outlined in the table. All projects in the Watershed Projects Database are not expected to be completed over the next five years, but each strategy listed is expected to be implemented and reported upon in future TBPs and subsequent phases of TMDL implementation plans and interim and final TBP report cards included in annual Clean Water Performance Reports.

In relation to the Lake Champlain Phosphorus TMDL, IT strategy progress will be measured against the five-year total TP reduction targets for each sector, outlined in Chapter 3. These reduction targets are addressed through both the regulatory programs described in Chapter 3 and the prospective reductions assigned to Clean Water Service Providers and guided by the IT strategies. The effectiveness of those strategies and related implementation efforts will be measured according to Total Phosphorus reductions estimated for each sector. Clean Water Initiative Program clean water project tracking and accounting will estimate the mass of pollutants reduced by implemented projects supporting IT strategies and track progress towards achieving the five-year target milestones. Progress achieved through outreach, technical assistance, and project funding will inform DEC's gap analysis related to each subsequent phase of TMDL implementation, each annual Clean Water Performance Report, and attendant interim and final TBP report cards.

As projects are developed, priority for Clean Water Initiative Program funding is given to those projects that achieve the highest water quality benefits. Projects that provide cumulative benefits (i.e., flood resiliency, water quality improvement, water resource protection, aquatic organism passage) receive additional consideration for prioritization. The Vermont ANR relies on collaboration with partners and stakeholders to help carry out the strategies identified in the basin plan and achieve implementation priorities.

Table 20. Implementation Strategies. Acronyms are listed on Page 154.

	Strategy	Priority Area or Watershed	Town(s)	Partner(s)	Funding
Strategies to address runoff from Agricultural Lands					
1	Support farmers in developing, updating, and implementing nutrient management plans.	Basin wide	All towns	AAFM, OCNRCD, NRCS, UVM Ext., RNRCD	NRCS, AAFM, RCPP, Pay for P, AGCWIP
2	Maintain cover cropping and other annual practices by supporting farmers' consecutive adoption of practices through education and outreach, and/or enrollment in applicable conservation programs.	Basin wide with focus on Lewis Creek, Little Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair	Middlebury, Panton, Ripton, Cornwall, Bristol, Starksboro, and Ferrisburgh	AAFM, NRCS, UVM Ext., OCNRCD, RNRCD	EQIP, CSP, AAFM, AGCWIP
3	Target technical assistance and increased funding to HUC 12 watersheds where field practice implementation has been lagging TMDL P reduction targets.	Lewis Creek, Little Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair	Middlebury, Panton, Ripton, Cornwall, Bristol, Starksboro, and Ferrisburgh	AAFM, OCNRCD, NRCS, UVM Ext., RNRCD	NRCS, AAFM, RCPP, Pay for P, AGCWIP
4	Assist farmers in accessing equipment through local rental programs, cost-shares, or cooperative applications to funding programs.	Basin wide	All towns	AAFM, OCNRCD, NRCS, UVM Ext., RNRCD	CEAP, VHCB, AGCWIP
5	Provide education, outreach, and technical assistance to farmers to implement and enhance field agronomic practices that improve soil health and reduce nutrient runoff.	Lewis Creek, Little Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair	Middlebury, Panton, Ripton, Cornwall, Bristol, Starksboro, and Ferrisburgh	AAFM, OCNRCD, NRCS, UVM Ext., RNRCD	AGCWIP, RCPP, TBPSG

	Strategy	Priority Area or Watershed	Town(s)	Partner(s)	Funding
6	Support collaborative efforts among partners to enhance service to the agricultural community, such as a farm team model that streamlines technical service provider interactions with individual farms.	Lewis Creek, Little Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair	Middlebury, Panton, Ripton, Cornwall, Bristol, Starksboro, and Ferrisburgh	AAFM, OCNRCD, NRCS, UVM Ext., RNRCD	AGCWIP, TBPSG
7	Convene meetings with partners to track progress on TBP agricultural strategies and identify emerging areas of concern.	Basin wide	All towns	AAFM, ACRWC, OCNRD, NRCS, UVM Ext., RNRCD	TBPSG, VAWQP
8	Support farm participation in environmental stewardship programs, such as the AAFM Pay for performance and NRCS Conservation Stewardship Program.	Lewis Creek, Little Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair	Middlebury, Panton, Ripton, Cornwall, Bristol, Starksboro, and Ferrisburgh	AAFM, OCNRCD, NRCS, UVM Ext., RNRCD	NRCS, AAFM, RCPP, Pay for P, USDA Conservation Stewardship Program
9	Identify and implement cost effective P reduction projects on non-RAP farms.	Lewis Creek, Little Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair	Middlebury, Panton, Ripton, Cornwall, Bristol, Starksboro, and Ferrisburgh	CVFC, VLT, ACRWC, AAFM, ACRPC, RRPC, OCNRCD	Formula
	Strategies to address runoff from Developed Lands - Stormwater				

	Strategy	Priority Area or Watershed	Town(s)	Partner(s)	Funding
10	Develop stormwater mapping reports, stormwater master plans (SWMPs), or illicit discharge and detection studies to identify priority stormwater projects.	Basin wide	Cornwall, Goshen, Leicester, Monkton, Mt. Tabor, Panton, Ripton, Salisbury, Sudbury, Tinmouth, Waltham, Weybridge, Whiting	DEC, ACRPC, RRPC, Municipalities, OCNRCD, RNRCD	CWI, Formula
11	Support partners in the prioritization, design, and implementation of stormwater projects.	Basin wide	Towns with existing stormwater master plans, phosphorus control plans, or other stormwater-related planning.	DEC, ACRPC, RRPC, Municipalities, OCNRCD, RNRCD, LCA	CWI, TBPSG, Formula
12	Provide outreach and technical assistance to landowners with 3-acre parcels.	Basin wide with emphasis on watersheds with high proportion of developed lands	Basin wide, especially Rutland City and Town, Middlebury, Brandon, Pittsford. See Table 16.	DEC, RRPC, ACRPC, RNRCD	LCBP, Green Schools Initiative, ARPA 3-acre funds

