Otter Creek Tactical Basin Plan

The Otter Creek

September 2019 | Final Draft

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.

Approved:

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Basin 3 Tactical Plan Overview

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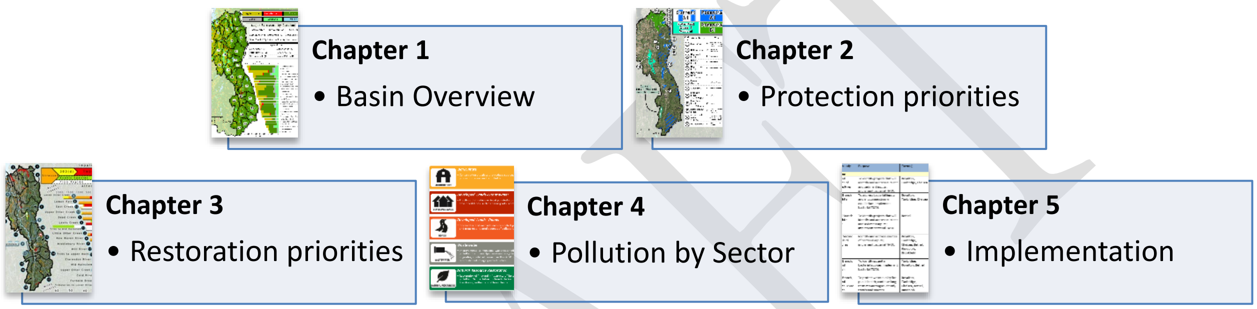
Executive Summary

The Basin 3 Tactical Basin Plan (TBP) provides an assessment of surface water conditions within the Otter Creek, Little Otter Creek, and Lewis Creek watersheds. The plan identifies current and future strategies to protect high quality waters and restore impaired water resources (see Vermont Surface Water Management Strategy (VSWMS)).

The five chapters in this plan are a framework for understanding Basin 3's unique characteristics and water quality issues, and where and how to implement projects to protect and restore water quality in the basin.



Chapter 1 provides broad context for the plan by presenting the following: climate change and implications for water resources, a basin description, and a high-level summary of water resource conditions. This plan centers on Basin 3, which drains 936 square miles and includes the Otter Creek watershed plus the watersheds of Lewis Creek, and Little Otter Creek, which drain directly to Lake Champlain. The basin covers portions of Bennington, Rutland, and Addison counties and includes all surface waters that flow into the Otter Creek, the longest river in Vermont.

Chapter 2 of the plan identifies high quality surface waters in the basin and recommends other waters as potential protection candidates (Figure 1):

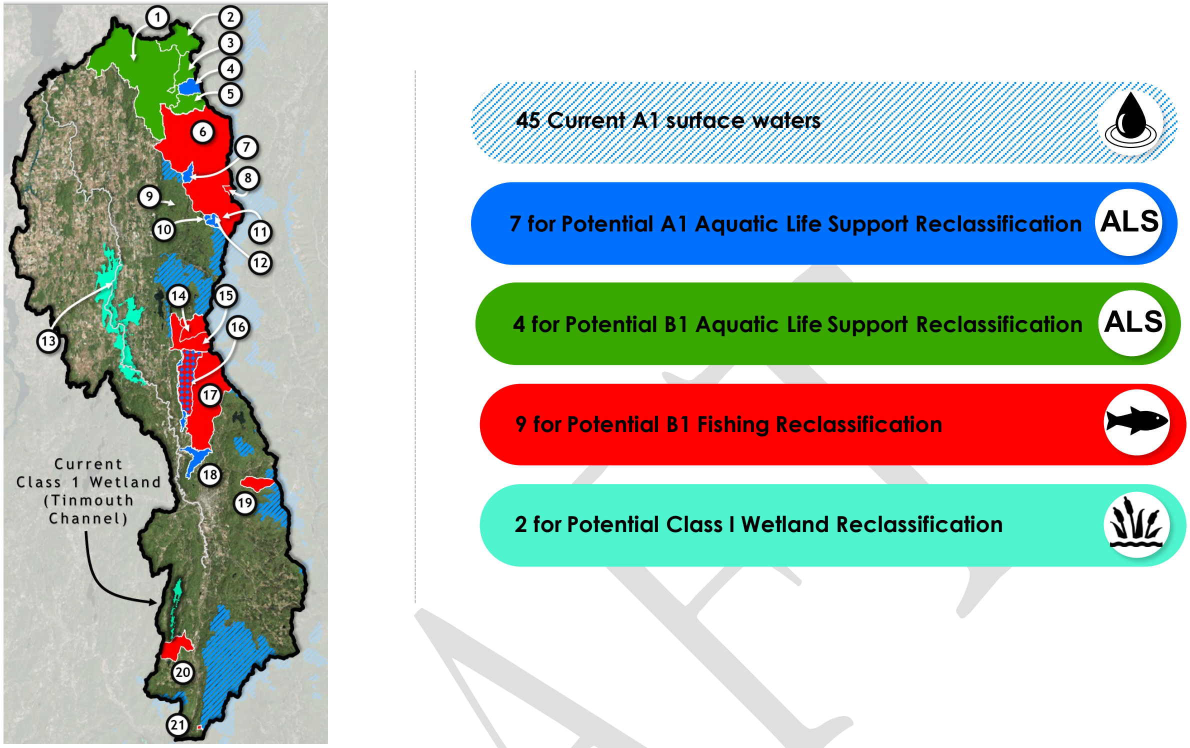


Figure 1. Summary of Protection Priorities for Basin 3. ALS = Aquatic Life Support.

In addition, 9 abandoned A(2) public water sources are recommended for reclassification to B(1) or B(2), 2 waters are designated as permanent A(2) public water sources, 1 lake is identified as a sentinel lake and is used by Lake and Ponds Program (LPP) as a 'reference' waterbody, and 11 others are identified by the LPP as protection priorities based on Lake Scorecard criteria.

Despite dedicated efforts to maintain existing conditions, numerous stressors degrade water quality in the basin (Figure 2). Many of these are linked to the following:

1. **Encroachment** of unpermitted stream alterations, non-buffered agricultural fields, and development within river corridors, floodplains, wetlands, and lake shores;
2. **Stream channel erosion** due to undersized crossing structures, lack of riparian vegetation for bank stabilization, and increases in stormwater flow and volume;
3. **Land erosion** due to unmanaged stormwater runoff from roads, developed lands, and agricultural lands; and
4. **Pathogens** from sources that likely stem from bacterial communities in soils, waste runoff from domesticated animals and livestock, and out-of-date and failed septic systems.

Chapter 3 of the plan identifies degraded surface waters in the basin, i.e., impaired and stressed waters and those with a Total Maximum Daily Load (TMDL) and recommends restoration candidates (Figure 2). More details are presented in Figures 12-18 and Table 2.

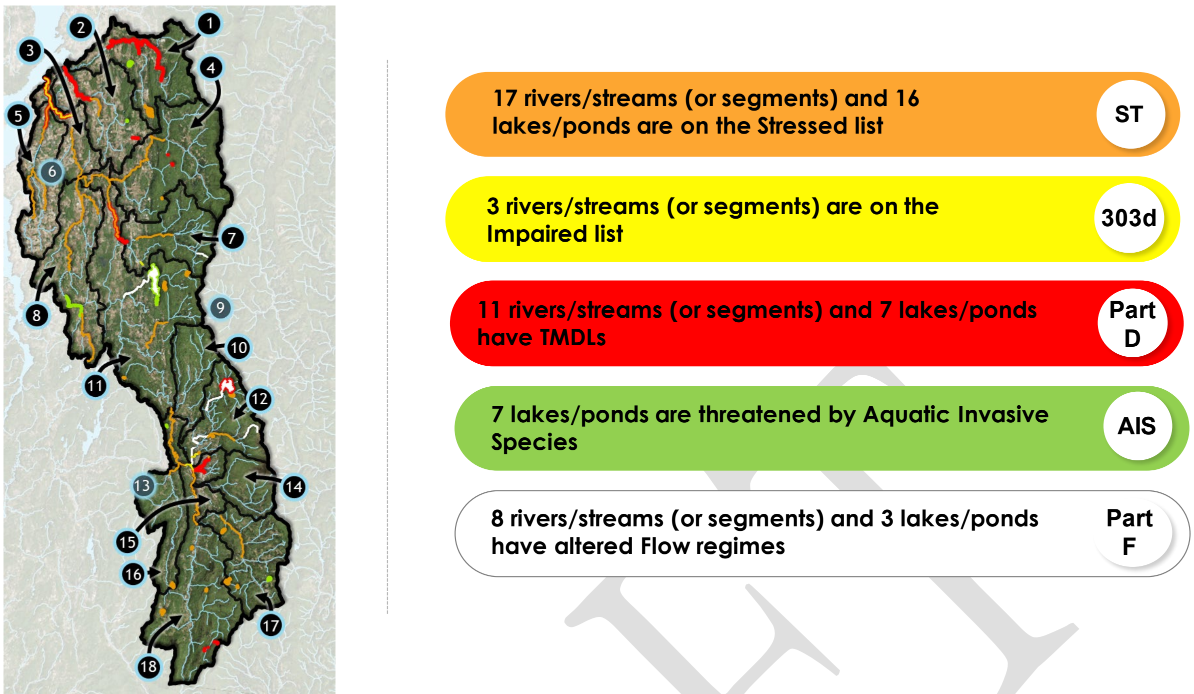


Figure 2. Summary of Restoration Priorities for Basin 3. ST= Stressed waters list, 303d = Impaired waters list, Part D = Aquatic Invasive Species list, and Part F = waters with altered flow regimes.

Chapter 4 of the plan is a guide for the next 5 years to address pollution from land use sectors contributing to water quality issues. Information from assessments in the basin and derived from public input have been compiled to guide the development of strategies for the following sectors: agriculture, developed lands—stormwater and roads, wastewater treatment facilities, and restoration of forest lands, lakes, rivers, and wetlands. A total of 55 strategies are listed in the Chapter 5 implementation table and rivers and lakes that have been identified for water quality monitoring are in the monitoring priorities table. Individual implementation projects are listed in the Watershed Projects Database.

What is a Tactical Basin Plan?

Tactical basin planning is carried out for the Vermont Agency of Natural Resources (VANR) by the Watershed Management Division's Monitoring, Assessment, and Planning Program (MAPP) in coordination with watershed partners. Tactical basin plans are developed in accordance with the VSWMS and the Vermont Water Quality Standards (VWQS) to protect, maintain, enhance, and restore the biological, chemical, and physical integrity of Vermont's water resources. The basin specific water quality goals, objectives, strategies, and actions described in the TBPs aim to protect public health and safety and ensure public use and enjoyment of VT waters.

The TBPs incorporate the U.S Environmental Protection Agency's (EPA) 9-element framework for watershed plans (Environmental Protection Agency, 2008) and meet obligations of the Vermont Clean Water Act. The planning process allows for the issuance of plans for Vermont's fifteen basins every five years, as required by statute 10 V.S.A. § 1253. Updating a basin plan includes: 1. monitoring water quality and summarizing existing information, 2. assessing and analyzing water quality data, 3. identifying strategies and projects to protect and restore waters, 4. seeking public input and finalizing the plan, and 5. plan implementation, tracking, and project identification, which are ongoing throughout the cycle (Figure 3).

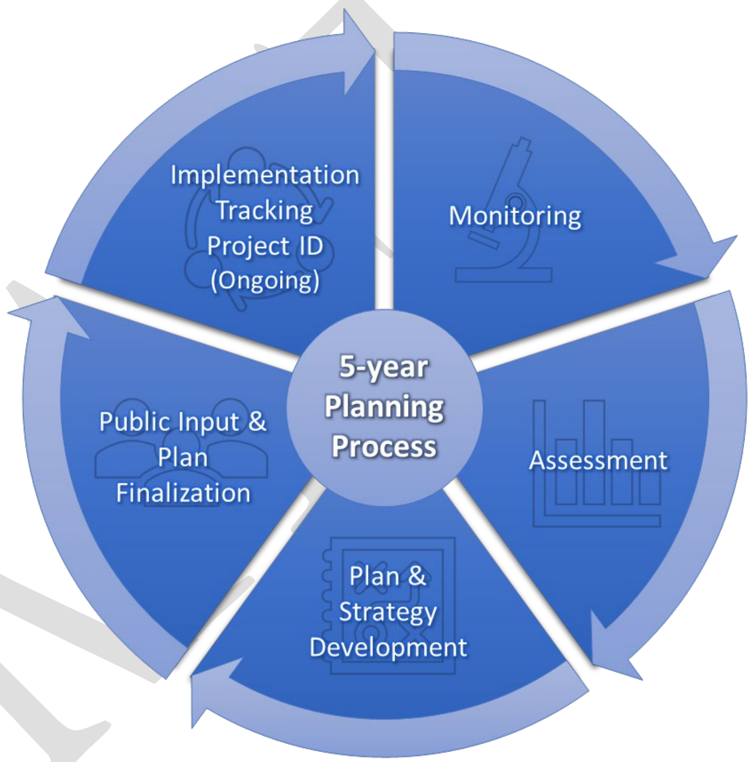


Figure 3. The tactical basin planning process.

Tactical basin plans are a guide for protecting and restoring VT surface waters for VANR and watershed partners. They identify opportunities for: a) protection through Outstanding Resource Water (ORW) designation and reclassification and b) restoration by addressing causes and sources of pollution. They also quantify pollutant reductions needed to meet the Lake Champlain and Lake Memphremagog TMDLs, foster education and outreach, and recommend restoration actions that are eligible for federal and State funding. The Plan's strategies, described in Chapter 5's implementation table, are tracked via the online clearinghouse, the Watershed Projects Database (WPD). The WPD is continuously updated to capture project information from the planning process, projects identified by assessments or watershed partners, and emerging projects due to natural and/or anthropogenic events. The 2012 Basin 3 Report Card in Appendix A provides the status and updated information for each of the objectives identified in the previous basin plan.

Chapter 1 – Basin Description and Conditions

A. Climate Change Implications for Basin 3 Surface Waters

The 2014 Vermont Climate Assessment documented state-level, climate changes, such as increasing temperatures and precipitation, which have implications for local surface waters (Galford et al., 2014). Since 1941, average temperatures have increased 2.7° F with warming occurring twice as fast in winter. Warmer winters result in earlier thaw dates for rivers, lakes and ponds, and snowpack. Average annual stream flows are increasing, which is expected to continue in the future. High flows now happen more frequently, which increase local flooding and fluvial erosion. Average annual precipitation has increased by 5.9 inches since 1960. The timing of precipitation and warmer temperatures, however, may increase the risk of summer drought due to earlier rains, decreased snowpack, and higher rates of evapotranspiration (Galford et al., 2014).

The effects of increasing streamflow and runoff in a watershed depends heavily on local land use and land cover. In Basin 3, both agricultural and developed land uses may experience more runoff thereby increasing non-point source pollution as flows carry eroded sediments, road sands, fertilizers, animal wastes, bacteria and nutrients from inundated septic systems, and other nutrient-rich materials into surface waters. Toxins such as mercury may increasingly be transported to aquatic ecosystems where warmer temperatures can accelerate mercury methylation and increase bioaccumulation in aquatic foodwebs (Stager and Thill 2010, https://bit.ly/2y6dpy2). In response, this plan's restoration projects incorporate stormwater and non-point source runoff controls to counteract pollutant transport as well as consider the potential for higher peak flows.

Aquatic habitats affected by increasing streamflow and runoff could experience increases in sediments, nutrients, scouring, and water temperature. Warmer waters hold less dissolved oxygen, which can be harmful to many aquatic species (e.g. brook trout). Furthermore, changes in the timing and duration of high and low flows could interfere with the life cycles of migratory fish or aquatic insects. In response, local species may shift their geographic ranges, seasonal activities, and alter their abundance. This plan focuses on maintaining and restoring habitat connectivity, increasing river and lake riparian buffers, and stream equilibrium conditions to reduce the impacts of climate change on Vermont's rivers, lakes and ponds, and wetlands. Additional information on climate change in Vermont can be found at: https://climatechange.vermont.gov.

B. The Otter Creek Basin

Basin 3 consists of the Otter Creek, Little Otter Creek, and Lewis Creek watersheds, which drain directly to Lake Champlain. The Otter Creek watershed encompasses 936 square miles, drains portions of Bennington, Rutland, and Addison counties, and includes all surface waters that flow into the Otter Creek. As the longest river in Vermont, the Otter Creek originates in Bennington County, flows through the Green Mountain National Forest, and travels ≈100 miles to its mouth in Addison County where it flows into Lake Champlain in Ferrisburgh. The river has been heavily developed for hydroelectric power generation, with seven active dams on the mainstem. Otter Creek's wide floodplains and vast wetland complexes, such as found in the Pomainville Wildlife Management Area (WMA) and the Cornwall Swamp WMA, significantly dampened the 2011 floods of Tropical Storm Irene.

Basin 3 also includes the watersheds of Little Otter Creek and Lewis Creek. Little Otter Creek is a lowland river and has three main branches draining 73 square miles. At approximately 25 miles long, it begins in Bristol and flows through New Haven, Monkton, and Ferrisburgh before entering Lake Champlain. The Lewis Creek originates in the hills of Starksboro. It flows north, then west, before returning to Addison County and emptying into Lake Champlain at Hawkins Bay.

The basin can be divided into 27 HUC12 watersheds and the dominant land use and land cover types are forest (58.74%), agriculture (21.12%), wetlands (11.04%), and development (1.91%) (Figure 5). Forested landscape is largely responsible for the good water quality in the basin. Degraded waters in Basin 3 are often adjacent to agricultural lands and dense road and residential development. Managing land use to reduce discharge of polluted runoff and allowing adequate space for treatment can both improve and protect water quality.

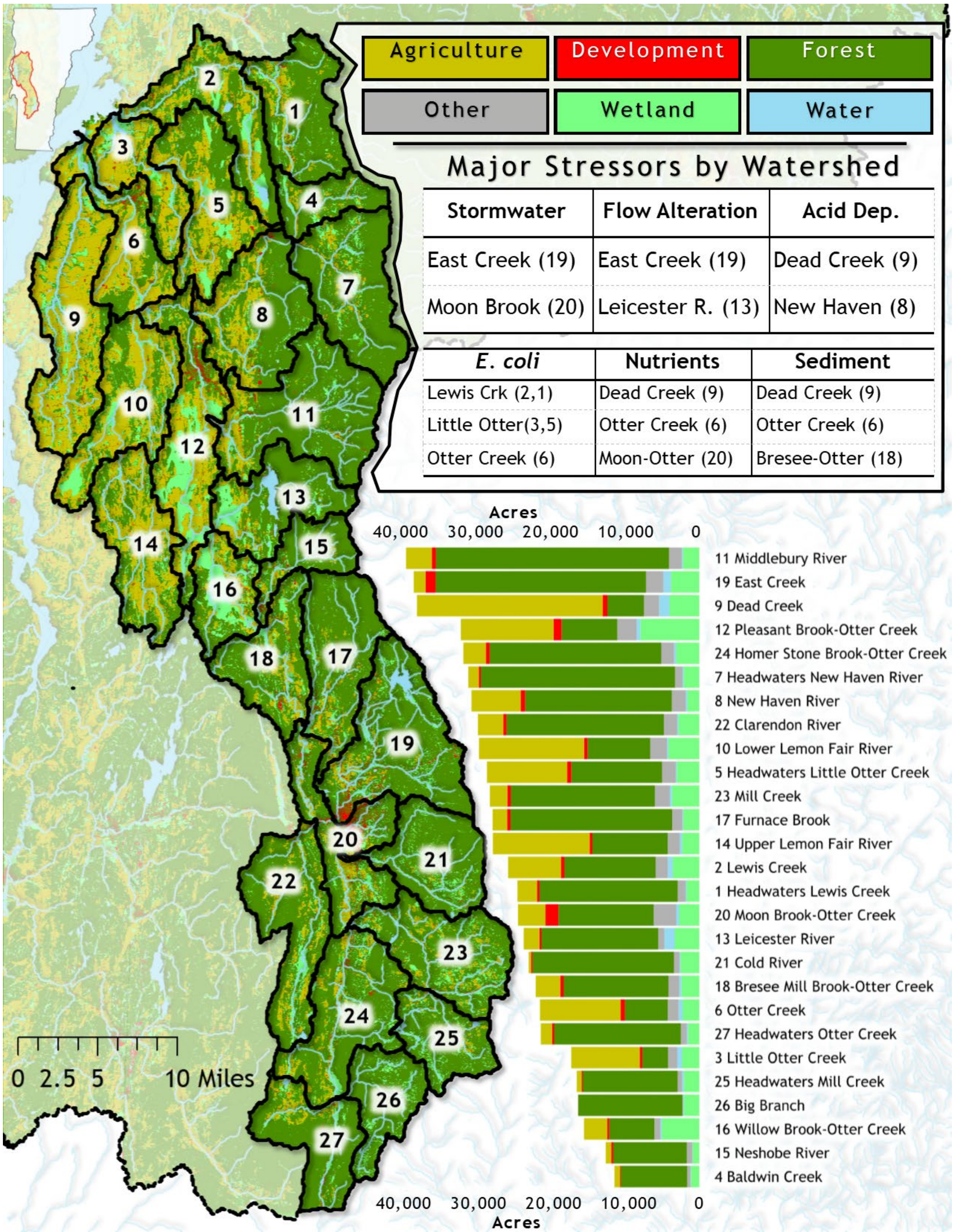


Figure 4. The land uses and major stressors of Basin 3 surface waters by HUC12 watershed.