	Strategy	Priority Area or Watershed	Town(s)	Partner(s)	Funding
13	Promote existing campaigns to raise awareness of simple residential stormwater management solutions (e.g., Rethink Runoff, Storm Smart, Lawn to Lake).	Basin wide	All towns	DEC, ACRWC, OCNRCD, RNRCD, RRPC, ACRPC, LCA	LCBP, TBPSG
14	Educate towns, businesses, and contractors on winter maintenance strategies that reduce use of road salts.	Catchments of chloride-impaired waters and watersheds with high proportion of developed lands--Barnes Brook, Beaver Brook, Moon Brook, Mussey Brook, and Tenney Brook	Middlebury, Rutland City	ACRWC, ACRPC, RRPC, OCNRCD, RNRCD, UVM, VTrans	LCBP
15	Support partners in evaluating town salt and sand storage facilities to improve stormwater management on these sites.	Basin wide	All towns	ACRWC, ACRPC, RRPC, OCNRCD, RNRCD, Municipalities	SWMG, GIA
Strategies to address runoff from Developed Lands – Roads					
16	Assist municipalities in updating REI inventories and prioritizing and implementing roads projects to meet the Municipal Roads General Permit (MRGP).	Basin wide	All towns	ACRPC, RRPC, Municipalities	GIA
17	Complete private road REIs to identify, develop, and implement private road restoration projects.	Prioritized private road networks: lakes with nutrient impairments, degrading nutrient trends, or otherwise steep private road networks	All towns	ACRPC, RRPC, OCNRCD, RNRCD, Municipalities	Formula, LCBP, TBPSG
Strategies to address Wastewater					

	Strategy	Priority Area or Watershed	Town(s)	Partner(s)	Funding
18	Support municipalities pursuing WWTF phosphorus optimization, expansion projects, and upgrades to meet TMDL allotments, phosphorus optimization, and CSO requirements.	Basin wide		DEC, RRPC, Municipalities	CWSRF, USDA-Rural Development
19	Assist communities in addressing inadequate individual on-site wastewater treatment on small, challenging sites including community wastewater systems (e.g., ANR Village Wastewater Solutions) or innovative/alternative on-site systems.	Basin wide	All towns	DEC	ARPA, CWSRF, EPA Engineering Planning Advance, MPG, TBPSG, USDA Community Facilities Program, USDA-RD SEARCH Grant
20	Educate onsite septic owners about septic system maintenance and alternative systems through local outreach and education programs such as Wastewater Workshops.	Lake watersheds with increasing nutrient trends or highly developed shorelines; River communities where septic is a likely source of *E. coli* impairment or where residential development is otherwise dense		VLPMPP, ACRPC, RRPC, Municipalities, Lake Associations, Conservation Commissions	TBPSG
Strategies to support Natural Resource Protection and Restoration - Rivers					

	Strategy	Priority Area or Watershed	Town(s)	Partner(s)	Funding
21	Develop and implement priority protection and restoration projects identified in Stream Geomorphic Assessments (SGAs), River Corridor Plans (RCPs), or culvert inventories.	SGA/RCP-identified sites, specifically the Cold River, Mill River, Clarendon River, Moon Brook, Lewis Creek	Shrewsbury, Clarendon, Wallingford, Rutland City, Rutland Town, Starksboro	VRP, ACRPC, RRPC, OCNRCD, RNRCD, LCA, TNC, TU	Building Resilient Infrastructure and Communities Fund, DIBG, Flood Resilient Communities Fund, Formula, RCEBG, WBBG
22	Enhance riparian buffers (beyond RAPs) by establishing woody buffers.	SGA/RCP-identified sites	All towns	AAFM, ACRPC, OCNRCD, LCA, NRCS, USFWS, RNRCD	CREP, Formula, LCBP, RCEBG, WBBG
23	Support adoption of innovative approaches to enhance buffers by addressing tree stock shortages, invasive species concerns, or accelerate landowner interest in buffer adoption (e.g., agroforestry).	SGA/RCP-identified sites	All towns	ACRWC, RNRCD	LCBP, Watershed Grant, TBPSG
24	Develop and implement low tech, process-based restoration projects (e.g., strategic wood addition, beaver dam analogs, post-assisted log structures) to restore fluvial processes in small drainages.	Basin wide	All towns	VRP, FWD, DEC, AAFM, OCNRCD, ACRPC, RRPC, RNRCD, TNC, USFWS, TU	CREP, DIBG, EQIP, Formula grants, NFWF, USFWS
25	Develop and implement projects from a list of priority culverts with AOP and geomorphic compatibility benefits.	Basin wide	All towns	VRP, RRPC, ACRPC, USFWS, OCNRCD, RNRCD, TU	LCBP, NFWF, TBPSG, USFWS, FWD

	Strategy	Priority Area or Watershed	Town(s)	Partner(s)	Funding
26	Identify, develop, and implement high priority dam removal projects.	Basin wide	All towns	VRP, FWD, DEC, AAFM, ACRPC, RRPC, TNC, TU, VNRC, OCNRCD, RNRCD, USFWS	DRBG, Formula grants, RCPP, NFWF, USFWS
27	Identify and remove streamside berms to increase floodplain access.	Basin wide, Cold River	All towns, Clarendon	VRP, FWD, NRCDs, FWR, TNC	CWI, SWG, USFWS Partners for Fish and Wildlife
28	Educate towns about and assist them in adopting new FEMA flood maps using model river corridor bylaw or similarly protective language.	Basin wide	All towns, esp. those without adequate river corridor protections in place. See Municipal Protectiveness Table (Appendix B)	RRPC, ACRPC, LCPC, Rivers	FEMA, TBPSG
29	Coordinate with FWD to develop and implement a native fish signage campaign that highlights the biodiversity co-benefits of water quality improvement and fosters river stewardship interest from new stakeholders.	Upland B(1) Fisheries candidates (allopatric brook trout) and lowland streams with other SGCN species, as identified by FWD	Multiple	FWD, NFC	Watershed Grant, Other
30	Support outreach to towns on opportunities to petition reclassifying waters to B(1) or A(1).	Basin wide		DEC, RRPC, ACRPC	604(b)
Strategies to support Natural Resource Protection and Restoration - Lakes					