C. Conditions of Surface Waters

Vermont Assessment Approach

The VANR Watershed Management Division (WSMD) in VDEC assesses the condition of a waterbody using biological, chemical, and physical criteria described in the Vermont Water Quality Monitoring Program Strategy 2011-2020 (VDEC, 2015). Most of these data can be accessed through the Vermont Integrated Watershed Information System, an online data portal.

VDEC uses monitoring and assessment data to evaluate individual surface waters in relation to the VWQS as outlined in the 2016 VTDEC Assessment and Listing Methodology (VDEC, 2016). The VWQS establish the minimum or maximum limits for water quality parameters at specific locations for the purpose of managing waters to support their designated uses. Designated uses include aquatic biota and habitat; swimming and contact recreation; boating; fishing; public water supply, and crop irrigation.

The four categories used to assess Vermont's surface water are **full support, stressed, altered** and **impaired**. Waters that currently support designated and existing uses and meet water quality standards are placed into the full support or stressed categories. Waters that do not meet VWQS are placed in the altered or impaired categories. Waters for which VDEC has no monitoring data or only limited information are considered unassessed.

Assessments that support tactical basin planning include, but are not limited to: biological monitoring (biomonitoring), water quality monitoring, Road Erosion Inventories (REIs), Stream Geomorphic Assessments (SGAs), Stormwater Master Planning (SWMP) and Illicit Discharge Detection and Elimination infrastructure mapping, and the Vermont Rapid Assessment Method (VRAM) of wetlands. Assessment results identify very high-quality waters, which are protected through reclassification (Ch. 2), and stressed, altered, or impaired waters, which are restored through regulation and project implementation (Ch. 3-4).

An overview of water quality conditions at state and basin scales are presented in the following subsections. This overview lends context to tactical basin planning efforts, which address the stressors and pollutants degrading waters through spatially explicit actions listed in the Chapter 5 Implementation Table and the online Watershed Projects Database.

Conditions of Lakes and Ponds

Vermont has over 800 lakes or ponds, with 220 of them larger than 20 acres in size. Basin 3 has 24 of those lakes or ponds that are 20 acres or larger. Four lakes with excellent 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. For more information about sentinel lakes in VT and/or High Pond, please read a 2018 Flow Blog post at: https://bit.ly/2KwMuCp.

Encroachment through shoreland development is the greatest stressor to Vermont and Basin 3 lakes (USEPA, 2016), Figure 6). Lakes assessed in Basin 3 have a higher percentage of lake area with poor shoreland conditions when compared to others assessed in Vermont. Out of 36 lakes assessed for shoreland condition in the basin, more than half are threatened by development. Sedimentation, eutrophication, aquatic invasive species (AIS), and artificial water level fluctuation also threaten lake and pond ecosystem health. Eleven Basin 3 lakes have increasing nutrient trends. Aquatic invasive species, especially Eurasian Water Milfoil, *Myriophyllum spicatum*, pose a threat to 11 lakes. Lake level manipulation is also a major cause of non-support of uses and values in the basin. Lake Dunmore, Silver Lake, Dunklee Pond, and Chittenden Reservoir are listed as stressed or impaired due to artificial water level fluctuation.

All Basin 3 lakes are under a Vermont Department of Health fish consumption advisory for exceeding the USEPA mercury (Hg) limits in fish, and Chittenden Reservoir is considered impaired based on elevated levels of mercury in walleye (Figure 3). Please refer to the following for a comprehensive assessment of mercury in Vermont Lakes (https://bit.ly/2KtkCAp).

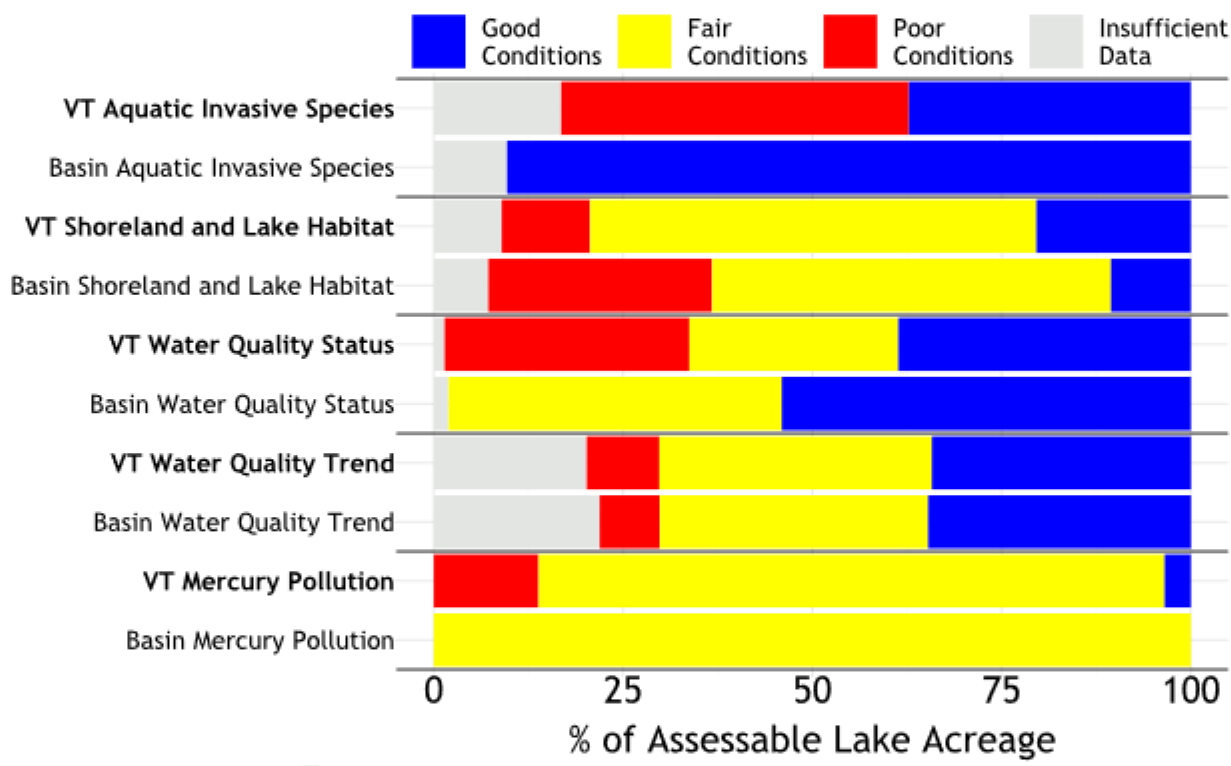


Figure 5. Conditions of Lakes and Ponds in VT and Basin 3 from Lake Scorecard data.

Conditions of Rivers

Many Basin 3 rivers are in good to excellent condition and support many uses (Figure 7). Approximately 60% of assessable river miles (i.e., rivers large enough to be mapped as **blue** lines on United States Geological Survey (USGS) topographic maps) fully support aquatic life and over 70% support fishing and boating uses. Excellent water quality in many of the tributaries along with striking geologic formations support popular swimming holes, e.g., Bartlett's Falls and Sycamore Park on the New Haven River and the Middlebury River Gorge. With community support, these stream reaches are natural candidates for Outstanding Resource Water based on their spectacular aesthetic value and swimming use. The North Branch of the Middlebury River is also popular for kayaking.

Increasing sediments, nutrients, pathogens, and temperatures are the most prevalent pollutants resulting in impairment of Basin 3 streams and rivers. Primary sources of these pollutants include agricultural land use, streambank modification/destabilization, and loss of riparian vegetation. Physical alterations are also present throughout the basin, ranging from habitat alteration, general stream channel instability, and flow alterations associated with water withdrawals or hydroelectric dams (e.g., East Creek). Development has encroached into the flood hazard zone (i.e., river corridors and floodplains) in many towns. In addition, atmospheric deposition of mercury causes stress for all surface waters in the basin.

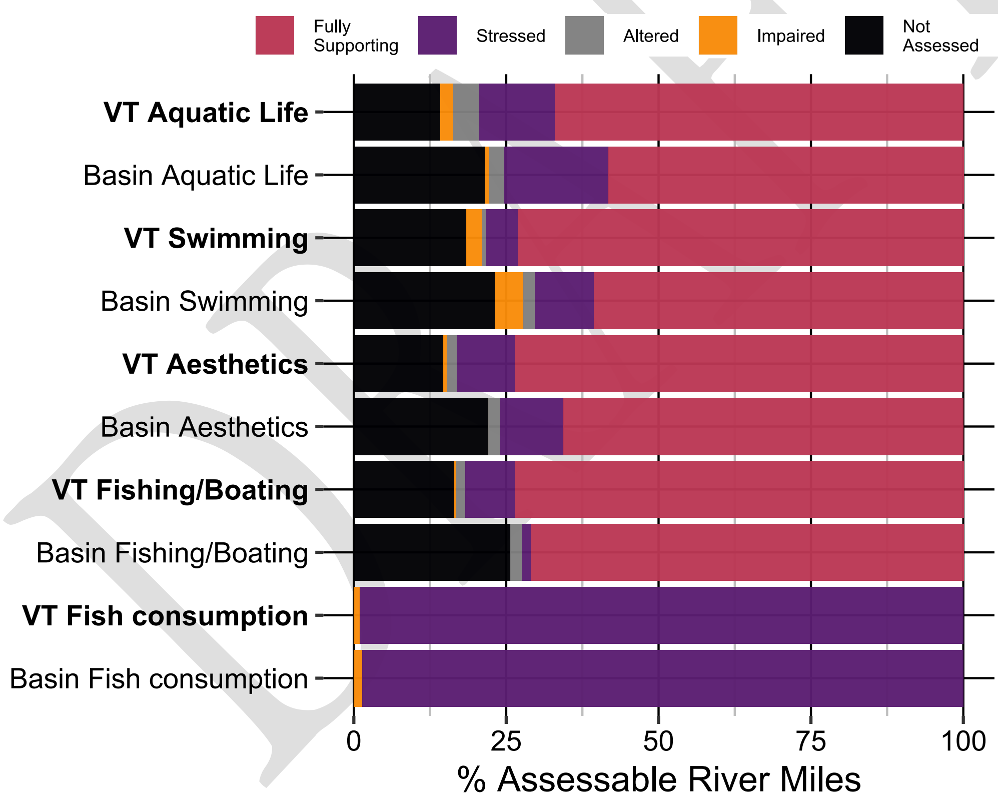


Figure 6. Distribution of River Uses in VT and Basin 3.

Of the streams with a Phase 2 Stream Geomorphic Assessment, Basin 3 has more river miles in both good and reference geomorphic condition than found statewide (Figure 8). The results of specific assessments are described in greater detail in Chapter 4.

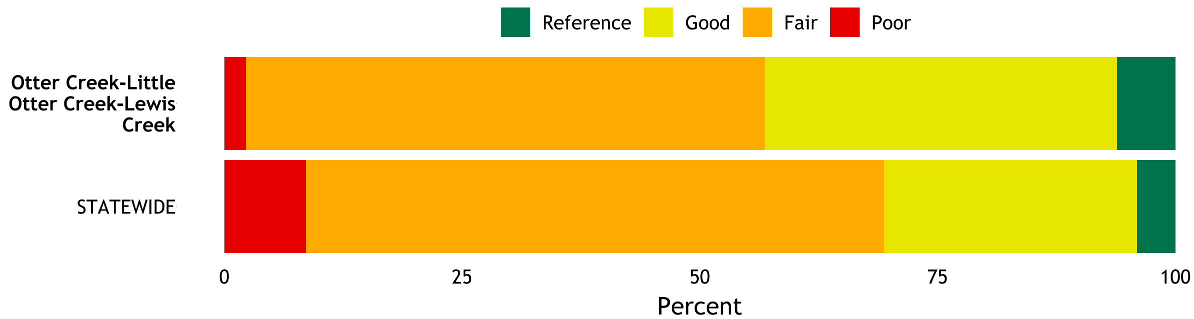


Figure 7. Geomorphic condition of rivers and streams in VT and Basin 3.

Conditions of Wetlands

Basin 3 wetlands have an extensive history of draining and clearing for agriculture and wood products. In recent years, residential, commercial, and industrial development have been the primary causes of wetland loss. Basin 3 wetlands span a range of conditions and thus provide numerous opportunities for protection (Ch. 2) and restoration (Ch. 4). Generally, poor condition wetlands are associated with agriculture and development in the lower basin, while excellent wetlands occur at higher elevations, in headwater regions, and in the central Otter Creek wetland complex from Brandon to Middlebury. The Otter Creek wetland complex serves an important function by effectively mitigating the effects of flooding (e.g., 2011 Tropical Storm Irene) thereby reducing damages incurred by downstream communities. In addition, the wetlands and surrounding forested areas south of Brandon provide a critical wildlife corridor link between the Taconic Mountains and the Green Mountains.

The USEPA's National Wetland Condition Assessment 2011 of Eastern Mountains wetlands, including Vermont's, estimated that 52% of wetland area is in *Good* condition; 11% is in *Fair* condition, and 37% is in *Poor* condition. Presently, the WSMD Wetlands Program conducts monitoring and assessment of vegetation, water quality, and other wetland metrics to discern wetland condition, function, and value. Compared to other basins, Basin 3 wetlands are relatively well sampled, with 78/500 VRAM plots and 30/200 vegetation plots. In addition, 80/440 Natural Heritage Inventory plant survey plots have been conducted in the basin. Basin 3 wetlands have 43/49 natural community types identified in Vermont by the VT Fish and Wildlife's Natural Heritage Inventory, which is the most of any basin in the state. To date many Basin 3 wetland assessments have focused on poor condition systems and as such, an unbiased comparison of Basin 3 and state wetland condition is not possible.

Chapter 2 – Priority Areas for Surface Water Protection

In order to protect VT surface waters and their designated uses, the VWQS establish water quality classes (Table 1) and associated management objectives. All surface waters are managed to support designated uses valued by the public at a level of Class B(2) (i.e., good condition) or better. Designated uses include: swimming, boating, fishing, aquatic biota, aquatic habitat, aesthetics, drinking water source, and irrigation. This section of the plan identifies surface waters where monitoring data indicate conditions meet or exceed the VWQS objectives and criteria. These high-quality waters may be protected by the anti-degradation policy of the VWQS or by upward reclassification through one of the following protection pathways:

- Reclassification of surface waters
- Class I Wetland designation
- Outstanding Resource Waters designation
- Identification of existing uses
- Designation of waters as cold-water fisheries

In addition to the above pathways, tactical basin plans identify opportunities to increase protection of high-quality waters through land stewardship programs, conservation easements, and land acquisition. Since 2012, the USDA Natural Resources Conservation Service has partnered with 25 private landowners and the US Fish and Wildlife Service to restore over 1000 acres of wetlands in the Otter Creek watershed through the Wetlands Reserve Program and Agricultural Conservation Easement Program Wetland Reserve Easement component. More examples of protection strategies are included in Chapter 5 of this plan.

Seven waters in Basin 3 are recommended A(1) aquatic biota reclassification, 4 for B(1) aquatic biota, 9 for B(1) fishing, 2 wetlands are recommended as a Class I wetland, and 9 abandoned A(2) public water sources are recommended for evaluation for reclassification (Figures 9-11). Two waters are designated as permanent A(2) public water sources in Basin 3.

Figure 8. Water quality protection actions in the 2019 Basin 3 plan.

The VANR is responsible for (re)classification or other designations and determining existing uses on a case-by-case basis or through tactical basin planning. The latter is the primary mechanism by which the Agency solicits public involvement in protecting VT surface waters. 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*". Emphasis on the identification of values and expectations for future water quality conditions can only be achieved through public contributions to the planning process. To this end, the public, watershed partners, and stakeholders are encouraged to make recommendations for additional monitoring and research where very high-quality waters appear to exist.

A. Surface Water Classification

Vermont's surface water classification system establishes management goals and supporting criteria for uses in each class of water. The VWQS begin classification with two broad groups based on elevation:

- All waters above 2,500 feet altitude, National Geodetic Vertical Datum, 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 altitude, National Geodetic Vertical Datum, are designated Class B(2) for all uses, unless specifically designated as Class A(1), A(2), or B(1) for any use.

Pursuant to Act 79 of 2016, the Vermont General Assembly, recognizing the wide range of quality for Class B waters, created an intermediary water quality class between B(2) and A(1), called B(1). Act 79 also sets forth the expectation that individual uses of waters (e.g., aquatic biota and wildlife, aquatic habitat, recreation, aesthetics, fishing, boating, or swimming) may be individually classified, so a specific lake or stream may have individual uses classified at different levels. The uses may be reclassified independently to Class B(1) for individual uses if the quality of those uses are demonstrably and consistently of higher quality than Class B(2).

Current classifications of surface waters and their uses are identified through the tactical basin planning process or on a case-by-case basis. The current classification, however, does not signify that the B(1) criterion is not met. Additional waters suitable for reclassification may be identified in the future as some waters have not been monitored. Table 1 lists the possible classes into which each use may be placed.

Table 1. A list of uses that can be placed into each water class in the VWQS.

Classification (2016)	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

Public Water Sources - A(2)

Fourteen waters are designated as A(2) public water sources in Basin 3. Nine of these have been abandoned as public water sources and are recommended to be reclassified to reflect their current condition for each designated use (Figure 10).