	Strategy	Priority Area or Watershed	Town(s)	Partner(s)	Funding
31	Use Lake Wise assessments, Lake Score Cards, Next Generation Lake Assessments, and AIS program Engagement to evaluate need for Lake Watershed Action Plans (LWAPs) or to rapidly identify restoration and protection needs in less complex lake watersheds.	Basin wide, including Chipman Lake	All towns	VLPMPP, OCNRCD, RNRCD, RRPC, ACRPC, Lake Associations	TBPSG, Formula Grant, PDBG
32	Support Lake Watershed Action Plans for priority lakes if there is sufficient community engagement.	Possibly Chipman Lake	Tinmouth	VLPMPP, OCNRCD, RNRCD, RRPC, ACRPC, Lake Associations	CWIP, Formula grant, LCBP,
33	Support Lake Wise assessments on priority lakes if there is sufficient community engagement.	Chipman Lake, Richville Pond	Tinmouth, Shoreham	VLPMPP, OCNRCD, RNRCD, RRPC, ACRPC, Lake Associations	Formula grants, PDBG, TBPSG
34	Develop, design, and implement priority projects identified through Lake Wise assessments, LWAPs, or Lakes Program recommendations.	Kingsland Bay State Park, Ferrisburgh Town Beach, D.A.R. State Park, Chimney Point Public Access Area, Button Bay State Park	Ferrisburgh, Addison, Vergennes	VLPMPP, OCNRCD, RNRCD, RRPC, ACRPC, Lake Associations	CWIP, Watershed Grant, DIBG, Formula grant
35	Coordinate aquatic invasive species spread prevention efforts through collaboration on local Public Access Greeter Programs, hosting VIP/A trainings, installing signage on public accesses, and conducting aquatic plants surveys.	Basin wide; coordinate with VT AIS Program	All towns	VLPMPP, OCNRCD, RNRCD, RRPC, ACRPC, Lake Associations	Aquatic Nuisance Control Grant, LCBP, TBPSG
36	Support Lake related trainings to enhance watershed partner contributions and participation.	Basin wide	All towns	VLPMPP, OCNRCD, RNRCD, RRPC, ACRPC, Lake Associations	LCBP, TBPSG

	Strategy	Priority Area or Watershed	Town(s)	Partner(s)	Funding
37	Support B(1) designation for qualifying lakes or additional monitoring to evaluate B(1) or A(1) eligibility elsewhere.	Current B(1) candidates		VLPMPP, OCNRCD, RNRCD, RRPC, ACRPC, Lake Associations	
Strategies to support Natural Resource Protection and Restoration - Wetlands					
38	Increase the identification, landowner outreach, development, and implementation of wetland protection and restoration projects, especially at smaller scales (10-50 acres).	SGA-, RCP-, or RCPP-identified sites	All towns	VWP, VCWIP, AAFM, LCA, VLT, ACRPC, RRPC	CWI, Formula grants, RCPP, ACEP-WRE
39	Support local efforts to reclassify Class I wetland candidates.	Any qualifying wetland, Otter Creek wetland	Multiple towns	VWP, Municipalities, RRPC, ACRPC	TBPSG
40	Support outreach to towns and the public – especially zoning administrators, prospective land purchasers, wastewater designers, and realtors – regarding updated wetlands mapping available in the Otter Creek basin	Basin wide	All towns	VWP, Municipalities, ACRPC, RRPC	DEC, TBPSG
41	Evaluate opportunities to incorporate adjacent wetlands into the footprints of existing and new river corridor easements.	Basin wide	All towns	VWP, VRP, Vermont Land Trust, Vermont Rivers Conservancy	TBPSG
Strategies to support Natural Resource Protection and Restoration - Forests					
42	Identify and prioritize of forest road segments with water quality impacts using the Forestland Erosion Assessment tool and subsequent forest REIs.	State and municipal lands with significant road and stream networks, especially in areas of high runoff potential	All towns	DEC, FPR, RRPC, ACRPC	CWI, LCBP, TBPSG

	Strategy	Priority Area or Watershed	Town(s)	Partner(s)	Funding
43	Identify and prioritize other erosional features like gullies using the Forestland Erosion Assessment tool when available.	State and municipal lands with significant stream networks, especially in areas of high runoff potential; as above.	All towns	DEC, FPR, RRPC, ACRPC	CWI, LCBP, TBPSG
44	Develop and implement AMPs and high priority forest road projects on state, municipal, and private lands.	High priority forest REI segments, Kingsland Bay State Park, Button Bay State Park, Chimney Point State Park, DAR State Park, Branbury State Park, West Rutland State Forest, and Aitken State Forest	All towns	DEC, FPR, RRPC, ACRPC, NRCS	CWI, EQIP, Formula, RCPP
45	Coordinate outreach and training on properly implementing the AMPs for practitioners, landowners, and technical service providers, including via local workshops and VAWQP presentations.	Basin wide	All towns	NRCS, UVM ext., VAWQP, FPR LEAP and Master Loggers Program	TBPSG
46	Encourage forest conservation and potential UVA enrollment wherever landowners express interest, and especially in Source Protection Areas	Surface- and groundwater Source Protection Areas with remaining unprotected lands	Multiple towns	CWIP, FPR, Vermont Land Trust	RCPP
47	Increase the use of skidder bridges through direct grants to foresters to purchase skidder bridges.	Basin wide	All towns	FPR, RNRCD	CWI

D. Monitoring and Assessment Table

The Monitoring and Assessment Table (Table 21) provides a preliminary list of water quality monitoring priorities to guide monitoring over the next five years. The ANR's Water Quality Monitoring Strategy describes the monitoring programs supported by ANR and its partners, who are listed in Chapter 2. Common goals for monitoring efforts across programs include identifying water quality conditions, tracking water quality trends, identifying pollution sources, and evaluating improvements over time. The table includes more sites than there is capacity to monitor and as such, will be further prioritized before monitoring occurs.

Table 21. Priorities For Monitoring and Assessment. Acronyms are listed on Page 154.

Waterbody	Project Description	Location	Partner(s)	Purpose
Lakes and Ponds				
Johnson Pond	Chemical monitoring, chlorophyll-a, Secchi, Next Generation Lake Assessment	Orwell	LPMPP; Lay Monitoring	High quality
Mud Pond	Chemical monitoring, chlorophyll-a, Secchi	Leicester	LPMPP; Lay Monitoring	High quality
High Pond	Chemical monitoring, chlorophyll-a, Secchi	Sudbury	LPMPP; Lay Monitoring	Sentinel site
Richville Pond	Biological monitoring	Shoreham	LPMPP; Lay Monitoring	AIS survey for EWM
Lake Dunmore	Chemical monitoring, chlorophyll-a, Secchi, Biological monitoring	Salisbury	LPMPP; Lay Monitoring	AIS survey for EWM and zebra mussels, P for nutrient trend
Fern Lake	Chemical monitoring, chlorophyll-a, Secchi, Biological monitoring	Leicester	LPMPP; Lay Monitoring	AIS survey for EWM and zebra mussels, P for nutrient trend