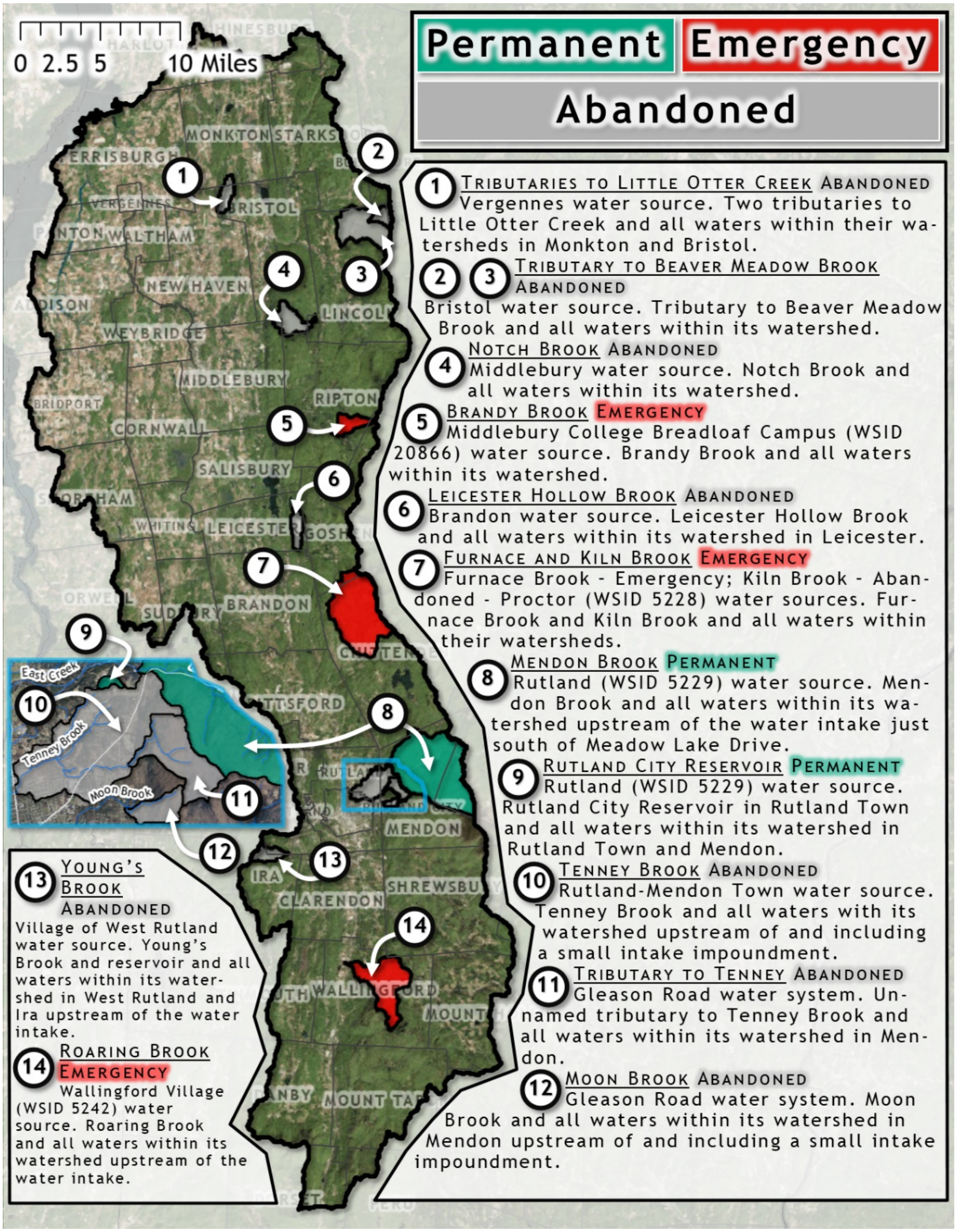
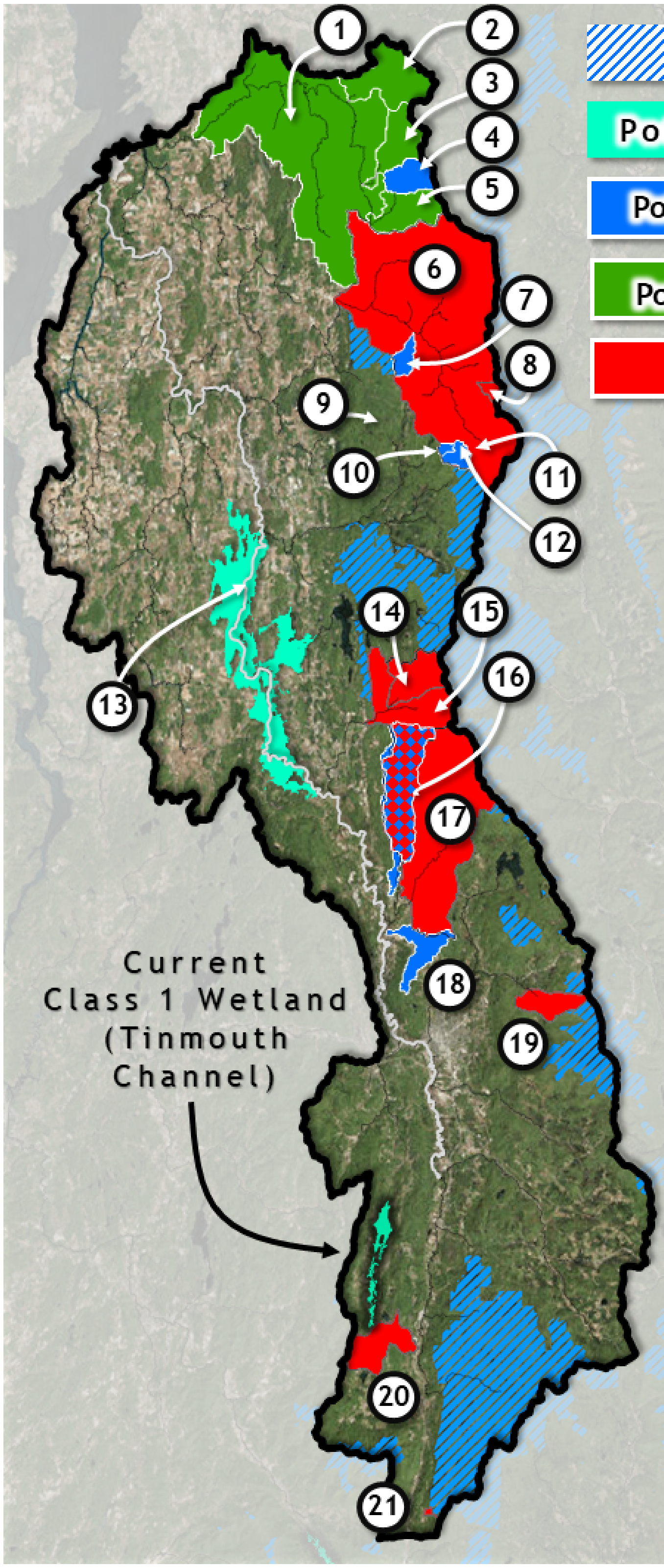


Figure 9. Class A(2) designated public water sources in Basin 3.

Very High-Quality Waters Supporting Aquatic Biota – A(1) & B(1)

The VDEC stream biomonitoring assessments indicate that 11 surface waters in Basin 3 consistently and demonstrably attain a higher level of quality than Class B(2) (Figure 11). A(1) reclassification candidates are: Hillsboro Brook, Alder Brook, Blue Bank Brook Tributary 6 (Upper and Lower), New Haven River Tributary 27, Sugar Hollow Brook, and Warner Brook. B(1) reclassification candidates are: Lewis Creek, Hollow Brook, High Knob Brook, and Upper Lewis Creek. Through the rulemaking process, which provides opportunities for public comment and input, these waters are recommended for reclassification to A(1) or B(1).

Five streams are recommended for additional sampling to determine eligibility for B(1) for aquatic biota: Jones Brook (River Mile (RM) 0.5 and RM 2.3), Seymour Brook (above RM 3.2), New Haven River (RM 21.8), Mendon Brook (RM 2.5), and McGinn Brook (RM 0.7).



Map ID	Waterbody	Potential
1	Lewis Creek	B1 ALS
2	Hollow Brook	B1 ALS
3	High Knob Brook	B1 ALS
4	Hillsboro Brook	A1 ALS
5	Upper Lewis Creek	B1 ALS
6	New Haven River	B1 Fishing
7	New Haven River Triutary 27	A1 ALS
8	Eubar Brook	B1 Fishing
9	Beaver Meadows	1 Wetland
10	Alder Brook	A1 ALS
11	Blue Bank Brook Trib. 6 Upper	A1 ALS
12	Blue Bank Brook Trib. 6 Lower	A1 ALS
13	Otter Creek Wetland Complex	1 Wetland
14	North Branch Neshobe River	B1 Fishing
15	Neshobe River	B1 Fishing
16	Sugar Hollow Brook	A1 ALS B1 Fishing
17	Furnace Brook	B1 Fishing
18	Warner Brook	A1 ALS
19	Brewers Brook	B1 Fishing
20	Baker Brook	B1 Fishing
21	Upper Otter Creek	B1 Fishing

Figure 10. Reclassification candidates and existing high-quality waters of Basin 3. ALS = Aquatic Life Support.

Very Good Waters for Recreational Fishing – B(1)

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 1000 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). The streams that meet B(1) criteria for recreational fishing (§29A-306) are: New Haven River, Eubar Brook, N. Branch Neshobe River, Neshobe River, Sugar Hollow Brook, Furnace Brook, Brewers Brook, Baker Brook, and Upper Otter Creek (Figure 11).

B(1) waters are managed to achieve and maintain very good quality fishing. Basin 3 B(1) waters may be amended in the future based on updated survey data and as protocols are refined. Waters that meet the revised criteria in the water quality standards for both B(1) and A(1) fishing use will be continually identified and updated. It is important to note that all waterbodies that would naturally support fish populations are protected and maintained in perpetuity.

Warm and Cold-Water Fish Habitat Designations

Warm-Water Fish Habitat

All surface water wetlands and the following waters are designated as warm-water fish habitat for purposes of the VWQS:

- All waters West of VT Route 22A and South of Vergennes
- Brilyea East Pond, Addison
- Brilyea West Pond, Addison
- Chipman Lake (Tinmouth Pond), Tinmouth
- Danby Pond, Danby
- Fern Lake, Leicester
- Lemon Fair River
- Mud Pond, Leicester
- Otter Creek from the outfall of the Proctor WWTF to its confluence with Lake Champlain, except the portion between the Beldens Dam and the Huntington Falls Dam in New Haven/Weybridge
- Richville Pond, Shoreham
- Stone Bridge Pond, Panton/Addison
- Wallingford Pond, Wallingford

The VWQS specify a lower minimum dissolved oxygen concentration than waters in the remainder of the basin, which are cold-water habitat.

Cold-Water Fish Habitat

All Basin 3 waters not designated as warm-water fish habitat are designated as cold-water fish habitat (Vermont Department of Environmental Conservation, 2017).

Outstanding Resource Waters Designation

Vermont Act 67 ("An Act Relating to Establishing a Comprehensive State Rivers Policy," 1987) provides protection to rivers and streams that have "exceptional natural, cultural, recreational, or scenic values" through the designation of Outstanding Resource Waters (ORW). ORW designation may protect exceptional waters through permit conditions in stream alterations, dams, wastewater discharges, aquatic nuisance controls, solid waste disposal, Act 250 projects, and other activities. ORWs are waters which can be designated by the VANR through a petition process. There are currently no ORW designations in Basin 3.

Class I Wetland Designation

The State of Vermont identifies and protects significant wetlands such that no net loss of wetlands and their values and functions is allowed. By evaluating 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, or
- **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 VT Wetlands Program's Class I website contains an interactive map and includes determinations for eight VT Class I wetlands: Dorset Marsh, Northshore Wetland, Tinmouth Channel, Chickering Fen, Dennis Pond Wetlands, Sandbar Wetlands, Peacham Bog and the LaPlatte River Wetlands. The last five wetlands were added in the past three years.

The Wetlands Program welcomes recommendations for Class I candidates. Tinmouth Channel is the only Class I wetland in Basin 3, however Beaver Meadow Wetland in Ripton and the Otter Creek Wetland Complex are recommended for Class I designation for having exceptional or irreplaceable functions and values. As of the writing of this plan, Beaver Meadow has an active Class I petition pending with the VDEC.

B. Identification of Existing Uses

The VANR 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 VANR may identify an existing use as Class B(1) when that use is demonstrably and consistently attained.

The VANR stipulates that all lakes and ponds in the basin have existing uses of swimming, boating, and fishing. The VANR recognizes that fishing activities in streams and rivers are widespread and too numerous to thoroughly document for Basin 3. In the case of streams too small to support significant fishing activity, the VANR 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 in Basin 3 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. The existing uses in Basin 3 of swimming, boating, fishing, and drinking water supply are found in Appendix B (Tables B1-B6). The public is encouraged to recommend waters for existing uses of swimming, boating, fishing, drinking water, and ecological significance given that they provide evidence of such use. New recommendations for existing uses should be sent to the Basin 3 Watershed Coordinator for review.

For existing uses of waters, the level of water quality necessary to protect those existing uses shall be maintained and protected regardless of the water's classification (VDEC, 2017).

Chapter 3 – Priority Areas for Surface Water Restoration

A. Stressed or Impaired Surface Waters

The VDEC monitors and assesses the chemical, physical, and biological status of individual surface waters to determine if they meet the VWQS per the 2016 VDEC Assessment and Listing Methodology (VDEC, 2016). Surface waters are assessed as: **full support, stressed, altered,** or **impaired**. To address Section 303(d) of the Federal Clean Water Act, the VDEC develops the 303(d) List of Impaired Waters, which includes impaired lakes, ponds, rivers, and streams that do not meet VWQS.

The State also produces the Priority Waters List, which identifies other waters that do not meet water quality standards, but do not require a TMDL. Sections of that list include: Part B- impaired waters that have other required remediation measures in place; Part D-impaired waters with TMDLs in place; Part E-waters altered by AIS; and Part F-waters altered by flow modifications. These lists can be viewed on the Vermont Environmental Atlas. For a more detailed description of monitoring results use the Vermont Integrated Watershed Information System online data portal. Figures 12-18 show the known stressed, impaired, or altered waterbodies in Basin 3. These figures also indicate where data gaps exist, which inform monitoring priorities for the 2019-2023 planning cycle (Table 14).

A primary goal of the plan is to identify and address pollutants degrading the listed waters (Figures 12-18) through strategies in the Chapter 5 Implementation Table. The types of actions prescribed are based on the sector-specific practices outlined in the Vermont Surface Water Management Strategy.

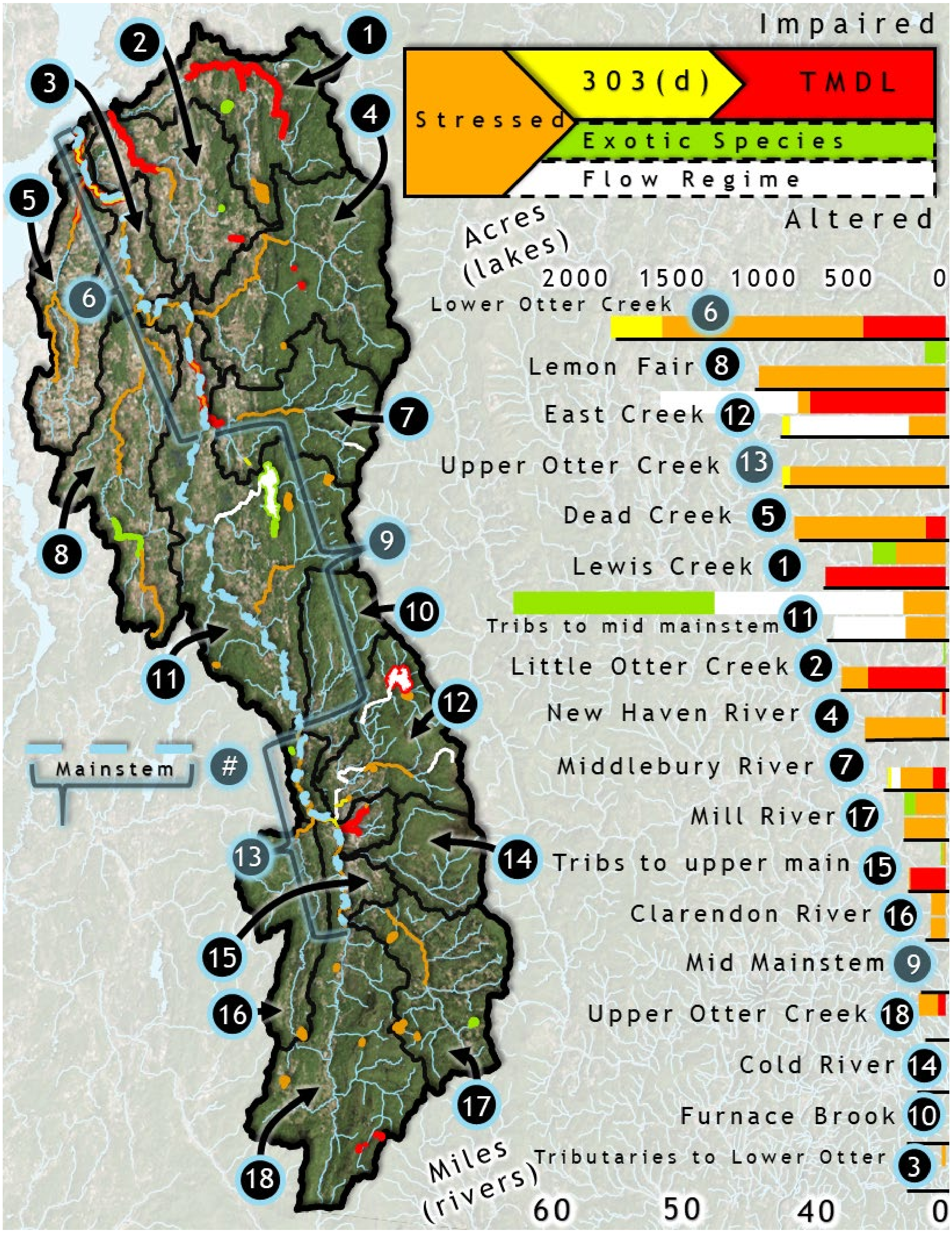


Figure 11. Overview of stressed and impaired waters in Basin 3.

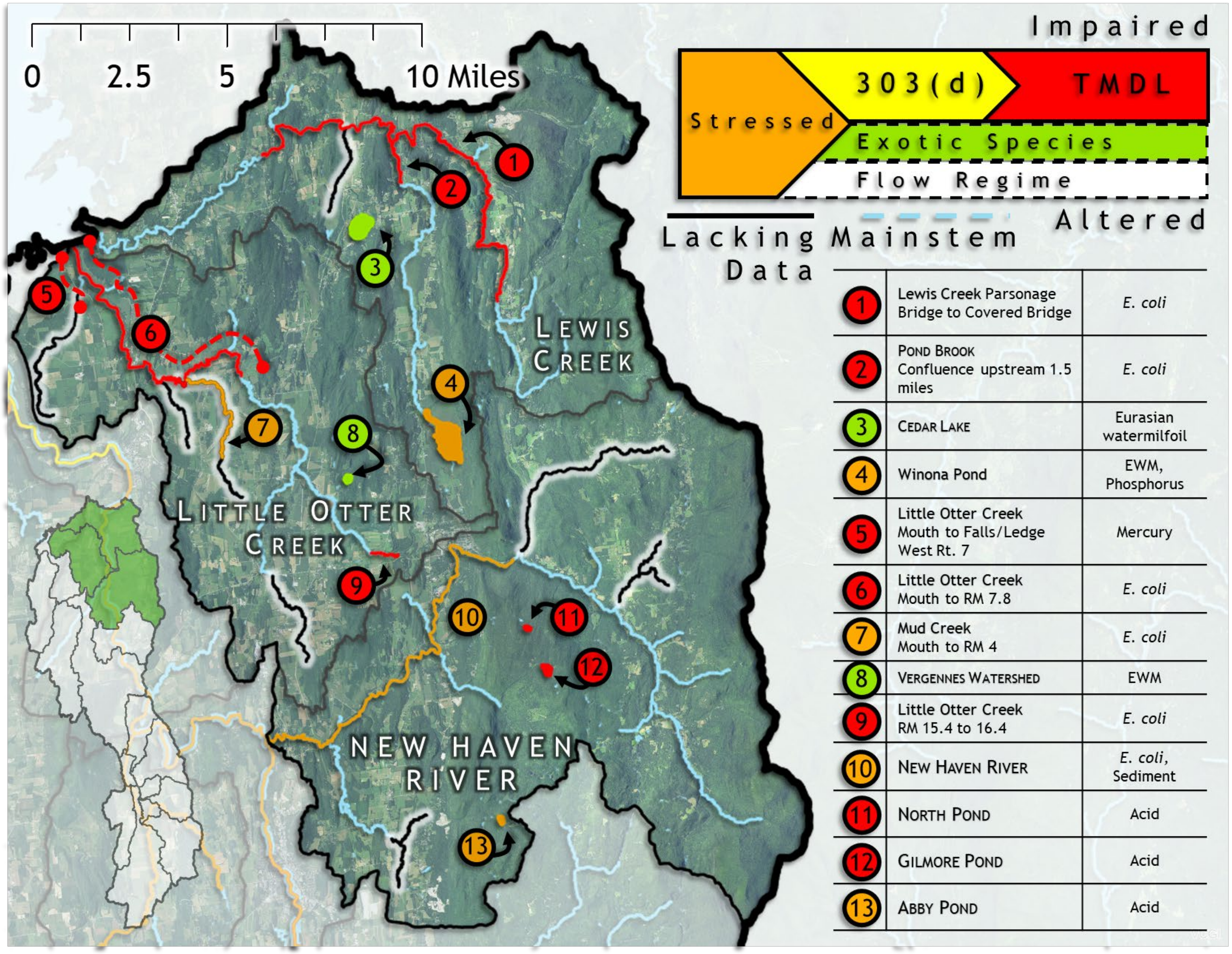


Figure 12. Stressed and impaired waters of Lewis Creek, Little Otter Creek, and the New Haven River. EWM = *Eurasian watermilfoil.*

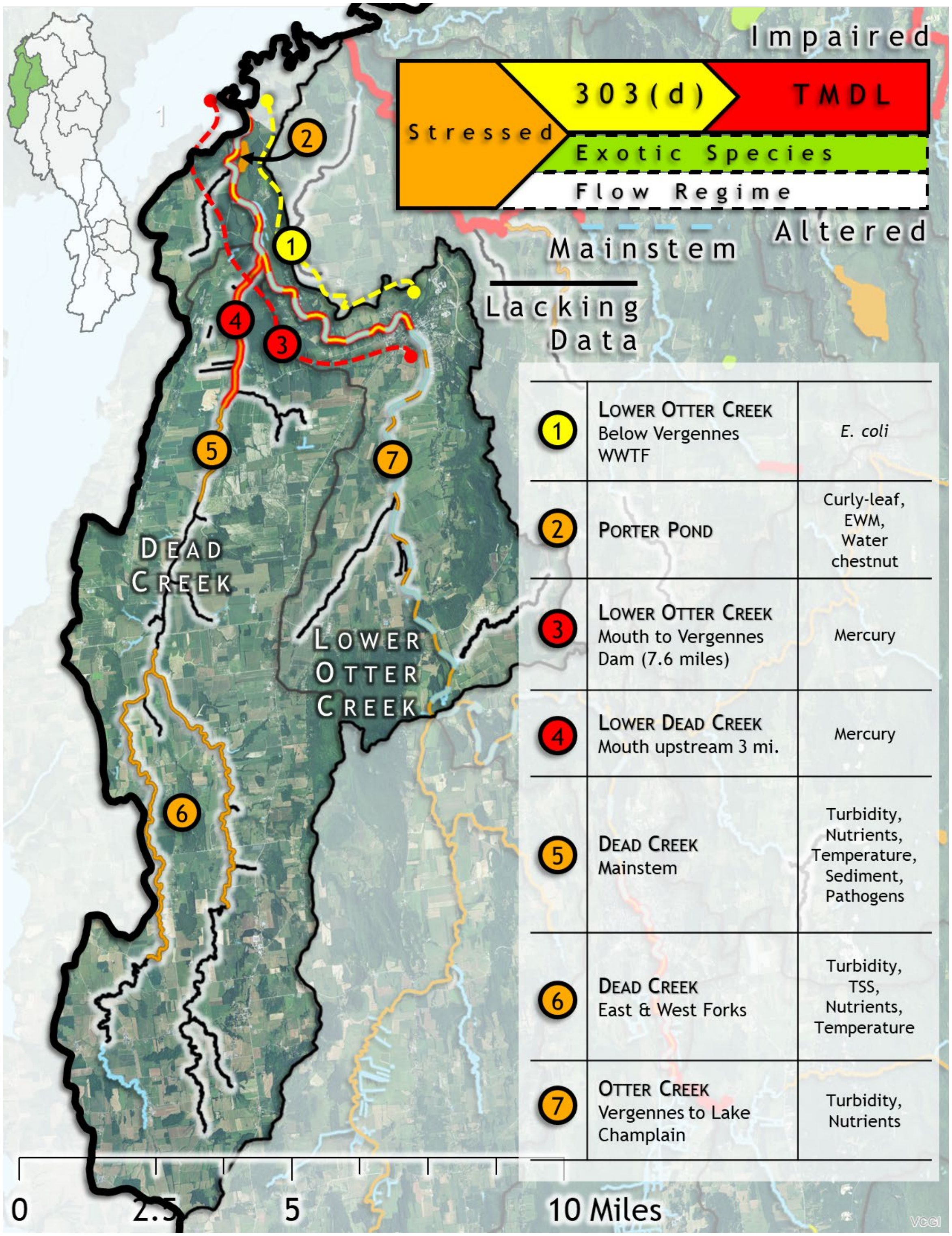


Figure 13. Stressed or impaired waters of Lower Otter Creek, including Dead Creek. EWM = *Eurasian watermilfoil*, TSS = Total Suspended Solids.

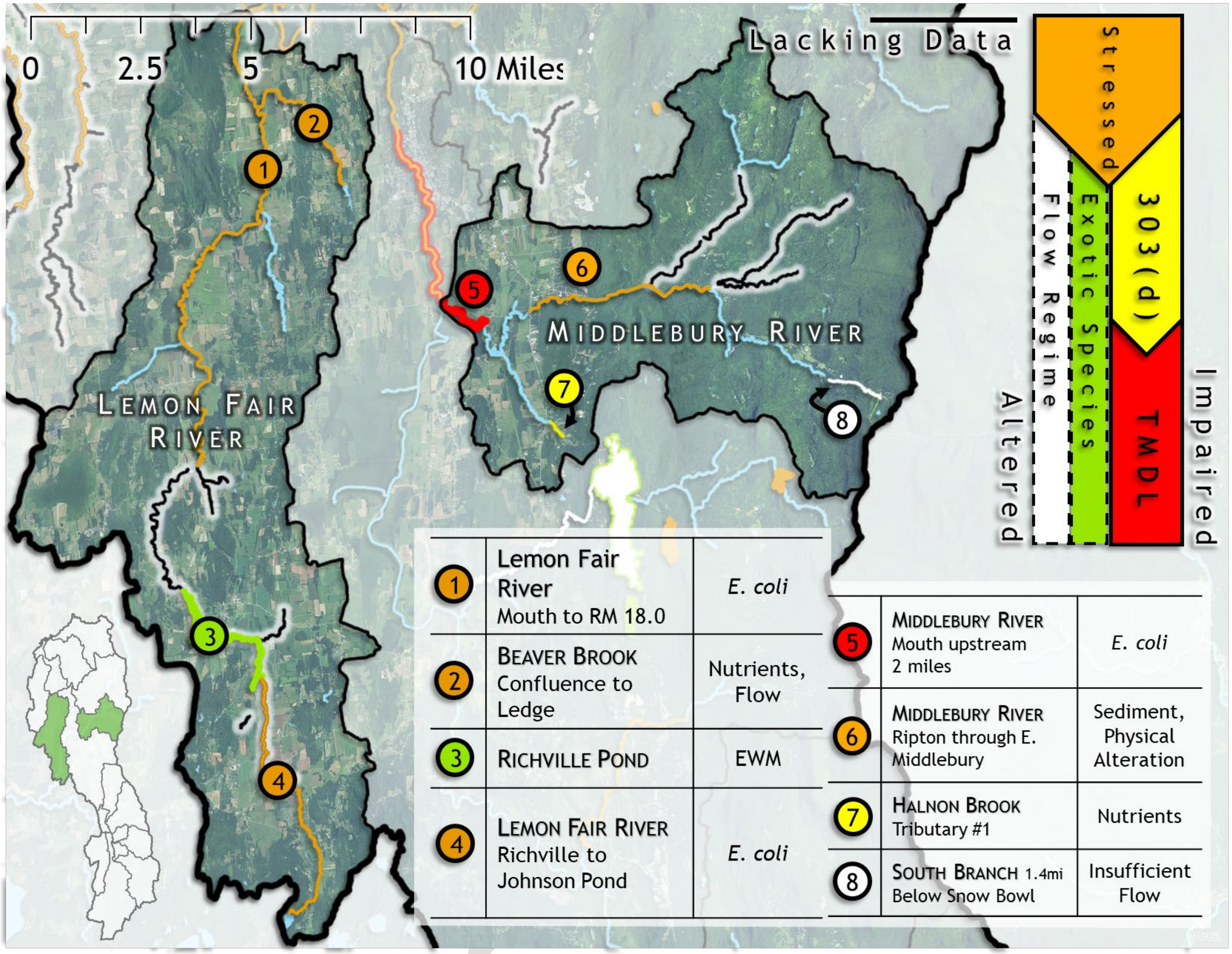


Figure 14. Stressed and impaired waters of the Otter Creek, including the Lemon Fair and Middlebury River. EWM = *Eurasian watermilfoil.*

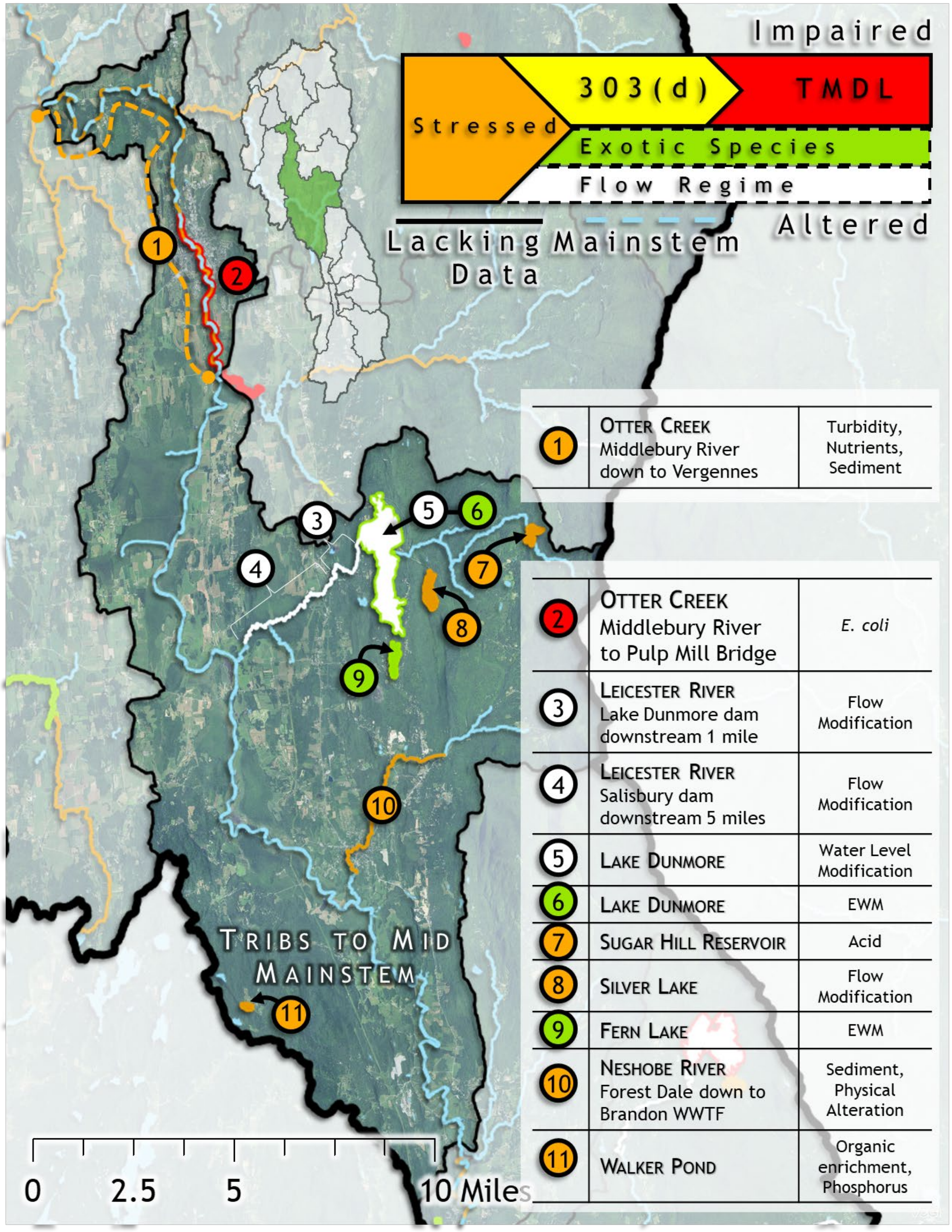


Figure 15. Stressed and impaired waters of the Otter Creek, including tributaries of the mid mainstem. EWM = *Eurasian watermilfoil*.

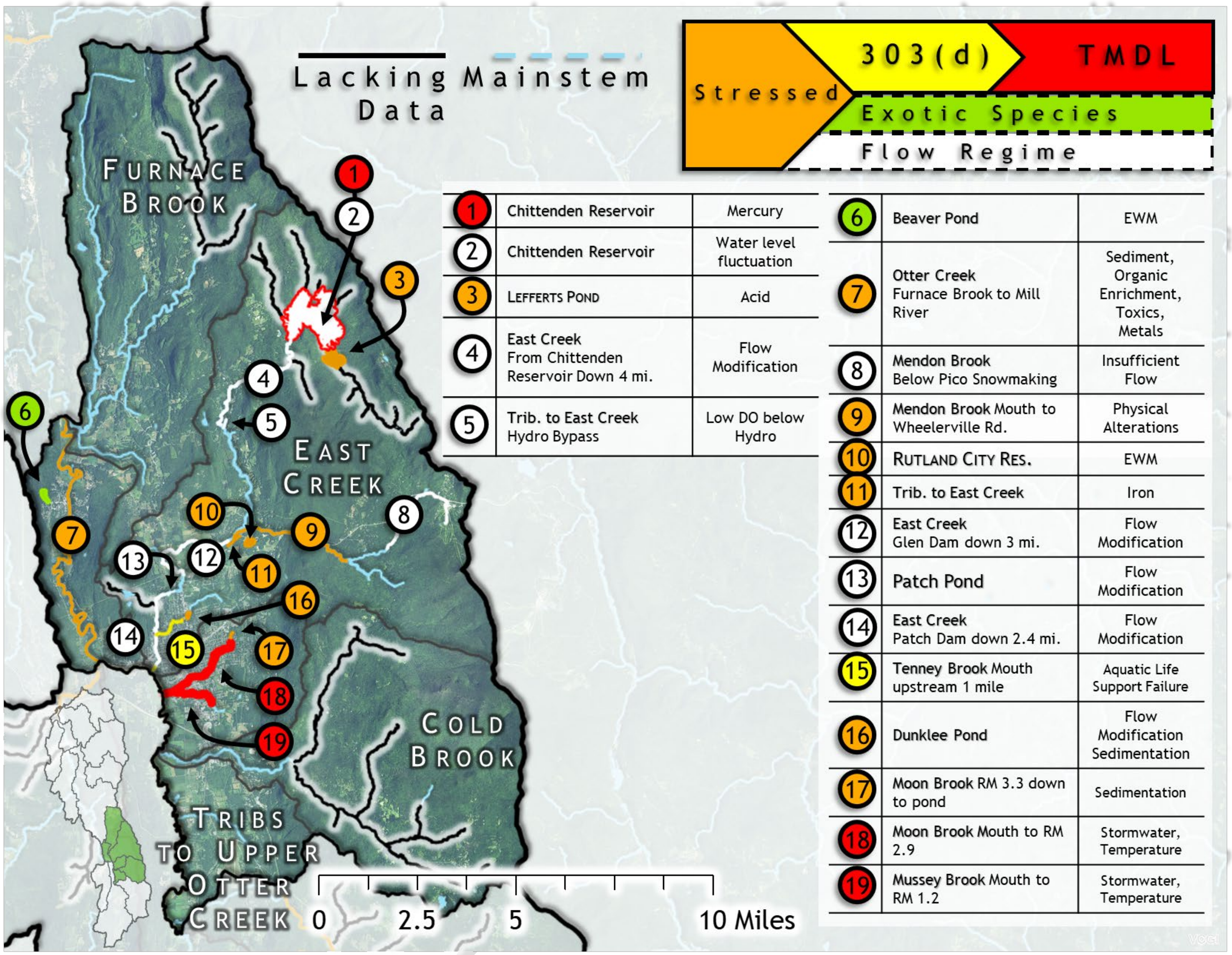


Figure 16. Stressed and impaired waters of the Upper Otter Creek watershed, including Furnace Brook, East Creek, and Cold Brook. EWM = *Eurasian watermilfoil,* DO = dissolved oxygen.

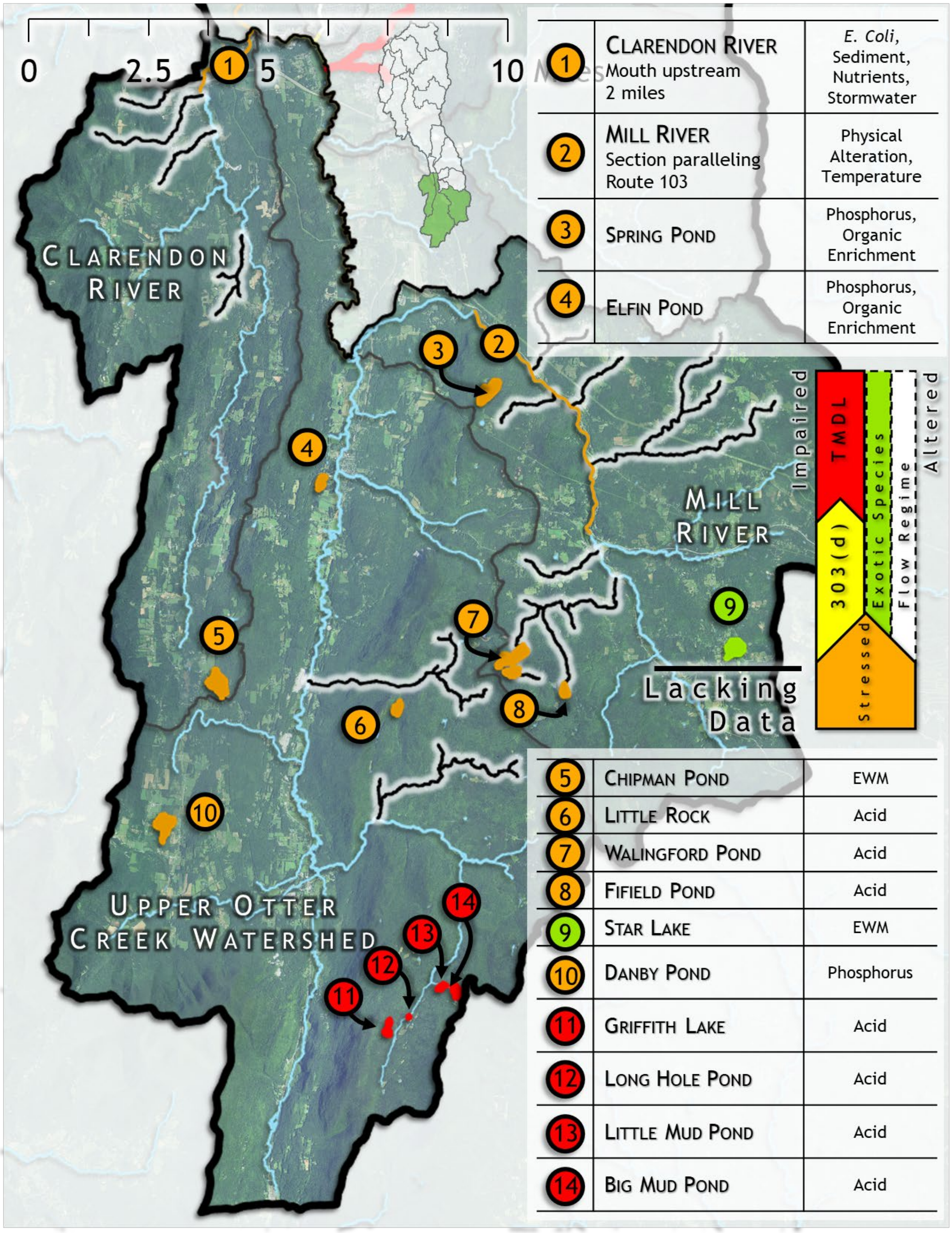


Figure 17. Stressed and impaired waters of the Upper Otter Creek watershed, including the Clarendon River and the Cold River. EWM = *Eurasian watermilfoil*.

B. Basin Specific Total Maximum Daily Loads (TMDLs)

A TMDL is the calculated maximum amount of a pollutant that a waterbody can receive and still meet VWQS. In a broader sense, a TMDL is a plan that identifies the pollutant reductions a waterbody needs to meet VWQS and develops a means to implement those reductions. 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 needed pollution reductions.

The Federal Clean Water Act requires TMDLs be developed for waters included on the state's 303(d) list of Impaired Waters. The list provides a schedule indicative of TMDL completion priority.

Waters with a completed TMDL or a TMDL equivalent are listed in 2018 Priority Listing of Vermont Waters. This list identifies waters that do not meet standards but do not require a TMDL.

Table 2. TMDLs in Basin 3.