Waterbody	Project Description	Location	Partner(s)	Purpose
Porter Pond	Biological monitoring	Ferrisburgh	LPMPP; Lay Monitoring	AIS survey for EWM, CLP, and WC
Walker Pond	Chemical monitoring, chlorophyll-a, Secchi	Hubbardton	LPMPP	Organic enrichment and P
Cedar Lake	Biological monitoring	Monkton	LPMPP	AIS survey for EWM
Winona Pond	Chemical monitoring, chlorophyll-a, Secchi, Biological monitoring	Bristol	LPMPP	AIS survey for EWM, P for nutrient trend
Beaver Pond	Biological monitoring	Mendon	LPMPP	AIS survey for EWM
Identified Lakes and Ponds	Complete AIS survey and plankton net survey	Multiple	LPMPP	Generate AIS status of lakes and ponds with no data.
Rivers and Streams				
10 Kilns Brook	Biological monitoring	Mount Tabor	FWD	Explore as Class B(1) Fishing Use
Ira Brook	Biological monitoring	Ira	FWD	Explore as Class B(1) Fishing Use
Leicester Hollow Brook	Biological monitoring	Leicester	FWD	Explore as Class B(1) Fishing Use
Mill Brook	Biological monitoring	Danby	FWD	Explore as Class B(1) Fishing Use
Neshobe River	Biological monitoring	Brandon	FWD	Explore as Class B(1) Fishing Use
North Branch Cold River	Biological monitoring	Mendon	FWD	Explore as Class B(1) Fishing Use
Little Brook	Biological monitoring	Pittsford	FWD	Explore as Class B(1) Fishing Use
Roaring Brook	Biological monitoring	Wallingford	FWD	Explore as Class B(1) Fishing Use
Prindle Brook	Biological monitoring	Charlotte	BASS	Determine attainment of aquatic biota use.Fish community not meeting criteria, potential agricultural sources
Pond Brook	Biological monitoring	Starksboro	BASS	Determine attainment of aquatic biota use. Fish community barely meeting criteria, elevated biotic index, potential agricultural sources
Little Otter Creek (mid-section)	Biological monitoring	New Haven	BASS	Determine attainment of aquatic biota use. Agricultural land uses as sources of nutrient and sediment, lack of riparian buffer as contributing stressor
Mount Florona Brook	Biological monitoring	Monkton	BASS	Determine attainment of aquatic biota use.

Waterbody	Project Description	Location	Partner(s)	Purpose
				Macroinvertebrate community not fully meeting criteria, high TP
Mud Creek	Biological monitoring	Mud Creek	BASS	Determine attainment of aquatic biota use. Macroinvertebrate community not fully meeting criteria, high TP
Little Otter Creek Trib 15	Biological monitoring	New Haven	BASS	Determine attainment of aquatic biota use. Macroinvertebrate community not meeting criteria, potential agricultural sources
Lemon Fair River Trib 7	Biological monitoring	Bridport	BASS	Determine attainment of aquatic biota use. Macroinvertebrate community barely meeting criteria, potential agricultural sources
Halnon Brook	Biological monitoring	Salisbury	BASS	Determine attainment of aquatic biota use. Macroinvertebrate community barely meeting criteria, potential agricultural sources, and hatchery impacts
Lemon Fair River	Biological monitoring	Shoreham	BASS	Determine attainment of aquatic biota use. Macroinvertebrate community barely meeting criteria, potential agricultural sources
Arnold Brook	Biological monitoring	Brandon	BASS	Determine attainment of aquatic biota use. Macroinvertebrate community not fully meeting criteria
Otter Creek Trib 27	Biological monitoring	Brandon	BASS	Determine attainment of aquatic biota use. Macroinvertebrate community failing criteria potential agricultural sources
Airport Brook	Biological monitoring	Clarendon	BASS	Determine attainment of aquatic biota use. High biotic index, fish community failing criteria
Mill River	Biological monitoring	Shrewsbury	BASS	Determine attainment of aquatic biota use. Potential impacts from geomorphic instability
Wetlands				
Dragon Brook	Level III	Ripton	Wetlands Program	To revisit a site that was previously surveyed in 2011
Mt. Tabor Area	Level III	Mt. Tabor	Wetlands Program	another 'new fen' on the landscape, don't have a lot of data from this area
Rutland Audubon Easement	Level III	Rutland	Wetlands	this disturbed wetland with common reed is of

Waterbody	Project Description	Location	Partner(s)	Purpose
			Program	concern to the community for reasons including water quality interest

List of Acronyms

319	Federal Clean Water Act, Section 319
604(b)	Federal Clean Water Act, Section 604b
A(1)	Class A(1) Water Management
A(2)	Class A(2) Water Management
AAFM	Agency of Agriculture, Food and Markets
ACEP-WRE	Agricultural Conservation Easement Program – Wetland Reserve Easements
AGCWIP	Agricultural Clean Water Initiative Grant Program
AIS	Aquatic Invasive Species
AMP	Acceptable Management Practice
ANR	Agency of Natural Resources
ARPA	American Rescue Plan Act
B(1)	Class B(1) Water Management
B(2)	Class B(2) Water Management
BASS	Biomonitoring and Aquatic Studies Section, DEC Watershed Management Division
BMP	Best Management Practice
CCNRCD	Caledonia County Natural Resource Conservation District
CCRCP	Chittenden County Regional Planning Commission
CREP	Conservation Reserve Enhancement Program
CVRPC	Central Vermont Planning Commission
CWI	Clean Water Initiative
CWIP	Clean Water Initiative Program
CWSP	Clean Water Service Provider
CWSRF	Clean Water State Revolving Fund
DEC	Department of Environmental Conservation
DIBG	Design-Implementation Block Grant
EPA	US Environmental Protection Agency
EQIP	Environmental Quality Incentive Program
ERAF	Emergency Relief and Assistance Fund
FEMA	Federal Emergency Management Agency
FFI	Functioning Floodplain Initiative
FMR	Friends of the Mad River
FPR	Vermont Forests, Parks and Recreation
FWD	Vermont Fish & Wildlife Department
FWR	Friends of the Winooski River
GIA	Grants-in-Aid
LCBP	Lake Champlain Basin Program
LCCD	Lamoille County Conservation District
LCPC	Lamoille County Planning Commission
LPMPP	Lake and Ponds Management and Protection Program
LWAP	Lake Watershed Action Plan
MRGP	Municipal Roads General Permit
MS4	Municipal Separate Storm Sewer System
NFWF	National Fish and Wildlife Foundation
NGLA	Next Generation Lake Assessment
NPDES	National Pollutant Discharge Elimination System

NRCS	Natural Resources Conservation Service
ORW	Outstanding Resource Water
PDBG	Project Development Block Grant
PFW	Partners for Fish and Wildlife
RAP	Required Agricultural Practice
RCEBG	River Corridor Easement Block Grant
RCP	River Corridor Plan
RCPP	Regional Conservation Partnership Program
REI	Road Erosion Inventory
SFY	State Fiscal Year
SGA	Stream Geomorphic Assessment
SWG	State Wildlife Grant
SWMG	Stormwater Management Grant
SWMP	Stormwater Master Plan
SOP	Standard Operating Procedure
TBP	Tactical Basin Plan
TBPSG	Tactical Basin Planning Support Grant
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TP	Total Phosphorus
TS4	Transportation Separate Storm Sewer System Permit
TU	Trout Unlimited
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
UVA	Use Value Appraisal program, or Current Use Program
UVM Ext.	University of Vermont Extension
VAWQP	Vermont Agricultural Water Quality Partnership
VLT	Vermont Land Trust
VNRC	Vermont Natural Resources Council
VRAM	Vermont Rapid (Wetland) Assessment Method
VRC	Vermont River Conservancy
VSA	Vermont Statutes Annotated
VTrans	Vermont Agency of Transportation
VWQS	Vermont Water Quality Standards
WBBG	Woody Buffer Block Grant
WSMD	Vermont Watershed Management Division
WWTF	Wastewater Treatment Facility

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Appendix A. Dams in the Otter Creek Basin

Table A1. List of dams in the Otter Creek basin. These dams are either in service, partially breached, breached, or removed. Source: Vermont Dam Inventory (accessed: 04/12/2024).

Dams ID	Dam Name	Stream	Town	Dam Status	Purposes	Hazard Potential
1	Farrel	Addison	Dead Creek-TR	In Service	Fish and Wildlife Pond	Low
2	Woodcock Site 2	Addison	Dead Creek-TR	In Service	Fish and Wildlife Pond	Low
4	Woodcock Site 4	Addison	Dead Creek-TR	In Service	Fish and Wildlife Pond	Low
5	Woodcock Site 3	Addison	Dead Creek-TR	In Service	Fish and Wildlife Pond	Low
6	Jerome	Addison	Dead Creek-TR	In Service	Fish and Wildlife Pond	Low
7	Brilyea West	Addison	West Branch Dead Creek	In Service	Recreation; Fish and Wildlife Pond	Low
8	Brilyea East	Addison	East Branch Dead Creek	In Service	Recreation; Fish and Wildlife Pond	Low
9	Norton	Addison	West Branch Dead Creek-TR	In Service	Fish and Wildlife Pond	Low
10	Tetreault	Addison	East Branch Dead Creek-TR	In Service	Fish and Wildlife Pond	Low
11	Warner Site 2	Addison	Middle Branch Dead Creek	In Service	Fish and Wildlife Pond	Low
12	Warner Site 3	Addison	Middle Branch	In Service	Fish and Wildlife Pond	Low

Dams ID	Dam Name	Stream	Town	Dam Status	Purposes	Hazard Potential
			Dead Creek-TR			
13	Martin	Addison	West Branch Dead Creek-TR	In Service	Fish and Wildlife Pond	Low
14	Harte	Addison	West Branch Dead Creek-TR	In Service	Fish and Wildlife Pond	Low
15	Norton Shallow Dike	Addison	West Branch Dead Creek-TR	In Service	Fish and Wildlife Pond	Low
16	McCuens Slang	Addison	Whitney Creek	In Service	Fish and Wildlife Pond	Low
17	Woodcock Site 1	Addison	Dead Creek-TR	In Service	Fish and Wildlife Pond	Low
18	Farrell North	Addison	Dead Creek-TR	In Service	Fish and Wildlife Pond	Minimal
19	DuBois Manure Pit	Addison	Otter Creek-OS	In Service	Other	Low
142	Blair	Brandon	Arnold Brook-TR	In Service	Recreation	Minimal
143	Adams Brook	Brandon	Otter Creek-TR	In Service		Significant
144	Jones Mill	Brandon	Jones Brook	In Service	Recreation	Significant
145	Goodnew	Brandon	Smalley Swamp-TR	In Service		Low
146	Brandon (Upper)	Brandon	Neshobe River	In Service		Minimal
147	Brandon (Lower)	Brandon	Neshobe River	In Service		Minimal
159	Lake Winona	Bristol	Pond Brook	In Service		Low

Dams ID	Dam Name	Stream	Town	Dam Status	Purposes	Hazard Potential
160	Coffin	Bristol	Winona Lake-TR	In Service	Recreation	Low
256	Scott Pond	Charlotte	Lewis Creek	In Service	Recreation	Minimal
274	Chittenden Reservoir	Chittenden	East Creek	In Service	Hydroelectric	High
275	Lefferts Pond West	Chittenden	East Creek	In Service	Hydroelectric	Low
276	Lefferts Pond East	Chittenden	East Creek	In Service		Low
292	Cornwall-1	Cornwall	Cedar Swamp-TR	In Service		Minimal
293	Norinsberg	Cornwall	Beaver Brook	In Service	Irrigation	Low
294	Kirk	Cornwall	Beaver Creek-TR	In Service	Recreation	Low
295	Perry-Jackson	Cornwall	Ledge Creek	In Service	Fish and Wildlife Pond; Recreation	Significant
317	Emerald Lake	Dorset	Otter Creek	In Service		Low
382	Harris	Ferrisburgh	East Slang-TR	In Service	Recreation	Low
383	Robinsons Slang	Ferrisburgh	East Slang-TR	In Service	Recreation	Low
384	Turner	Ferrisburgh	Little Otter Creek	Breached		
385	Callery	Ferrisburgh	Little Otter Creek-TR	In Service	Recreation	Low
386	Danyow	Ferrisburgh	Otter Creek-TR	Breached		Minimal
387	Bergh	Ferrisburgh	Little Otter Creek-TR	In Service	Recreation	Low