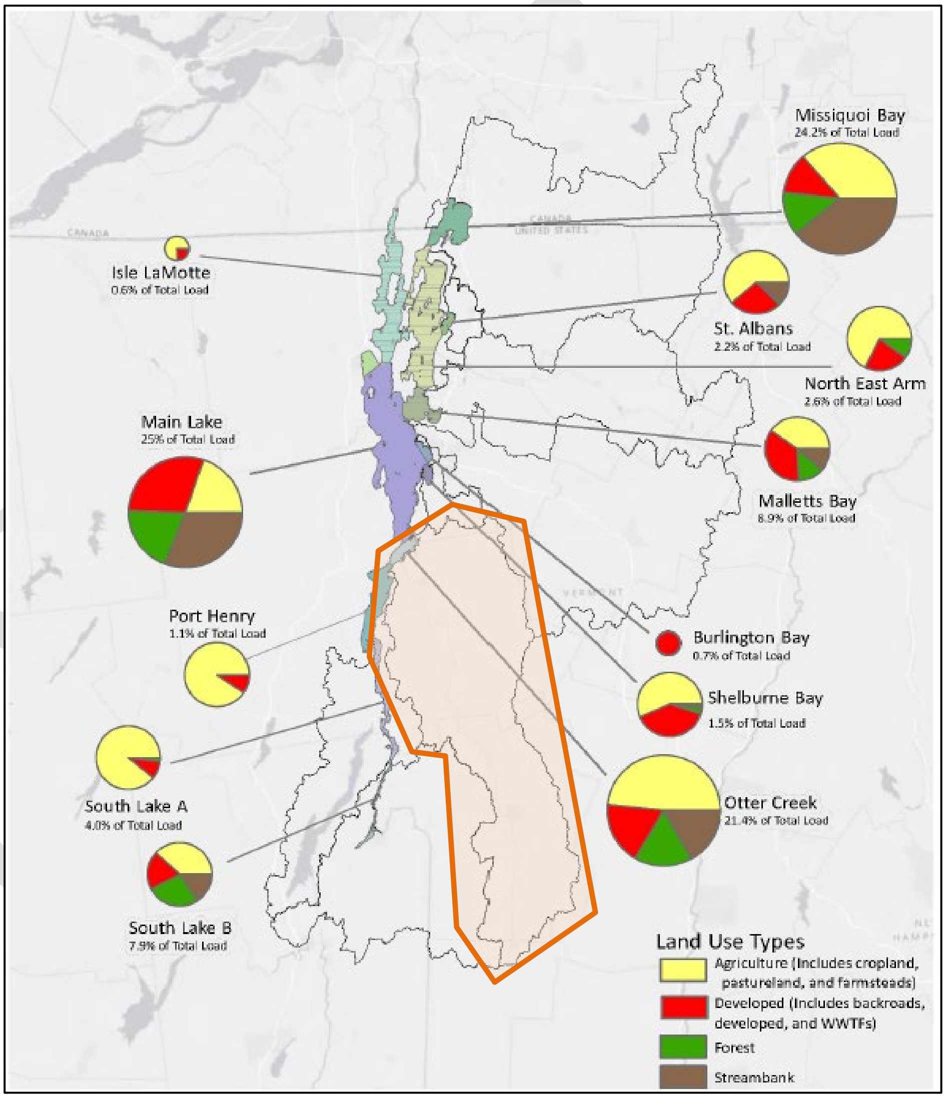
Name	Pollutant	Problem	Status
Otter Creek, mouth of Middlebury River to Pulp Mill Bridge (4.0 Mi.)	*E. coli*	Agricultural runoff, possible failed septic systems, Middlebury CSOs	EPA APPROVED TMDL SEPTEMBER 30, 2011
Lower Otter Creek, mouth upstream to Vergennes Dam (approx. 7.6 miles)	Mercury	Elevated levels of Hg in Walleye	EPA APPROVED REGIONAL MERCURY TMDL ON DECEMBER 20, 2007
Moon Brook, mouth to RM 2.9 (including Mussey Brook)	Stormwater	Stormwater runoff; erosion	EPA APPROVED TMDL FEBRUARY 19, 2009
Moon Brook, RM 1.8 to RM 2.9	Temperature	Elevated instream temperatures; impoundments and lack of shading	Thermal TMDL completed by VDEC and approved by EPA Region 1, May 2018
Mussey Brook, upstream from mouth to RM 1.2	Stormwater	Stormwater runoff; erosion	EPA APPROVED TMDL (as part of Moon Bk. TMDL) FEBRUARY 19, 2009
Mussey Brook, RM 0.1 to RM 0.5	Temperature	Elevated instream temperatures; Trout avoidance of stream reaches	Thermal TMDL completed by VDEC and approved by EPA Region 1, May 2018
Little Otter Creek, mouth upstream to falls/ledge West Rt. 7 (circa 1 Mi.)	Mercury	Elevated levels of Hg in Walleye; fish present only seasonally; extremely low #s	EPA APPROVED REGIONAL MERCURY TMDL ON DECEMBER 20, 2007
Little Otter Creek, mouth to RM 7.8	*E. coli*	Elevated *E. coli* monitoring results	EPA APPROVED TMDL SEPTEMBER 30, 2011

Little Otter Creek, RM 15.4 to RM 16.4	*E. coli*	Agricultural runoff	EPA APPROVED TMDL SEPTEMBER 30, 2011
Lewis Creek, Parsonage Bridge Rd. (LCR19.5) to covered bridge (LCR7.3)	*E. coli*	Agricultural runoff	EPA APPROVED TMDL SEPTEMBER 30, 2011
Pond Brook, from Lewis Creek confluence upstream (1.5 miles)	*E. coli*	Agricultural runoff	EPA APPROVED TMDL SEPTEMBER 30, 2011
Lower Dead Creek, from mouth upstream (approx. 3 miles)	Mercury	Elevated levels of Hg in Walleye	EPA APPROVED REGIONAL MERCURY TMDL ON DECEMBER 20, 2007
North Pond (Bristol)	Acid	Atmospheric deposition: critically acidified; chronic acidification	EPA APPROVED TMDL SEPTEMBER 30, 2003
Gilmore Pond (Bristol)	Acid	Atmospheric deposition: extremely sensitive to acidification; episodic acidification	EPA APPROVED TMDL SEPTEMBER 30, 2003
Middlebury River, from mouth upstream 2 miles	*E. coli*	Agricultural runoff, livestock, possible failed septic systems	EPA APPROVED TMDL SEPTEMBER 30, 2011
Chittenden Reservoir (Chittenden)	Mercury	Elevated levels of Hg in Walleye	EPA APPROVED REGIONAL MERCURY TMDL ON DECEMBER 20, 2007
Griffith Lake (Peru)	Acid	Atmospheric deposition: extremely sensitive to acidification; episodic acidification	EPA APPROVED TMDL SEPTEMBER 30, 2003
Big Mud Pond (Mt. Tabor)	Acid	Atmospheric deposition: extremely sensitive to acidification; episodic acidification	EPA APPROVED TMDL SEPTEMBER 30, 2003
Long Hole (Mt. Tabor)	Acid	Atmospheric deposition: critically acidified; chronic acidification	EPA APPROVED TMDL SEPTEMBER 30, 2003
Little Mud (Mt. Tabor)	Acid	Atmospheric deposition: extremely sensitive to acidification; episodic acidification	EPA APPROVED TMDL SEPTEMBER 30, 2003
Otter Creek section - Lake Champlain (Ferrisburgh)	Mercury	Elevated levels of Hg in Walleye	EPA APPROVED REGIONAL MERCURY TMDL ON DECEMBER 20, 2007

Otter Creek section - Lake Champlain (Ferrisburgh)	Phosphorous	P enrichment	EPA APPROVED LAKE CHAMPLAIN PHOSPHORUS TMDL JUNE 2016

C. The Lake Champlain Phosphorus TMDL

In 2016 EPA approved the [Vermont Lake Champlain Phosphorus TMDL Phase 1 Implementation Plan]() and the State is implementing a 20-year, phased restoration plan for the Lake and its tributaries. The plan addresses all major sources of Phosphorous (P) to the Lake and involves new and increased efforts from nearly every sector, i.e., agriculture, developed lands—stormwater and roads, wastewater, and natural resources. The State's "all-in" approach depends on federal and state government working with municipalities, farmers, developers, watershed organizations, and homeowners to improve water quality.



Source: US Environmental Protection Agency, 2016.

Figure 18. Vermont sources of P loading to Lake Champlain segments, by land use; annual average of 2001-2010. The Otter Creek Basin is highlighted in the orange polygon.

Vermont contributes ≈ 69% (630.6 MT/yr.) of the total phosphorus (TP) load per year to Lake Champlain in comparison to Quebec at 9% (77 MT/yr.) and New York at 23% (213.8 MT/yr.). On average, the Otter Creek receives ≈ 21. 4% (141 MT/yr.) of the VT portion of the TP load to Lake Champlain compared to the South Lake, which receives ≈ 13% (84.6 MT/yr.) of the total load and Shelburne Bay, which receives ≈ 1.5% (10.2 MT/yr.) of the total load (Figure 19).

Phosphorus in the Lake comes primarily from nonpoint sources. Nonpoint sources deliver P from the land to waterways by rain or snowmelt. Nonpoint sources include: stormwater runoff from developed lands including roads and parking lots, lawns, agriculture, timber harvest operations, and eroding river channels. Point sources of P include: regulated stormwater discharges and waste water treatment facilities (WWTF).

Measuring the amount of P in water that comes out of a pipe (point source) is less complicated than measuring P in water flowing over land surfaces (non-point source). As a result, determining P loading of non-point sources requires environmental modeling based on long-term field measurements and land use information from satellite imagery and LiDAR data. More information on how P loading was projected in the Lake Champlain Basin (LCB) can be found in Chapter 5 of the Phosphorus TMDLs for Vermont Segments of Lake Champlain.

The Otter Creek Basin and the Lake Champlain Phosphorus TMDL

The Otter Creek drains into the Otter Creek segment of Lake Champlain, which then flows north. Compared to the 10 major watershed contributors shown in Figure 20, the Otter Creek Basin is

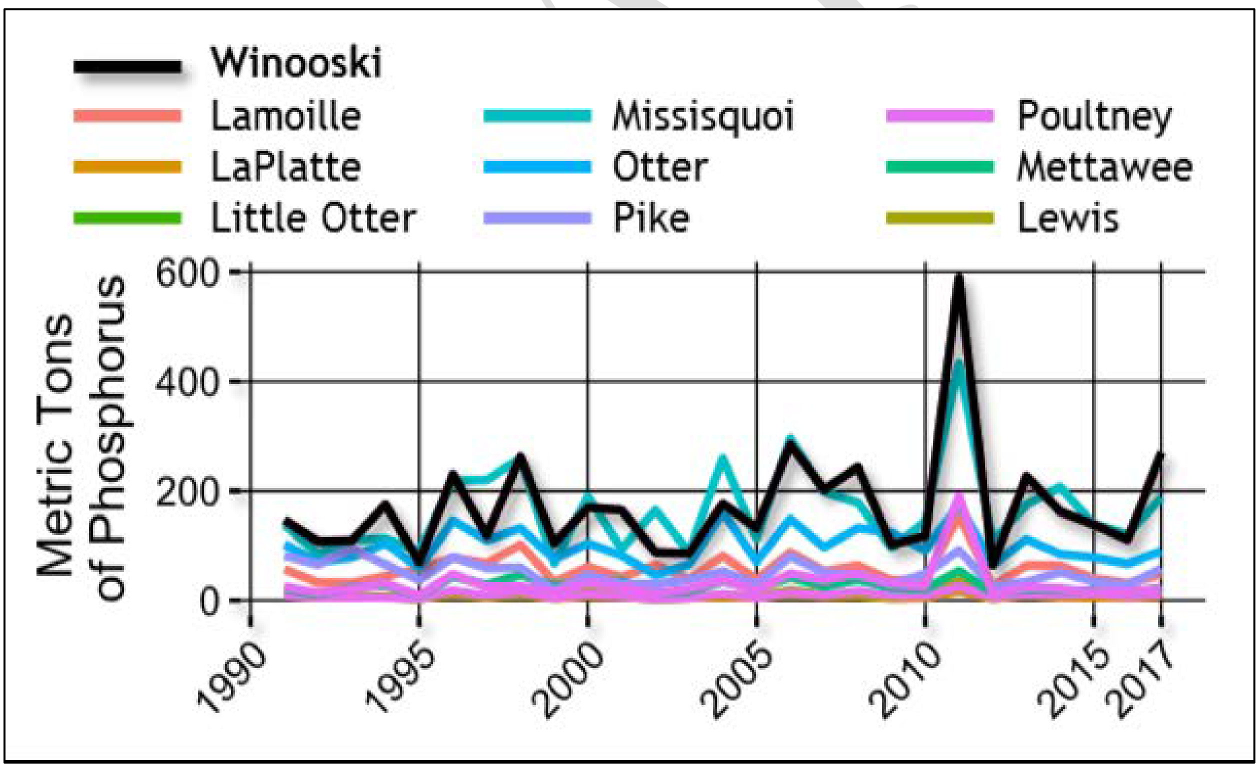


Figure 19. Annual total P contributions to Lake Champlain from 1990 to 2017 by the 10 watersheds in the Lake Champlain basin. The Otter Creek is shown in BLUE. Source: www.lcbp.org.

Vermont's third highest contributor of P into Lake Champlain after the Winooski and Missisquoi basins. In order to implement the Lake Champlain P TMDL (LC TMDL), annual TP loading into the Otter Creek is required to decrease by approximately 47 % (averaged across all sectors) or by ≈ 40 MT/yr.

Phosphorus pollution in the Otter Creek Basin ultimately ends up in Lake Champlain, but the sources of P by land use type are slightly different within the Otter Creek Basin compared to the entire LCB (Figures 21 and 22).

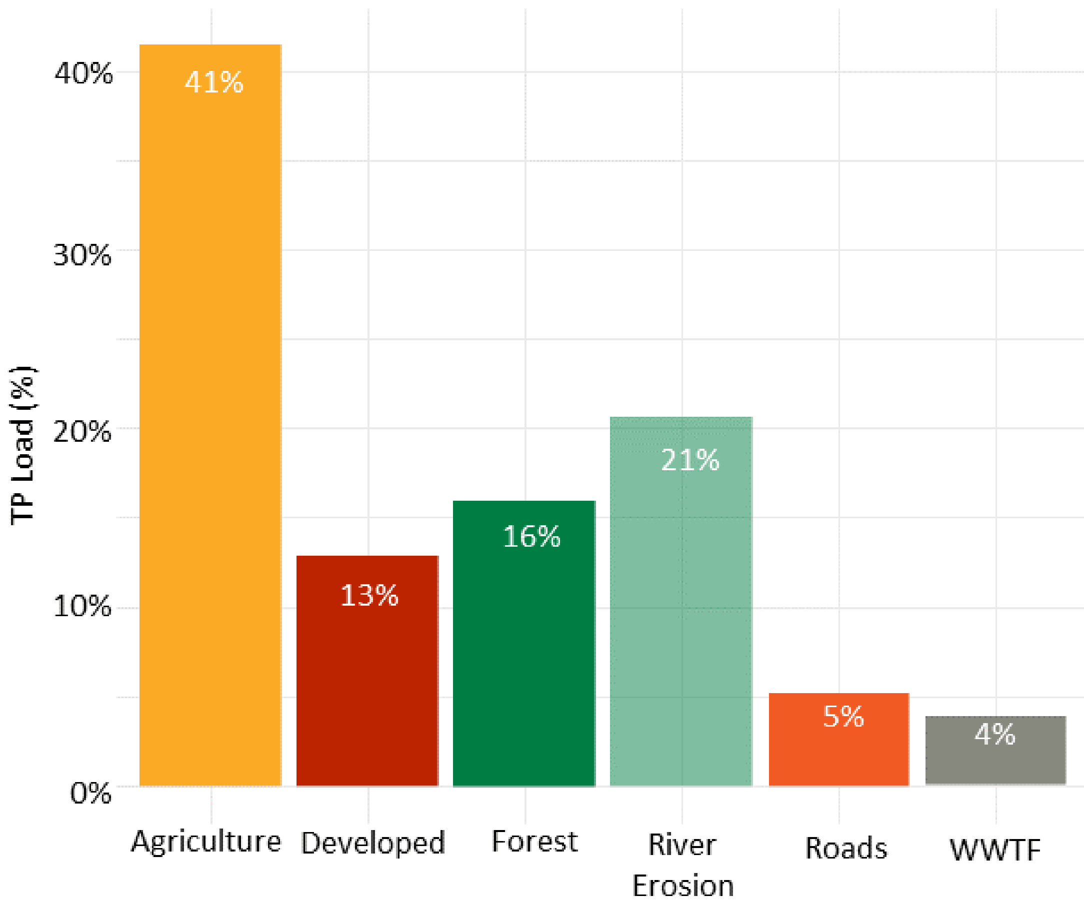


Figure 20. Modeled total P loading (%) to Lake Champlain by land use sector. Source: Tetra Tech Inc., 2016.

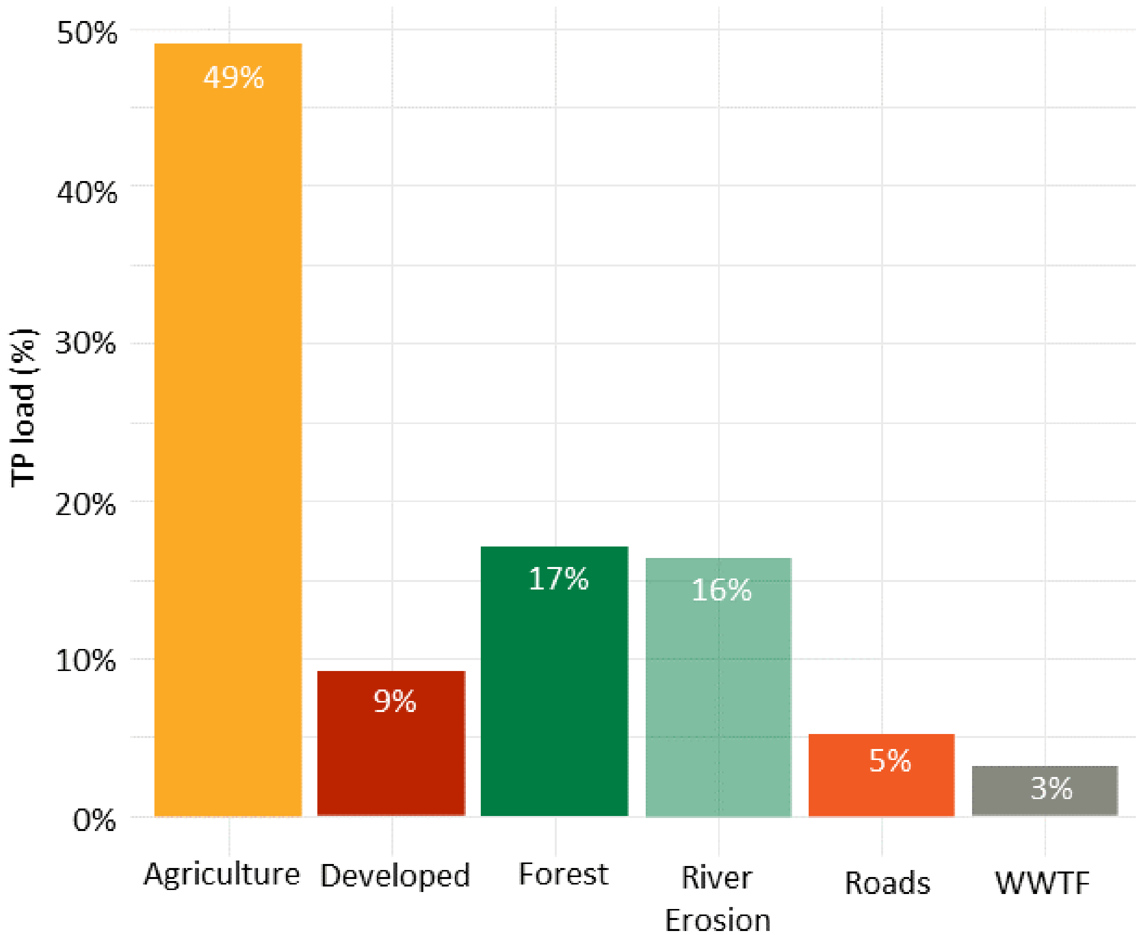


Figure 21. Modeled total P loading (%) to Lake Champlain by land use sector from the Otter Creek segment. Source: Tetra Tech Inc., 2016.

Specifically, Basin 3 contributes more P from agricultural lands (49%) and less from developed lands (9%) and river erosion (16%) compared to the entire LCB (Figures 21 and 22).

Understanding the relationship between P and land use is important, because P pollution is a significant threat to clean water in the Otter Creek Basin and Lake Champlain, which both provide recreational and drinking water uses, as well as aquatic life and habitat functions. Addressing P pollution through actions on the landscape will also lead to reductions in other pollutants in the watershed. This is because other pollutants (e.g., N and bacteria) can be released from land and river erosion as well as land use runoff. Much of the P from the eroding landscape comes in the form of particulate P, which is bound to sediment and becomes a transport mechanism of P to surface water during periods of runoff.

This plan reports actions to reduce P loading from different land uses in sub-watersheds and watersheds within the basin. However, the reduction of P in Lake Champlain could take decades and accomplishing all the necessary P reduction actions will require many phases. Progress is currently being tracked through the Clean Water Initiative Program's (CWIP) internal tracking system (i.e., Best Management Practice Accounting and Tracking Tool (BATT)) and also in the Interagency Clean Water Projects Dashboard.