Dams ID	Dam Name	Stream	Town	Dam Status	Purposes	Hazard Potential
388	Jackman	Ferrisburgh	East Slang	In Service	Fish and Wildlife Pond	Minimal
389	Goose Creek	Ferrisburgh	Goose Creek	In Service		Minimal
401	Sugar Hill Reservoir	Goshen	Sucker Brook	In Service	Hydroelectric	High
402	Stewart	Goshen	Dutton Brook-TR	In Service	Recreation	Low
403	Kingsland	Goshen	Neshobe River	In Service		Low
476	Walker Pond	Hubbardton	Bresee Mill Brook-TR	In Service	Recreation	Low
477	Mudd	Hubbardton	Bresee Mill Brook-TR	In Service	Recreation	Low
505	Silver Lake	Leicester	Sucker Brook-TR	In Service	Hydroelectric	High
510	Goeselt	Lincoln	New Haven River-TR	In Service		Low
511	Lincoln-2	Lincoln	New Haven River-OS	In Service		Minimal
512	Senk	Lincoln	New Haven River - TR	In Service		Minimal
588	Beaver Pond	Mendon	Mendon Brook	Removed	Recreation	
591	Mendon-4	Mendon	Eddy Brook-TR	In Service		Minimal
592	Ballantyne	Mendon	Tenney Brook-TR	In Service	Recreation	Low
593	Middlebury Upper	Middlebury	Otter Creek	In Service		Minimal
594	Middlebury Lower	Middlebury	Otter Creek	In Service	Hydroelectric	Low

Dams ID	Dam Name	Stream	Town	Dam Status	Purposes	Hazard Potential
595	Dow Pond	Middlebury	Muddy Branch	Removed	Other	Significant
596	Middlebury Reservoir	Middlebury	Muddy Branch-TR	In Service	Water Supply	Minimal
598	Wood	Middlebury	Muddy Branch-TR	In Service	Recreation	Minimal
599	Pominville	Middlebury	Muddy Branch-TR	In Service		Low
600	Middlebury Industrial Park	Middlebury	Otter Creek-TR	In Service	Fire Protection, Stock, or Small Farm Pond; Other	Significant
601	Buttolph	Middlebury	Otter Creek-OS	In Service		Minimal
616	Vermont Kaolin Corporation	Monkton	Pond Brook-TR	In Service		Low
642	Star Lake	Mount Holly	Mill River-TR	In Service	Recreation	High
670	Huntington Falls	New Haven	Otter Creek	In Service	Hydroelectric	Low
671	Beldens	New Haven	Otter Creek	In Service	Hydroelectric	Low
672	Brooksville	New Haven	New Haven River	Removed		
718	Orwell-4	Orwell	Lemon Fair River-TR			
720	Stone Bridge	Panton	Dead Creek	In Service	Recreation; Fish and Wildlife Pond	Low
743	Kendrick Pond	Pittsford	Sugar Hollow Brook	Removed	Recreation	

Dams ID	Dam Name	Stream	Town	Dam Status	Purposes	Hazard Potential
744	Smith Pond	Pittsford	Otter Creek-OS	In Service		Low
778	Beaver Pond	Proctor	Otter Creek-TR	In Service	Recreation	Low
779	Olympus Pool	Proctor	Otter Creek-TR	In Service	Water Supply; Other	Significant
780	Reynolds Reservoir	Proctor	Otter Creek-TR	In Service	Recreation; Other	Significant
781	Proctor	Proctor	Otter Creek	In Service	Hydroelectric	Low
806	Bread Loaf	Ripton	Brandy Brook	In Service	Water Supply	Minimal
834	Patch Pond	Rutland City	East Creek	In Service	Hydroelectric	Significant
835	Dunklee Pond	Rutland City	Tenney Brook	Removed		Significant
836	Combination Pond	Rutland City	Moon Brook	In Service	Recreation	Significant
837	Lower Eddy Pond	Rutland City	Mussey Brook	Breached	Recreation	
838	Ripley Mills	Rutland City	Otter Creek	In Service		Minimal
839	Piedmont Pond	Rutland City	Moon Brook	In Service	Recreation	Minimal
840	Rutland-1	Rutland Town	East Creek-TR			
841	Rutland-2	Rutland Town	East Creek-TR			
842	Glen	Rutland Town	East Creek	In Service	Hydroelectric	Low
843	Rutland City Reservoir	Rutland Town	East Creek-TR	In Service	Water Supply	High
844	Upper Eddy Pond	Rutland Town	Mussey Brook	In Service	Recreation	Significant
845	Rutland-6	Rutland Town	East Creek-TR	In Service	Water Supply	Minimal

Dams ID	Dam Name	Stream	Town	Dam Status	Purposes	Hazard Potential
846	Rutland-7	Rutland Town	East Creek-TR	In Service		Minimal
847	Rutland City Reservoir Dike	Rutland Town	East Creek-TR	In Service	Water Supply	Low
929	Richville Pond	Shoreham	Lemon Fair River	In Service	Recreation	Low
930	Pomainville	Shoreham	Perry Brook	Removed		
1078	Chase	Wallingford	Otter Creek-TR	In Service	Recreation	Minimal
1146	Youngs Brook	West Rutland	Youngs Brook	Breached (Partial)	Other	Significant
1264	Halnon Pond Dam	Salisbury	Middlebury River	Breached (Partial)	Other	
848	Center Rutland	Rutland Town	Otter Creek	In Service	Hydroelectric	Low
868	Lake Dunmore	Salisbury	Leicester River	In Service	Hydroelectric	Low
869	Sucker Brook	Salisbury	Sucker Brook	In Service	Hydroelectric	Significant
870	Salisbury	Salisbury	Leicester River	In Service		Low
929	Richville Pond	Shoreham	Lemon Fair River	In Service	Recreation	Low
932	Connolly Pond Dam	Shrewsbury	Mill River-TR	Removed	Recreation	Significant
1038	Chipman Lake	Tinmouth	Tinmouth Channel-TR	In Service		Low
1063	Vergennes No. 9	Vergennes	Otter Creek	In Service	Hydroelectric	Low
1079	Quinn Lower	Wallingford	Homer Stone Brook	In Service		Low
1154	Weybridge	Weybridge	Otter Creek	In Service	Hydroelectric	Significant

Appendix B. Otter Creek Basin Municipal Protectiveness Table

Table B1. Surface-water related protections adopted by municipalities predominantly in the Otter Creek basin.

	National Flood Insurance Program	Road and Bridge Standards	Local Emergency Management Plan	Local Hazard Mitigation Plan	River Corridor Protection[1]	ERAF Rate	E911 Structures in Special Flood Hazard Area (SFHA)	SFHA Structures Insured	Critical or Public Structures in SFHA	Percent of All Town Structures in SFHA	Steep Slope Protection	Water Resource Setbacks In by-laws, ordinances, town plan, or zoning?		
	Enrolled?	Adopted?	Completed?	Adopted?	None, CRS, By-Law, or Interim	Percent	Count	Percent	Count	Percent	In by-laws, ordinances, town plan, or zoning?	Rivers	Wetlands	Lakes
Addison	Yes	Yes	No	No	None	7.5	10	0	0	1	Yes	Yes	Yes	Yes
Brandon	Yes	Yes	Yes	Yes	By-law	17.5%	66	11	4	4	Yes	Yes	No	No
Bridport	Yes	Yes	No	Yes	None	7.5	21	19	0	3	Yes	No	No	Yes
Bristol	Yes	Yes	Yes	Yes	None	7.5	31	13	0	20	Yes	Yes	No	No
Chittenden	Yes	Yes	Yes	Yes	None	12.5%	20	5	0	3	No	No	No	No
Clarendon	Yes	Yes	Yes	Yes	None	12.5%	11	27	0	1	No	No	No	No
Cornwall	Yes	Yes	No	Yes	None	7.5	1	0	0	0	No	Yes	No	No
Danby	Yes	Yes	Yes	Yes	None	12.5%	16	0	0	2	No	No	No	No
Ferrisburgh	Yes	Yes	Yes	Yes	None	7.5	141	5	0	9	Yes	Yes	Yes	Yes
Goshen	Yes	Yes	No	No	None	7.5	10	0	0	1	Yes	Yes	Yes	Yes
Ira	Yes	Yes	Yes	Yes	None	12.5%	2	100	1	1	Yes	No	No	No
Killington	No	Yes	Yes	Yes	None	7.5	6	0	0	0	No	No	No	No
Leicester	Yes	Yes	Yes	Yes	None	12.5	56	0	0	8	Yes	Yes	Yes	Yes
Lincoln	Yes	Yes	Yes	Yes	Interim	7.5	41	10	2	6	Yes	Yes	No	No
Mendon	Yes	Yes	Yes	Yes	None	12.5%	1	0	0	0	Yes	Yes	Yes	Yes
Middlebury	Yes	Yes	Yes	Yes	None	12.5	24	29	1	1	Yes	Yes	Yes	No
Middletown	Yes	Yes	Yes	Yes	None	12.5%	30	7	0	5	No	No	No	No
Monkton	Yes	Yes	Yes	Yes	None	7.5	45	2	0	5	Yes	Yes	Yes	Yes

	National Flood Insurance Program	Road and Bridge Standards	Local Emergency Management Plan	Local Hazard Mitigation Plan	River Corridor Protection[1]	ERAF Rate	E911 Structures in Special Flood Hazard Area (SFHA)	SFHA Structures Insured	Critical or Public Structures in SFHA	Percent of All Town Structures in SFHA	Steep Slope Protection	Water Resource Setbacks In by-laws, ordinances, town plan, or zoning?		
	Enrolled?	Adopted?	Completed?	Adopted?	None, CRS, By-Law, or Interim	Percent	Count	Percent	Count	Percent	In by-laws, ordinances, town plan, or zoning?	Rivers	Wetlands	Lakes
Mount Holly	Yes	Yes	Yes	Yes	Yes	17.5%	23	4	0	2	Yes	No	No	No
Mount Tabor	No	Yes	Yes	Yes	None	7.5	3	0	1	2	No	No	No	No
New Haven	Yes	Yes	Yes	Yes	None	7.5	19	21	1	2	Yes	No	Yes	Yes
Orwell	Yes	Yes	Yes	No	Interim	17.5%	27	0	0	4	Yes	Yes	Yes	Yes
Panton	Yes	Yes	Yes	Yes	None	12.5	2	0	0	1	No	Yes	No	No
Pittsford	Yes	Yes	Yes	Yes	None	12.5%	33	12	1	2	No	No	No	No
Proctor	Yes	Yes	Yes	Yes	By-law	17.5%	42	17	1	5	Yes	Yes	Yes	Yes
Ripton	Yes	Yes	Yes	Yes	Interim	17.5%	9	11	1	2	Yes	Yes	Yes	Yes
Rutland City	Yes	No	Yes	No	None	7.5	135	15	2	2	No	No	No	No
Rutland Town	Yes	Yes	Yes	Yes	None	12.5%	30	3	0	2	No	Yes	No	No
Salisbury	Yes	Yes	No	Yes	None	7.5	3	0	0	0	Yes	Yes	Yes	No
Shoreham	Yes	Yes	Yes	No	None	7.5	11	9	0	1	Yes	Yes	Yes	Yes
Shrewsbury	Yes	Yes	Yes	Yes	By-law	17.5%	4	0	1	<1	Yes	Yes	Yes	Yes
Starksboro	Yes	Yes	Yes	Yes	None	7.5	18	6	0	2	Yes	Yes	Yes	Yes
Sudbury	Yes	Yes	Yes	No	None	7.5	9	11	0	2	Yes	Yes	Yes	Yes
Tinmouth	Yes	Yes	Yes	Yes	None	12.5%	11	0	0	3	Yes	Yes	Yes	Yes
Vergennes	Yes	Yes	No	No	None	7.5	13	23	0	1	Yes	Yes	Yes	Yes
Wallingford	Yes	Yes	Yes	Yes	None	12.5%	91	12	4	8	No	No	No	No
Waltham	No	Yes	Yes	No	None	7.5	0	0	0	0	Yes	No	No	No
West Rutland	Yes	Yes	Yes	Yes	None	12.5%	56	11	2	6	Yes	No	No	No
Weybridge	Yes	Yes	No	No	None	7.5	12	8	0	3	No	Yes	No	No
Whiting	No	Yes	Yes	No	None	7.5	2	0	0	1	No	No	No	No

[1]The River corridor protection eligibility criteria for a 17.5% Emergency Relief and Assistance Fund (ERAF) rate can be met through Community Rating System participation (CRS), River Corridor by-law adoption (By-law), or temporarily through early adopter status for communities that adopted some river corridor protections before October 2014 (interim).