TMDL allocations for the Otter Creek segment of Lake Champlain

Table 3 below provides the final P allocations and the resulting reductions required for the Otter Creek segment of Lake Champlain. These values are taken directly from the final LC TMDL and the Phase I Implementation Plan (2016). For the Otter Creek segment, the allocations reflect a 40.1% reduction from streambanks, a 5% reduction from forest lands, a 46.9% reduction from agricultural sources, and a 15% reduction from developed lands.

Table 3. Summary table of allocations for the Otter Creek segment of Lake Champlain.

Source	Category	Allocation Category	Total Allocation (MT/yr.)	Reduction Required (%)
Forest	All lands	Load	22.78	5
Stream Channels	All streams	Load	13.76	40.1
Agriculture	Fields/pasture	Load	35.48	46.9
	Production areas	Wasteload	0.41	80
Developed Lands	VTrans owned roads and developed lands	Wasteload	17.56	15
	Roads MRGP	Wasteload		
	MS4	Wasteload		
	Larger unregulated parcels	Wasteload		
Wastewater	WWTF discharges	Wasteload	11.98	0
	CSO discharges	Wasteload	included with developed lands	15

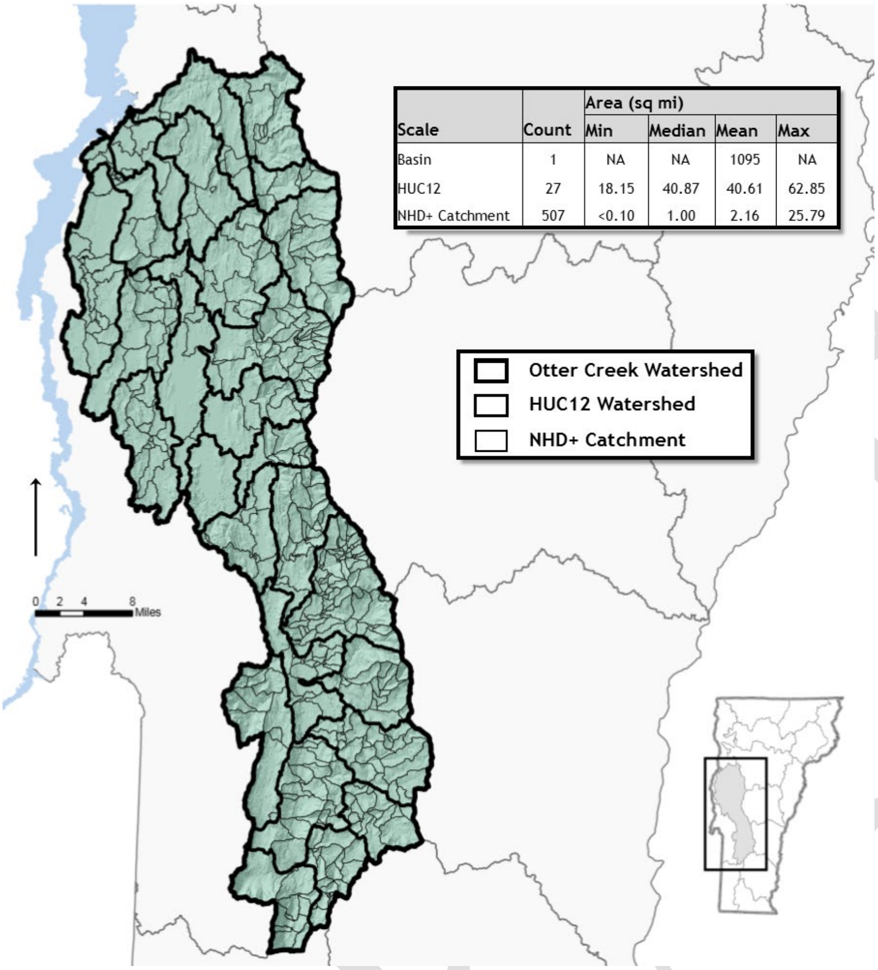
Lake Champlain Phosphorus TMDL Phase II Plan

The LC TMDL establishes the allowable P loadings, or allocations, from the watershed for lake water quality to meet established standards. These allocations are apportioned both by land use sector (e.g., developed land, agriculture, etc.) and by lake watershed basin (e.g., South Lake, Otter Creek, etc.). Due to the large size of the LCB in VT, the modeling techniques used to estimate loading were implemented at a coarse scale. For example, the modeled loading at the mouth of the major river basins is based on monitoring data and represents the collective inputs from the various land uses and physical features of the watershed. At the basin scale, this is useful to estimate the necessary level of P reducing Best Management Practices (BMPs).

As part of the LC TMDL development, EPA completed a "Reasonable Assurance" analysis at the basin scale and determined it was theoretically possible to obtain to necessary P reduction through appropriate application of BMPs across all sectors. However, there is no specific prescription as to where BMPs should be applied. It is through tactical basin planning that local opportunities for BMPs can be identified and prioritized for implementation.

The LC TMDL is being implemented through site specific BMPs and regulatory and non-regulatory programs. While many programs are "self-implementing", in many instances, application follows a two-step process of first knowing "where to look" for opportunities followed by "what to do". Many P reduction programs require an initial assessment phase to identify what BMPs already exist on the landscape and where others are needed. After the assessment phase, tactical basin plans prioritize areas expected to export the most P, identify funding sources, and implementation is carried forward. Chapter 4 of this plan examines how these P reductions will be met across all land use sectors within the Otter Creek Basin including regulatory and non-regulatory programs.

Several modeling products were used to determine where LC TMDL reductions will be most effective to implement the TMDL. The EPA SWAT (Soil and Water Assessment Tool) model was developed to estimate P loading from the LCB from various land use sectors for development of the TMDL. Discrete SWAT models were calibrated and validated for each of the Hydrologic Unit Code – level 8 (HUC8) watersheds as well as for direct drainages to the lake. Three additional tools were developed from the SWAT modeling results: the HUC – level 12 (HUC12) Tool, the BMP Scenario Tool, and the Clean Water Roadmap, which downscales the SWAT modeling from the HUC12 scale to the catchment level. In the sector-specific sections of Ch. 4, varying spatial scales are used, depending on the source sector (Figure 23). In order of decreasing size, they are the major river basin (i.e., HUC-8), major tributary or sub-basin (i.e., HUC12), and the NHD+ catchment scale.



Scale	Count	Area (sq mi) Min	Median	Mean	Max
Basin	1	NA	NA	1095	NA
HUC12	27	18.15	40.87	40.61	62.85
NHD+ Catchment	507	<0.10	1.00	2.16	25.79

Figure 22. Comparison of Basin, HUC12, and NHD+ Catchment spatial scales used in this plan.

The LC TMDL also incorporates an "Accountability Framework" to ensure that P reduction actions are implemented at a sufficient pace to meet the TMDL requirements. While the specific timeline for lake improvement isn't specified by the TMDL, an estimate of the projected P reduction is identified within each TBP on a 5-year, rotating basis. Beginning in 2018, the "Accountability Framework" is built around the priority milestones contained in the each of the Phase 2 Implementation (Tactical Basin) Plans. Each TBP's implementation table lays out priority actions to be taken by specific dates and if not specified, the 5-year basin planning cycle is implied. Those actions and dates constitute the report card elements for the basin. EPA envisions issuing an interim report card halfway through each 5-year cycle and a formal assessment at the end of the cycle. The TBP implementation tables translate the results of the integrated assessments into spatially explicit areas for project implementation and support programmatic and partner installation of BMP's in order to reduce P loads by a projected amount for each planning cycle. These science-based assessments also serve to identify where additional regulatory program requirements may be brought to bear by the relevant programs. Tactical basin plan implementation tables will be frequently updated to reflect the implementation of practices that are required as a result of regulatory program requirements. Subsequent iterations of TBP implementation tables will be considered as subsequent phases of TMDL implementation, which are intended to:

1. Document and report on progress made per assessment and implementation efforts,
2. Identify gaps in programmatic capacity the jurisdictions will need to address in the next 5-year cycle for each major river basin in the LCB,
3. Identify corollary and/or co-benefits from project implementation, and
4. Revisit local, regional, and federal engagement strategies and commitments.

D. Priority Areas for Restoration

By analyzing the priority waters list and areas identified as sources in TMDL's, the following focus areas have been identified for water quality restoration by land use sector, i.e., Agriculture, Developed Lands—Stormwater, Developed Lands--Roads, Wastewater, and Natural Resources. (see detailed sector descriptions in Ch. 4).

Table 4. Focus areas for implementation of water quality projects by sector in Basin 3.

Sector	*Focus Areas (not to exclude work in other areas)*	*Strategies*
AGRICULTURE	Dead Creek, Little Otter Creek, Lewis Creek, Upper and Lower Lemon Fair	• Support regional agricultural working group • Hold annual soil health, BMP and/or RAP workshops • Support farmers in developing and implementing Nutrient Management Plans (NMPs) • Initiate a regional equipment sharing program • Identify areas lacking vegetated riparian buffer zones and promote buffer planting programs • Identify areas where agriculture is coincident with wetlands to guide restoration efforts • Conduct water quality monitoring and research to understand P, bacteria, and sediment source areas
DEVELOPED LANDS	Rutland City, West Rutland, Rutland Town, Mendon, Brandon, Pittsford, Clarendon, Middlebury, Vergennes	• Develop Stormwater Master Plans/Reports (Ch. 4) • Implement priority practices from Stormwater Master Plans/Reports • Develop and implement GSI practices at local schools • Support MS4 municipalities and non-municipal MS4s in their work to develop and implement Flow Restoration Plans and P Control Plans

Sector	*Focus Areas (not to exclude work in other areas)*	*Strategies*
ROADS	Homer Stone Brook-Otter Creek (i.e., Towns of Wallingford, Tinmouth, Danby, Mount Tabor), Mill Creek (i.e., Mount Holly, Shrewsbury), Clarendon River (i.e., Ira, Clarendon), and in the headwaters of the Lewis Creek (i.e., Hinesburg, Starksboro	• Complete REI's (Ch. 4) and provide technical support to towns • Support for towns in applying for funding to target WQ issues • Address Class 4 WQ issues with support from Addison County Regional Planning Commission (ACRPC) and Rutland RPC (RRPC) • Host Workshops and Peer to Peer sharing on BMP's • Identify towns in need of equipment and apply for shared equipment grant funding
Forestland NATURAL RESOURCES	Timber harvest areas, A(1) and B(1) watersheds	• Support skidder bridge program • Promote AMPS and implementation of Voluntary Harvesting Guidelines with an emphasis on riparian buffer protections
Lakeshore NATURAL RESOURCES	Tinmouth, Cedar Lake	• Support Lake Wise planning, assessment and implementation • Complete a Lake Wise assessment of Tinmouth Pond and Cedar Lake and implement practices
River Connectivity NATURAL RESOURCES	Rutland City, Chittenden, Mendon, Goshen, Lewis Creek, Cold River, East Creek, Middlebury River, Mill Brook, Moon Brook, Mussey Brook, New Haven River	• Develop and implement projects from river corridor plans • Restore floodplain access and stream stability through active projects or river corridor easements & buffer planting projects • Remove obsolete or compromised dams (e.g., Dunklee Pond Dam). • Strategic wood additions in locations where this is identified by VFW and USFS. • Provide outreach to communities on floodplain and river corridor protections
Wetlands NATURAL RESOURCES	Otter Creek Watershed	• Increased mapping of wetlands by municipalities or by VDEC, which becomes a public facing advisory layer on the ANR Atlas • Analyze restoration potential maps and pursue restoration of high priority areas

*Project leaders and partners are identified in Chapter 5.

Chapter 4 –Strategies to Address Pollution by Source Sector

Tactical basin plans address water quality by sector as summarized in the following sections which are consistent with the CWIP's Clean water investment report (State of Vermont Treasurer, 2019).

Agriculture

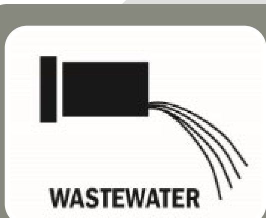
- Conservation practices that reduce sources of pollution from farm production areas and farm fields.

Developed Lands--Stormwater

- Practices that reduce or treat polluted stormwater runoff from developed lands, such as parking lots, sidewalks, and rooftops.

Developed Lands--Roads

- Stormwater and roadside erosion control practices that prevent erosion and treat road-related sources of pollution.



Wastewater

- Improvements to municipal wastewater infrastructure that decrease pollution from municipal wastewater systems through treatment upgrades, combined sewer overflow (CSO) abatement, and refurbishment of aging infrastructure.

Natural Resource Restoration

- Restoration of "natural infrastructure" functions that prevent and abate pollution. Natural infrastructure includes: floodplains, river channels, lakeshores, wetlands, and forest lands.

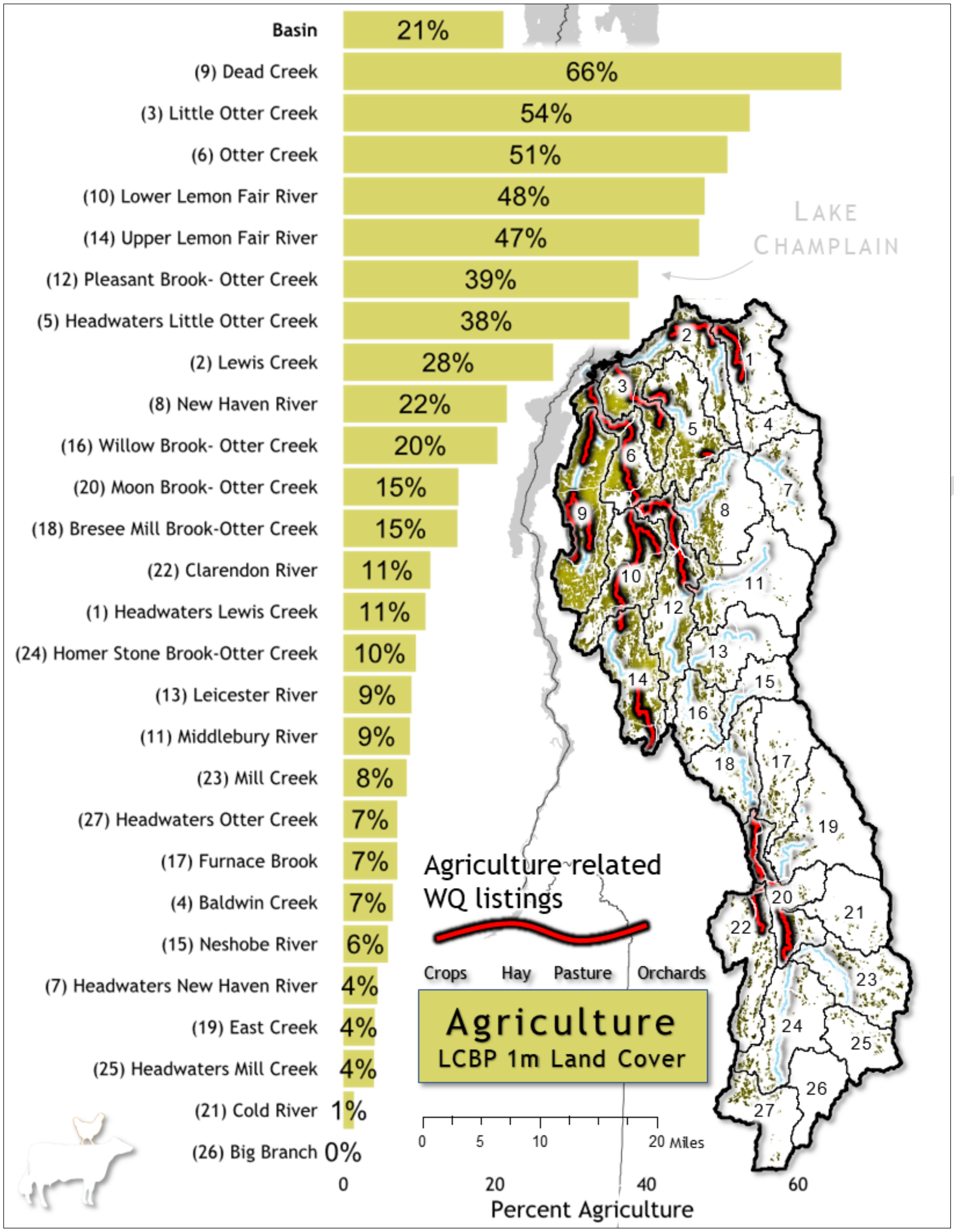
A. Agriculture

Agriculture accounts for 21% of Basin 3 land use and is concentrated in Dead Creek, Little Otter Creek, Lower Otter Creek, and the Upper and Lower Lemon Fair (Figure 24). Runoff from agriculture adversely affects 122.4 miles of rivers and 668 acres of lakes in the basin. These estimates represent 62% of the total impaired river miles and 41.3% of the total stressed/impaired lake acreage in the basin. Agricultural loads are 49% of the estimated P loading to Lake Champlain from the Otter Creek segment (Figure 22).

Agriculture can adversely affect water quality as nutrients, pathogens, and sediments are exported from farms when waste storage facilities or erosion control methods fail, or heavy rains and floods inundate fields and wash sediment, manure, or fertilizer from fields and farmstead areas. Conversely, well managed agricultural lands and implementation of BMPs can filter precipitation, improve soil health, and remove nutrients through vegetative uptake (i.e., from crops or riparian buffers), especially in comparison to developed lands.

This section presents basin specific strategies to address agricultural water resource impairments through regulatory programs, BMP implementation, funding sources, outreach efforts, and partnerships. The tactical basin planning approach engages local, regional, and federal partners in the development of these strategies needed to accelerate agricultural BMPs to meet the state's clean water goals including reductions to comply with the LC TMDL. This section is organized around the Vermont Agency of Agriculture, Food, and Markets (VAAFM) regulatory programs including the Required Agricultural Practices (RAPs), the Large Farm Operation Program (LFO), the Medium Farm Operation Program (MFO) and the Certified Small Farm Operations Program (CSFO), and the available agricultural assistance and outreach programs, and local coordination efforts.

Figure 23. Combined agricultural land uses in Basin 3. Percentages are for the entire basin and each individual HUC12 watershed.



EXPLANATION OF FIGURE

High-resolution mapping (≈1m) shows agricultural land use is concentrated in the Dead Creek, Little Otter Creek, Lower Otter Creek, and Upper and Lower Lemon Fair and these areas are coincident with many agriculture related water quality listings (red lines, Data source: https://bit.ly/2YD88g5).

Agricultural Regulatory Programs

The VAAFMs RAPs, formerly the Accepted Agricultural Practices, and existing MFO and LFO permit programs set baseline farm management practices to ensure environmental stewardship. MFO and LFO permits have been in place for over 10 years. The RAPs were revised in 2016 and 2018 to support the necessary P load reductions for the Lake Champlain and Lake Memphremagog TMDLs and nitrogen reductions for the Long Island Sound TMDL. The RAP revisions will result in a significant increase in practice implementation by requiring nutrient management plans (NMPs) within the new small farm certification program, increasing vegetative buffers, and reducing maximum soil erosion rates.

Project Spotlight-2014-15 Last Resort Farm Gully Stabilization

Water quality monitoring by the LCA, a member of the ACRWC, identified chronic exceedances of VWQS in the lower Pond Brook tributary. During SGAs in 2012, erosion from 6 gullies originating along the edge of hay fields on the Last Resort Farm was identified as a likely contributing source of sediment and nutrients to Pond Brook.

With grant funding from the NRCS EQIP and the VANR ERP, and in-kind labor and materials from the landowner, 6 gullies were stabilized from 2014-2015 using stone-lined waterway practice (Figure 1) and bioengineering practice of log check dams.

Figure 1. NRCS Rock-Lined Waterway practice installed to stabilize Gully #3, Jan 2015

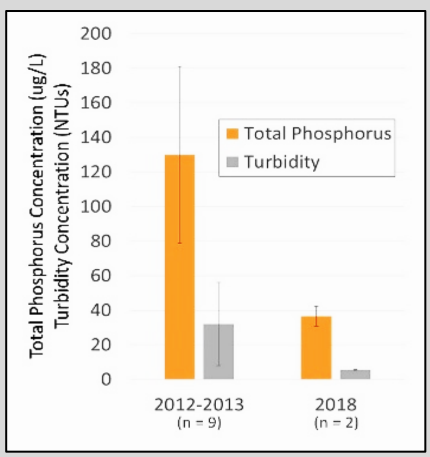


Figure 2. Water quality monitoring conducted at a downstream station on the Pond Brook before (2012-2013) and after (2018) gully stabilization during high-flow conditions. Whiskers denote standard error of the mean.

Post-practice water quality monitoring is underway, with provisional results from the summer of 2018 indicating a significant reduction in TP and Turbidity during high-flow conditions (Figure 2). Post-implementation water quality monitoring, including targeted storm events, will continue in 2019 and 2020 with funding from LaRosa Program Organizational Support and Analytical Support grants.

Large (LFO) and Medium (MFO) Farm Operation Programs

VAAFM's LFO Program requires farms with > 700 mature dairy cows or the equivalent in other livestock types to operate under an individual permit. The MFO Program requires farms with 200-700 mature dairy cows or the equivalent to operate under a general permit. Both permit program requirements exceed those of the technical components of the Federal Clean Water Act and aim to reduce the amount of P and other nutrients entering state waterways.

As of the date of this plan, there are 11 individually permitted LFOs and 23 MFOs seeking coverage under the MFO General Permit in the basin (Figure 25). VAAFM inspects all LFOs annually and all MFOs every 3 years. Inspections include assessments of farm NMPs, production area assessments of all facilities associated with the permitted operation, and cropland management assessments in accordance with the farm's individual NMP, the RAPs, and the VWQS.

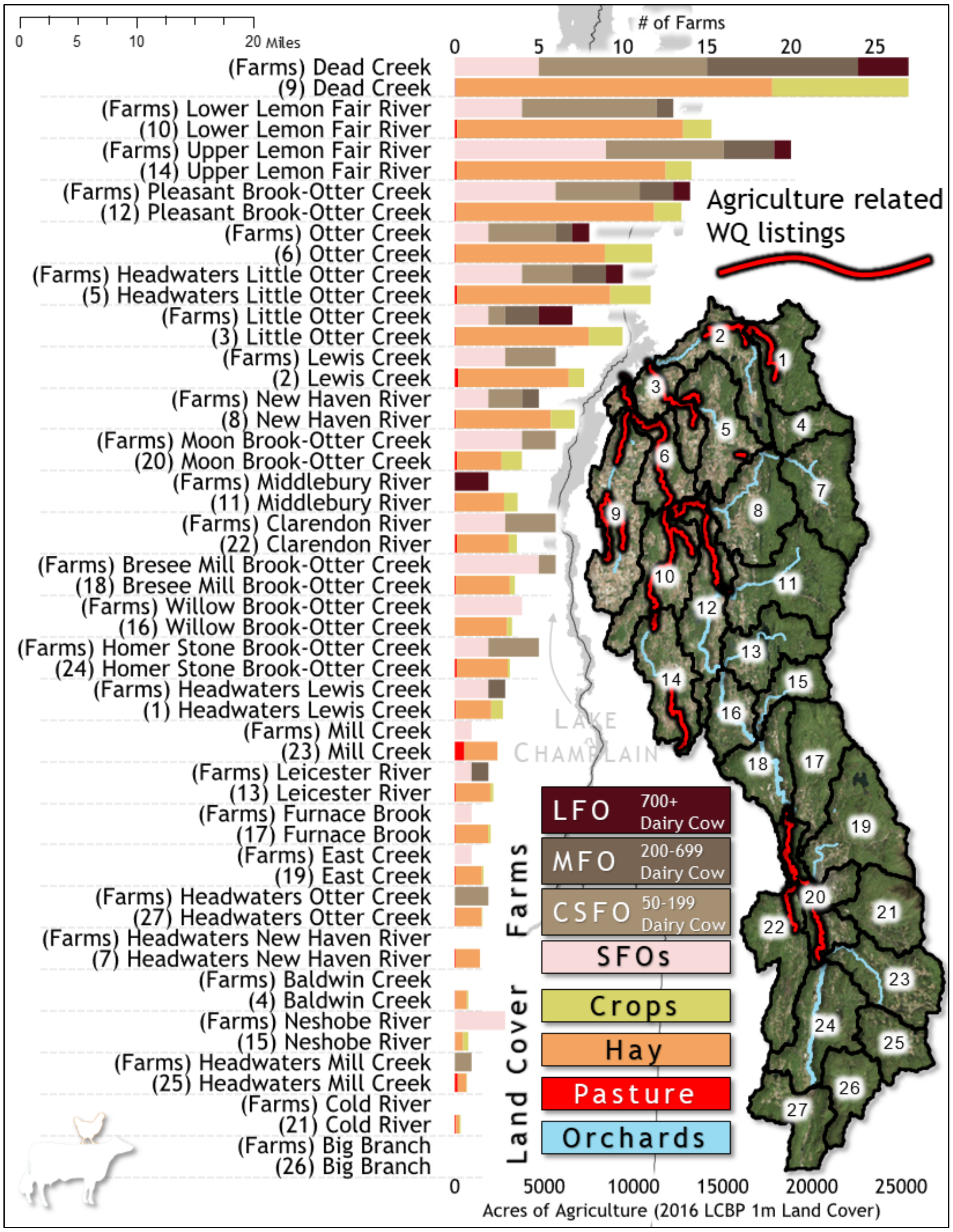
Certified Small (CSFO) and Small Farm Operations (SFO) Programs

VAAFM's CSFO program began July 1, 2017, and supports farmers to ensure their clear understanding of the RAPs, while helping assess, plan, and implement any conservation and management practices necessary to meet water quality goals. CSFOs (defined as having 50-199 dairy cows or equivalents in other species) are required to annually certify their operations and will be inspected at least once every 7 years. VAAFM estimates there are 55 farms in Basin 3 that meet the CSFO threshold. In 2018, 44 CSFOs submitted the required annual certification. Based on the 2018 CSFO annual certifications, CSFOs manage at least 16,170 acres (or 2.3%) in Basin 3 (Figure 25). Priority watersheds for inspection in this basin include the Dead Creek, and Upper and Lower Lemon Fair watersheds. Since the program is new, many CSFOs have not yet been inspected and so much of the current effort is focused on education and outreach about regulations and financial and technical assistance programs.

The VAAFM estimates 64 SFOs in Basin 3 will fall within RAP jurisdiction, but do not need to certify. These farms have less than 50 dairy animals (or equivalents in other species), and are not regularly inspected, but must follow the RAPs. VAAFM or VDEC will inspect if complaints are received. VAAFM has also identified 317 locations where livestock may be housed, however some of these locations may have livestock numbers or land base below the requirements to follow the RAPs. Figure 25 shows the distribution of farms by size and agricultural land use in each HUC 12 watershed and agriculture related water quality listings. Outreach will continue to the remaining farms or locations to help landowners understand where they fall within the RAP farm size categories and to help them understand the RAP requirements.

Farm Distribution in Basin 3

Figure 24. Number of farms by size and agricultural land cover in Basin 3 by HUC12 watershed.



EXPLANATION OF FIGURE

More farms and agricultural land cover are located in Dead Creek than in any other HUC12 watershed. The Upper and Lower Lemon Fair River also has a high number of farms and agricultural land cover. These areas are coincident with many agriculture related water quality listings (red lines). Based on 2016 LCBP 1m data, the dominant agricultural land cover in most watersheds is hay.

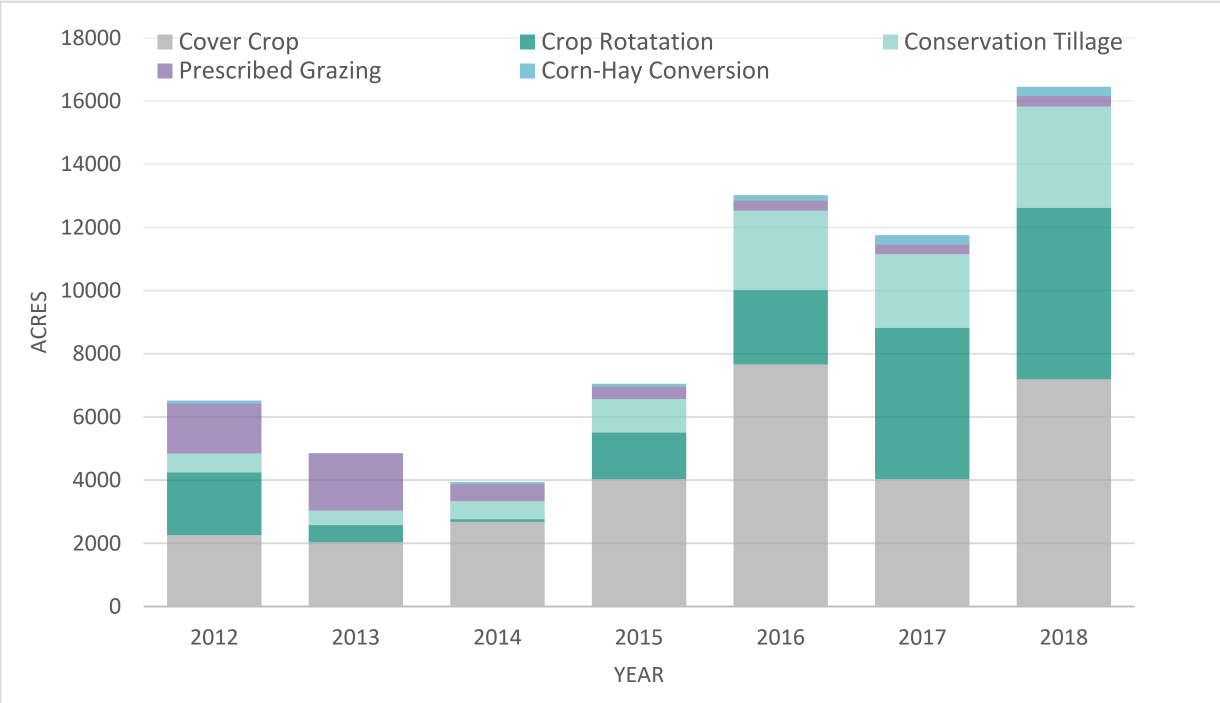
Agricultural Assistance and Outreach Programs

In addition to work completed to meet regulatory requirements, farm operators have increased voluntary adoption of BMPs in recent years with increased availability of technical and financial assistance throughout the basin. VAAFM and NRCS fund programs that assist farmers with developing NMPs, implementing field and farmstead practices, and purchasing equipment to improve water quality. For information about VAAFM programs go here and for NRCS programs go here.

Figures 26-29 represent field and farmstead BMPs implemented through state and federal assistance programs during this planning cycle. Figure 26 shows VAAFM and NRCS combined acreage of Basin 3 field BMPs from 2012-2018. The most popular field practice types are cover cropping and crop rotation with 29,900 acres of cover crop and 16,651 acres of crop rotation practices implemented between 2012-2018. Basin wide field BMP acreage increased from 2012-2018 due to increased usage of crop rotation, cover cropping, and conservation tillage practices. Prescribed grazing acreage declined from 2012-2018.

Many farmers implement conservation practices without state or federal financial assistance and these are not included in Figures 26-29. In 2019, the VAAFM launched the Multi-Partner Agricultural Conservation Practice Tracking and Planning Geospatial Database ("Partner Database") to improve planning and tracking of NRCS, VAAFM, and farmer-funded agricultural field and farmstead BMP implementation across the state. During the next basin planning cycle, local practice implementation will be tracked using the CWIP's BATT. The BATT will also account for BMPs by estimating combined P reduction effectiveness (i.e., multiple practices on one farm) of BMP systems with individual BMPs having different lifespans.

Figure 25. Acreage of VAAFM and NRCS field BMPs installed in Basin 3 from 2012-2018.

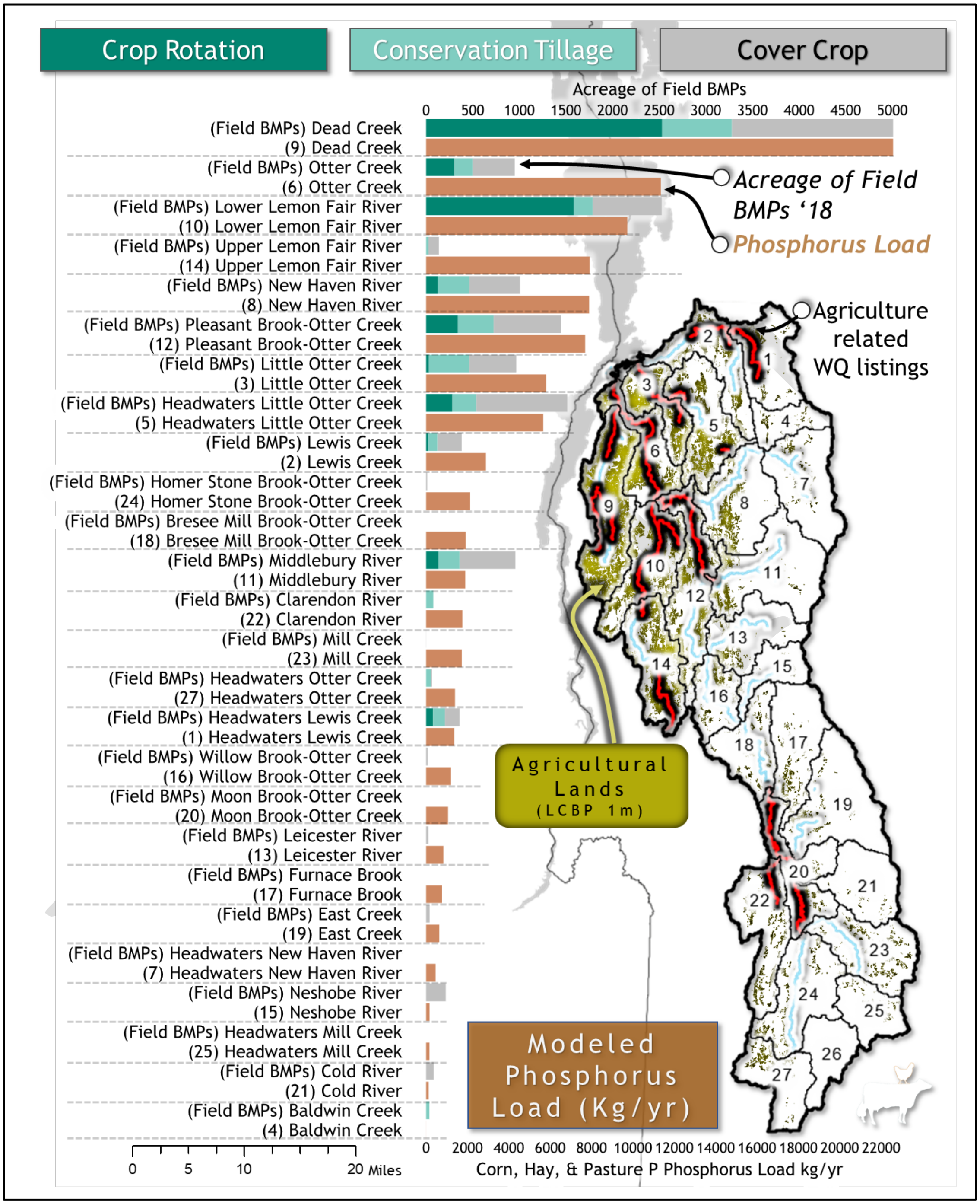


EXPLANATION OF FIGURE

Basin 3 field BMPs increased from 2012-2018 due to increased use of cover cropping (+318%), crop rotation (+273%), and conservation tillage (+202%). These data represent funding of field BMPs and as a result, a decrease over time reflects ending payments for a given practice. In reality however, the farmer may continue implementing the practice. Also, acreage of some field BMPs may overlap as each practice is counted separately, but may occur on the same field area.

Figure 27 shows the top three field BMPs applied to agricultural fields in 2018 in HUC12 watersheds with high modeled P loads. This indicates many field BMPs were funded and implemented in high priority watersheds where the largest P reductions are required. During the next Basin 3 planning cycle, BMPs will be tracked using the VAAFM Partner Database and the CWIP's BATT will be used to assign practice-specific P reduction values at the site scale.

Figure 26. 2018 VAAFM and NRCS field BMPs by HUC 12 and modeled P load. Note: Acreage of some field BMPs may overlap as each practice is counted separately, but may occur on the same field area.

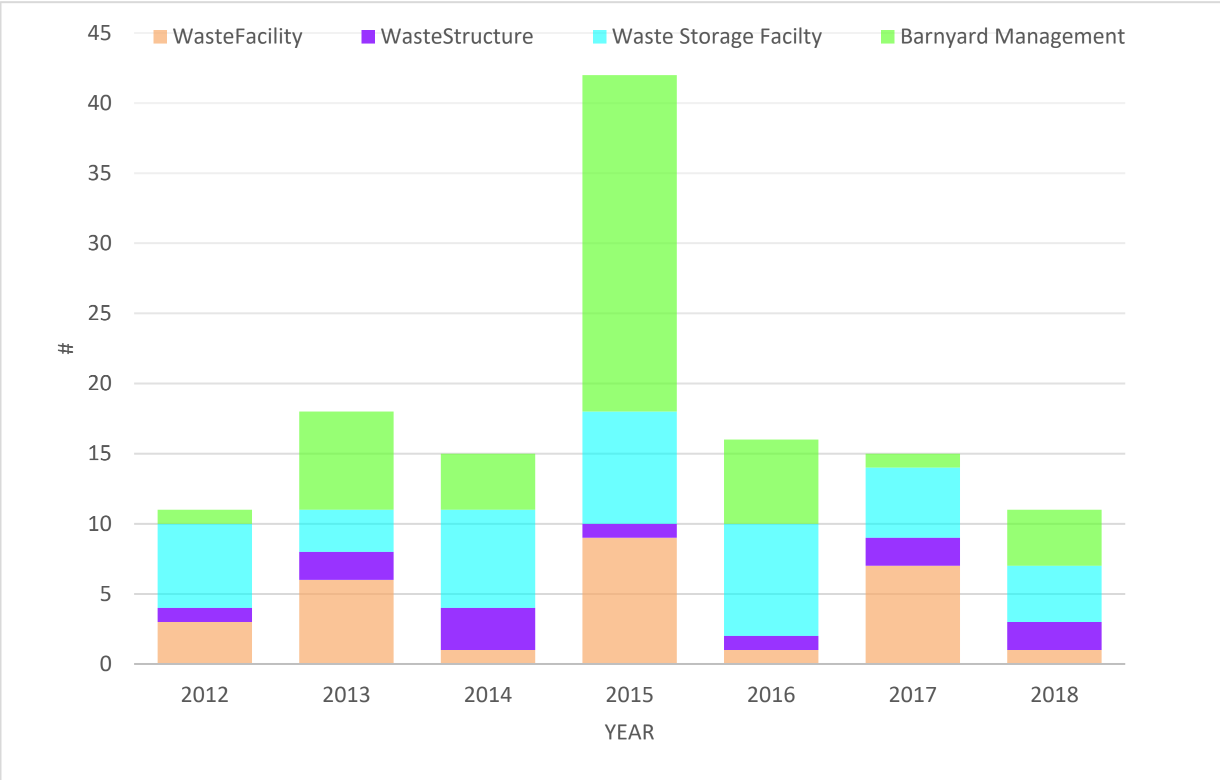


EXPLANATION OF FIGURE

2018 field BMPs were implemented in watersheds with high modeled P loads (e.g., Dead Creek and Lower Lemon Fair). Continued progress toward meeting the LC P TMDL will require more field practices be implemented in the Otter Creek and the Upper Lemon Fair watersheds as well as those with little/no practice implementation.

There has also been steady installation of farmstead BMPs from 2012 through 2018 (Figure 28). These were primarily installed in the Dead Creek watershed and headwaters of Little Otter Creek

Figure 27. Number of VAAFM and NRCS farmstead BMPs installed in Basin 3 from 2012-2018.