Appendix C. Responsiveness Summary

Comment: I am concerned that three critical issues that are being overlooked and yet have the potential to critically impact water quality are Pesticides, Petroleum products, and Fluoride. – *from Ross Conrad*

Response: The state's general approach to organic contaminants (e.g., pesticides and petroleum) and inorganic contaminants (e.g., fluoride) is discussed in Chapter 2: Toxic Substances of the 2017 Vermont Surface Water Management Strategy, and subsequent revisions may provide some information on compounds of concern or those with timely updates. For example, it may be important to note that recently passed Vermont law classifies neonicotinoids as a restricted use pesticide, meaning that their purchase and use is now limited to only state-licensed applicators. However, it is beyond the scope of the Otter Creek Tactical Basin planning process to revise the Surface Water Management Strategy or recommend additional regulations.

The Public Health and Agricultural Resource Management Division (PHARM) of the Vermont Agency of Agriculture, Food & Markets (AAFM) has been monitoring select surface water sites throughout high agricultural use areas of the state for pesticides since 2017. Our watershed planning process includes regular check-ins with AAFM to review surface water impairments related to agricultural land use and identifies restorative actions as appropriate.

It is the mission of the Drinking Water and Groundwater Protection Division to manage Vermont's drinking water supplies; to protect the quality and quantity of Vermont's groundwater resources; and to regulate wastewater disposal activities that could adversely affect groundwater. The Division accomplishes this mission through its outreach, education, assistance, and regulatory activities.

All public water systems in Vermont must conduct required monitoring of their drinking water in accordance with state and federal regulations. Drinking water monitoring is necessary to ensure that public health is being adequately protected. Chemical contaminants are largely regulated under the Chemical Contaminants Rule, or federal Phase II/V Rule.

Community Systems and Non-Transient Non-Community (NTNC) Water Systems are routinely required to sample for Inorganic Compounds (IOCs) and Volatile Organic Compounds (VOCs). Fluoride is one of fourteen regulated analytes monitored by the State of VT Drinking Water Program. There are 21 analytes regulated as VOCs.

An exceedance of the Maximum Contaminant Level (MCL) for any of the regulated chemical and radionuclide contaminants requires the water system to develop a plan and schedule to explore options which typically require the system to either treat or abandon the drinking water source.

For additional information about potential health effects for any of the contaminants listed above, visit the Vermont Department of Health's website.

Comment: Wastewater treatment systems put P directly into the Otter Creek. They have been doing this even before the permitting process. Farmers apply nutrients to soil so they can grow a crop. Only a small percentage ends up in the waters of the state. I heard recently that the P in the waters of the state is going down. That is what farmers know. *– from Otter Creek NRCD*

Response: About 6% of the annual total phosphorus load to Lake Champlain comes from WWTFs (2024-State-of-the-Lake-Report.pdf). Recent investments in wastewater treatment facilities and policy changes have driven significant reductions in phosphorus loading to Lake Champlain. In the Otter Creek basin, the estimated total P (TP) loading from agricultural sources is 106,313 kg/yr., which is approximately 52% of the total. The LC TMDL agricultural reduction goal for the Otter Creek basin is 48,390 kg TP, for non-point agricultural field sources and 2,510 kg TP for barnyard production area sources. The reductions to meet the 2036 goals will be achieved through Required Agricultural Practices (RAP) compliance and non-regulatory Best Management Practice (BMP) adoption.

The agricultural community has made substantial progress towards meeting agricultural TMDL targets. Basin-wide in SFY 2023, 48.5% of the total barnyard management goal and 19.7% of the field practice reduction goal were met, though some field practices like cover cropping must be maintained annually to sustain these reductions.

Appendix D. Letters of Conformance

RUTLAND REGIONAL PLANNING COMMISSION

November 1, 2024

Angie Allen, Watershed Planner

Vermont Department of Environmental Conservation
271 North Main Street, Suite 215

Rutland, Vermont 05701

Dear Ms. Allen:

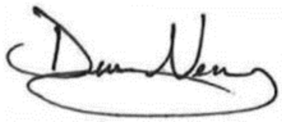
On behalf of the Rutland Regional Planning Commission (RRPC), I am writing to express our support for the 2024 B3 Tactical Basin Plan. The RRPC has determined that the 2024 B3 Tactical Basin Plan is in conformance with the Rutland Regional Plan, adopted on June 18, 2018, as well as the municipal plans within our Region.

The protection and preservation of natural resources and water quality are of paramount importance to our Region. The priorities and strategies outlined in the 2024 B3 Tactical Basin Plan align with our ongoing efforts to maintain and enhance the environmental integrity of our watershed areas. This alignment is essential for sustaining the high quality of life that our residents cherish and ensuring the health and resilience of our natural ecosystems.

We are particularly supportive of the Plan's comprehensive approach to addressing water quality issues and fostering community resilience. By prioritizing actions such as watershed restoration, riparian buffer enhancements, and phosphorus reduction projects, including efforts like those addressing erosion-prone gullies, the Plan advances our shared goals of protecting vital water resources.

The RRPC appreciates the Vermont Department of Environmental Conservation's commitment to safeguarding water quality and implementing sustainable natural resource management. We look forward to continued collaboration to achieve lasting benefits for our communities and ecosystems.

Sincerely,



Devon Neary
Executive Director

Addison County Regional Planning Commission

14 Seminary Street Middlebury, VT 05753 • www.acrpc.org • Phone: 802.388.3141

November 15th, 2024

Angie Allen, Watershed Planner

Vermont Department of Environmental
Conservation 271 North Main Street, Suite 215

Rutland, Vermont 05701

Dear Ms. Allen,

On behalf of the Addison County Regional Planning Commission (ACRPC), I am writing to express our support for the 2024 B3 Tactical Basin Plan. The ACRPC has determined that the 2024 B3 Tactical Basin Plan is in conformance with the Addison Regional Plan, adopted on June 18, 2018, as well as the municipal plans within our Region.

Protecting and preserving natural resources and water quality is a key priority for our Region. The 2024 B3 Tactical Basin Plan outlines strategies that complement our ongoing efforts to safeguard and enhance the environmental integrity of our watershed areas. This alignment plays a vital role in maintaining the exceptional quality of life our residents value while supporting the health and resilience of our natural ecosystems.

We strongly support the Tactical Basin Plan's holistic approach to tackling water quality challenges and promoting community resilience. By emphasizing initiatives such as watershed restoration, riparian buffer improvements, and phosphorus reduction projects the Tactical Basin Plan aligns with our shared commitment to safeguarding critical water resources.

The ACRPC appreciates the Vermont Department of Environmental Conservation's commitment to safeguarding water quality and implementing sustainable natural resource management. We look forward to continued collaboration to achieve lasting benefits for our communities and ecosystems.

Sincerely,

Hannah Andrew

Natural Resources Planner