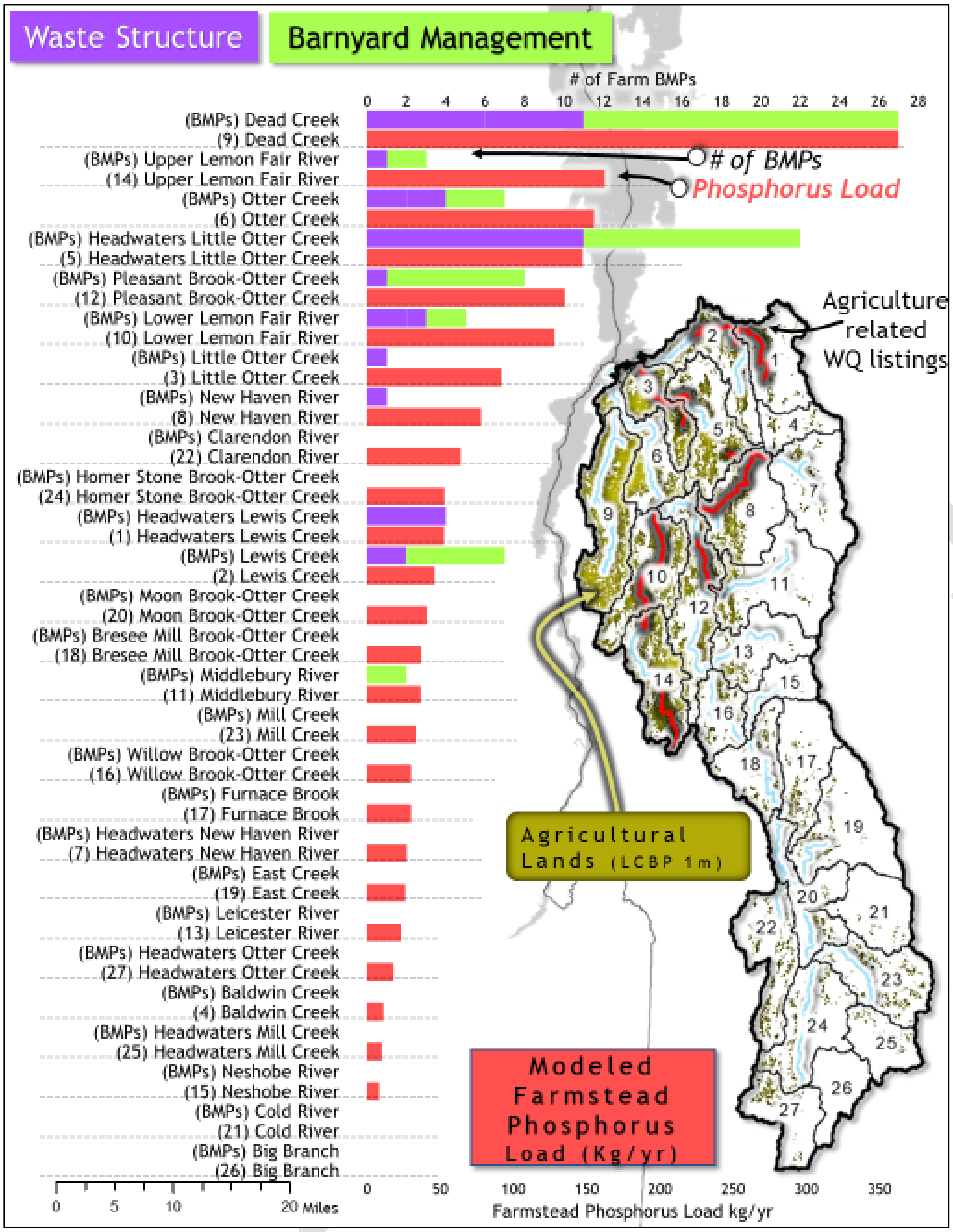


EXPLANATION OF FIGURE

Farmstead BMPs were consistently implemented in Basin 3 from 2012-2018 with the highest # installed in 2015. Waste storage facilities and barnyard management were the most common practices. These practices collectively can receive up to an 80% total P load reduction efficiency and have lifespans between 10-15 years if properly maintained.

and to a lesser degree in Upper and Lower Lemon Fair and Otter Creek watersheds (Figure 29). Although practices were focused in the Dead Creek and Headwaters of Little Otter Creek watersheds, additional work in these areas may be necessary to address P and *E. coli* sources, respectively. Since 2012, few or no farmstead BMPs were implemented through State and Federal cost share programs in the Little Otter Creek, New Haven River, and Clarendon River watersheds. Compared to other Ag BMPs, farmstead BMPs are expensive to install, but if maintained they have a long practice life of 10-15 years and effectively manage nutrients and *E. coli*.

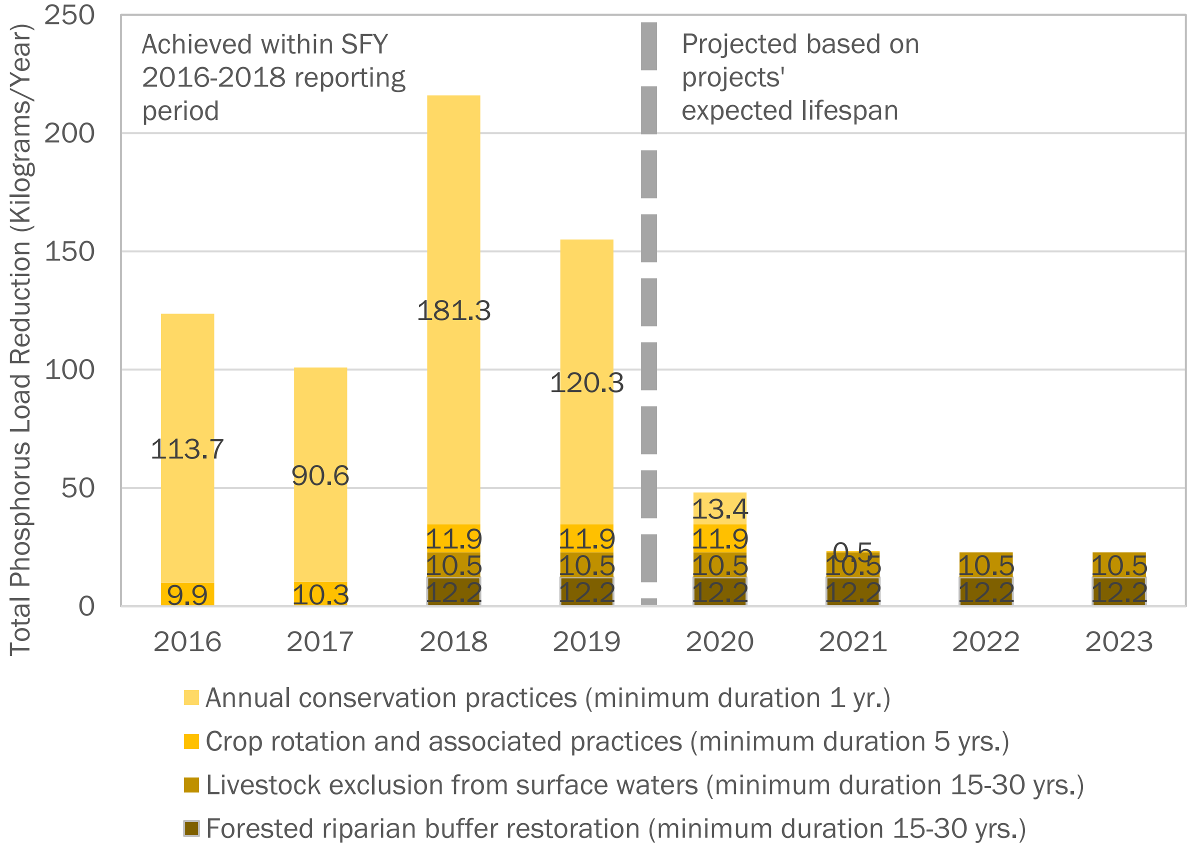
Figure 28. 2012-2018 VAAFM and NRCS farmstead BMPs implemented by HUC 12 and modeled P load.



EXPLANATION OF FIGURE

2012-2018 Basin 3 farmstead BMPs were installed in watersheds with high modeled P loads (e.g., Dead Creek and Headwaters Little Otter Creek). Continued progress toward meeting the LC P TMDL will require more farmstead BMPs in the Upper and Lower Lemon Fair, Otter Creek, Little Otter Creek, and New Haven River watersheds as well as those with no BMPs (e.g., Clarendon River).

Figure 29. Annual average estimated total P load reduction (kg/yr.) achieved by state-funded agricultural pollution prevention projects implemented SFY 2016-2018, and projected reductions based on currently implemented practices for the 5-year, Basin 3 planning cycle.



EXPLANATION OF FIGURE

P reductions achieved by agricultural projects increased in SFYs 2018-2019 compared to the previous 2 years. Projected P reductions, based on projects' anticipated lifespan (see legend), are shown to the right of the dashed line. The 2020-2023 projections don't account for the most commonly used annual practices, and as a result, are gross underestimates. Practices must be maintained for pollutant reductions to continue in future years.

Local planning, goal development, and implementation—Agriculture

In order to coordinate agricultural water quality improvement efforts identified through the basin planning process, several pre-existing watershed and farm-focused organizations have been actively engaging their communities for several years. These include: VAAFM, UVM Extension, NRCS, the ACRWC, Lewis Creek Association, the Champlain Valley Farmer Coalition, and RPCs.
Public forums were held in Basin 3 over several years of this planning process. Sustaining and coordinating with these groups is an important strategy in this plan to effectively target agricultural

BMP implementation to improve water quality. Examples of priority actions from the public forums include:

- Hosting annual workshops on improving soil health, RAPs revisions, and the Flood Hazard & River Corridor Rule, implementing conservation tillage and cover cropping practices,
- Supporting farmers in developing NMPs and creating a program to continue to work with priority farms on implementing NMPs,
- Developing regional equipment sharing programs to support the implementation of cover cropping,
- Conducting outreach to promote buffer planting programs across the basin,
- Developing water quality monitoring and outreach aimed at understanding P, bacteria, and sediment source areas in the Dead Creek, Little Otter Creek, and Lemon Fair watersheds.

Click the following hyperlink to view summary strategies to address Runoff from Agricultural Lands.

B. Developed Lands -- Stormwater

Despite the primarily rural character of much of Basin 3, stormwater runoff contributes to many of the basin's water quality issues. Urban streams such as Moon and Mussey Brooks have stormwater TMDLs and exhibit impacts from stormwater runoff. Stormwater also affects water quality where growth areas have encircled traditional Vermont towns and villages or where runoff from developments was improperly directed onto unstable soils or slopes. Examples can be found in villages and towns such as Brandon and Bristol. Stormwater runoff from developed lands also degrades water quality of many upland lakes through impacts from encroachment on the littoral zone and nutrient and sediment loading. These include Chipman Lake, Fern Lake, Cedar Lake, and Richville Pond.

This section integrates basin specific information on stormwater-related water resource impairments, regulatory programs, stormwater master plans (SWMPs), Illicit Discharge Detection and Elimination (IDDE) studies, implementation efforts, and partnerships to inform strategies to address water resource impairments. The tactical basin planning approach engages local, regional, and federal partners needed to accelerate stormwater treatment practice implementation in the development of these strategies in order to meet the state's clean water goals including reductions needed to comply with the LC P TMDL. The section is organized around regulatory programs including the 3 acre permit, Municipal Separate Storm Sewer System Permit (MS4), and then SWMP and IDDE studies, which are the primary drivers for voluntary implementation efforts in the basin.

Stormwater Regulatory Programs

Operational three-acre impervious surface permit program

Act 64 of the 2015 Vermont State Legislature requires the VDEC Stormwater Program to issue a general permit in 2019 for stormwater from so-called "three-acre sites". These sites have 3 or more acres of impervious surface and lack a stormwater permit based on the 2002 Vermont Stormwater Management Manual. Following issuance of the general permit, the Program will identify and notify affected owners. Basin 3 parcels will need to apply for permit coverage by 2023. Since this date is at the end of the 5-year timeframe for this plan, voluntary SWMPs will be the primary drivers for stormwater implementation efforts for this planning cycle. Though early adoption of the 3-acre permit requirements is encouraged.

It is anticipated that the "three-acre impervious surface" program will address the developed lands P reductions necessary to achieve the LC TMDL that are not addressed by other developed lands programs. Once the program is implemented, this projection will be verified by tracking P reductions achieved through implementation using the CWIP's BATT. If additional reductions are required to implement the LC TMDL, developed lands permitting requirements may be adjusted accordingly, including requiring projects with less than three acres of impervious surface to obtain post 2002 permit coverage.

An initial estimate of parcels containing three or more acres of impervious was completed by TetraTech, Inc. with funding from EPA (Table 5). The initial estimate of the three-acre parcel coverage will require additional screening by VDEC prior to notification of the affected parties. The analysis does not yet identify which impervious surfaces have permit coverage that incorporates the requirements of the 2002 VSMM. VDEC will also identify eligible impervious surfaces from existing permits that were not identified in the TetraTech analysis and permitted common plans of development such as residential and commercial subdivisions, because the impervious surface is located on more than one parcel.

Table 5. Estimated three-acre parcels and associated impervious cover for Basin 3 towns (Tetra Tech, Inc. 2016).

Town	Estimated # of 3+ acre parcels	Impervious acres
Brandon	7	44.07
Bristol	3	12.50
Ferrisburgh	1	5.64
Killington	1	3.38
Mendon	3	29.18
Middlebury	29	219.11
Pittsford	4	38.33
Proctor	1	15.24
Rutland City	9	73.83
Rutland City CSO	9	104.42
Rutland Town	24	147.21
Shoreham	2	7.81
Vergennes	6	38.54
Wallingford	1	3.89
West Rutland	2	25.31
Total	**99**	**764.1**

Stormwater Master Planning and Outreach

Stormwater master plans (or reports) have been completed or are planned for 25/44 of the communities with stormwater systems in Basin 3 (Table 6). Below are brief updates on the stormwater master planning efforts in several of these communities.

Table 6. Progress of Basin 3 towns toward completing Stormwater Master Plans or Reports.

SWMP Status	Complete	Planned	Incomplete
Towns	Brandon, Bristol, Charlotte, Danby, Dorset, Ferrisburgh, Hinesburg, Hubbardton, Ira, Killington, Lincoln, Middlebury, Mount Holly, Pittsford, Proctor, Orwell, Rutland Town, Rutland City, Shoreham, Starksboro, Vergennes, Wallingford, West Rutland	Clarendon	Addison, Bridport, Buels Gore, Chittenden, Cornwall, Goshen, Leicester, Mendon, Mount Tabor, Monkton, New Haven, Panton, Ripton, Shrewsbury, Salisbury, Sudbury, Tinmouth, Waltham, Weybridge, Whiting

Rutland Town--Moon Brook

The 2016 Flow Restoration Plan (FRP) for the section of the Moon Brook Watershed (MBW) that falls within the Town of Rutland was developed in accordance with requirements for Municipal Separate Storm Sewer System (MS4) entities. This FRP became part of the MS4 stormwater permit plan prepared by the Town of Rutland. The purpose of this Moon Brook FRP was to identify the necessary stormwater BMPs that will be used to achieve the flow restoration targets prescribed in the Moon Brook TMDL document.

Local Stormwater water quality improvements over the last 5 years

- ✓ **Completion of the Stormwater Master plans in Rutland City and installation of:**
  - ✓ 2015 a bio-infiltration project was designed and implemented to mitigate stormwater runoff from the Giorgetti Arena parking into East Creek.

Rutland City--Moon Brook

As of the writing of this plan, a flow Restoration Plan (FRP) Stormwater Master Plan (SWMP) to reduce stormwater flow, temperature, and sediment, and nutrient loading is being drafted for the MBW. The SWMP will enable the City to identify and pursue priority projects such as infiltration basins, gravel wetlands, sand filters, underground storage, etc. to make progress toward the flow reductions called for in the 2008 Moon Brook TMDLs.

The SWMP identified 32 stormwater "problem areas" and 20 projects were selected for further development and design. These sites were assessed via an in-depth ranking matrix that will include pollutant reductions and cost estimations. Once outreach has been completed and there is comitment from landowners, 30% designs will be produced for at least 3 of these projects.

Moon Brook is an impaired waterway, and has been impacted by uncontrolled stormwater runoff, including increased flow, elevated temperature, and other stressors. The outcome of the study will be the development of a comprehensive retrofit plan that will achieve flow targets as set forth in the Moon Brook TMDL. Prioritized projects will be included in the Watershed Projects Database.

East Creek and Tenney Brook SWMP

A SWMP for the East Creek and Tenney Brook in the City of Rutland was completed in December of 2014. Creating the SWMP involved research into the stressors faced by the water bodies within the watershed, assembling all relevant data in a watershed data library and assessing that data for quality and completeness, as well as generating new data where necessary to support future management actions. Finally, a series of recommendations were made as to priority project sites. 18 project sites were identified, conceptual designs were completed for 8/18 projects, and 3 of these projects have been implemented.

East Creek and Tenney Brook flow through some moderately-to-heavily urbanized areas of Rutland Town and Rutland City, leading to increased flows in the streams, as well as sediment and nutrient wash-off. The presence of combined sewers in Rutland City leads to combined sewer overflows. These overflows have led to 303(d) listing of East Creek as *E. coli* impaired.

The City, the Rutland Natural Resources Conservation District (RNRCD), and Watershed Consulting Associates, LLC, developed a broad array of projects, from traditional end-of-pipe BMPs like gravel wetlands and infiltration galleries, to more distributed green stormwater infrastructure practices like bioretention and sub-surface infiltration galleries integrated into a new 'green streets' boulevard in the heart of the City. Extensive water quality modeling for all priority projects allowed the team to create a ranking matrix that will help the RNRCD and City develop a priority list of projects.

Brandon

The Town of Brandon SWMP was completed in 2017 and identified 6 parcels within Brandon with 3 acres or more of impervious surfaces. The following 5 were selected for further development to 30% engineering designs: 1. Park Street 2. Pearl Street 3. Café Provence parking lot area 4. West Seminary Street Public Park 5. Rite Aid / Hannaford's. Additional opportunities for project development, include:

- Installation of stormwater improvements for the Parking lot behind Café Provence BMPs (e.g., Café Provence) project, receiving drainage from Chase Street, a portion of High Street and the southern end of Pinehurst Street.
- Park Street is considered for a "Green Street" design and there is already a conceptual overview (Figure 31).

Figure 30. Park Street Green Plan Conceptual Design. Green = targeted areas for installation of bioswales upgradient from drop inlets to better infiltrate stormwater runoff.

Bristol

The Town of Bristol SWMP will be completed in 2019. A total of 55 stormwater "problem areas" were identified and prioritized, including opportunities for BMP installation, erosion control, and gully prevention and stabilization. Twenty (20) projects were selected for further development and design. The following 4 projects were completed with 30% designs:

(1) A system of sub-surface chambers is envisioned for the School St 001, a 3-acre site.

These chambers would sit under the park and essentially be invisible, other than a manhole structure that would be used for operation and maintenance access. Total phosphorus removal is estimated to be 57 lbs. Total estimated cost is $610,000.

(2) North St 001: similar to (1) this project would be substantially larger than either of the smaller two systems and therefore require a temporary loss of use of the park during construction. This project also has the potential to encounter additional challenges in the form of underground utilities or other conditions. Total phosphorus removal is estimated to be 103 lbs. Total estimated cost is $997,000.

(3) School 1 & 2: another infiltration system similar to the above two. A system of sub-surface chambers is envisioned for the School 1 (northern) and School 2 (southern) sites. These chambers would sit under the playground and essentially be invisible, other than a manhole structure that would be used for operation and maintenance access. Total phosphorus removal for School 1 is estimated to be 95.5 lbs. and School 2 is 7 lbs. Total estimated cost for School 1 is $1,000,000 and School 2 is $162,000.

(4) West St 002 and 003: A series of dry wells of different sizes could be used in this area to replace existing catch basins. The dry wells would capture runoff and slowly bleed it off through the perforations in the bottom and sides, with a grate and overflow pipe that would function similarly to a normal catch basin. Total phosphorus removal is estimated to be 9.5 lbs. Total estimated cost is $20,000.

Middlebury

The Town of Middlebury completed a Stormwater Infrastructure Report (SWIR) in 2012. 10 stormwater "problem areas" were identified and prioritized. Creation of a more in-depth Stormwater Master Plan in 2016 followed completion of the SWIR. The Plan focused on subwatersheds in Middlebury's downtown area, approximately 37.1 acres, of which 12.5 acres are impervious. The Plan found 23 potential sites available for retrofit. Three 30% designs were completed, which include a series of stormwater retrofits and implementation of new management practices that build on each other. At this time, further design for these projects is not being pursued due to the high cost of projects and the impact to private landowners.

In 2019, Middlebury received a Better Connections Transportation and Community Development grant. The project includes "Green Alley" improvements for Bakery Lane, Mill Street, and Printer's Alley, such that street repaving incorporates green stormwater features, including a gravel subbase with permeable pavers, planters, and wall vegetation. These practices will reduce stormwater runoff into Otter Creek or into catch basins with outfalls to Otter Creek. They also reduce P, petroleum residue, and road salts from pavement runoff entering the Creek. Plantings, planter boxes, and green walls will reduce the volume of runoff on narrow streets.

Wallingford

552 acres were assessed for stormwater pollution and a SWMP was developed for the Otter Creek Watershed in the Town of Wallingford, Vermont. The completed SWMP includes a review of pre-existing data, on-the-ground-assessment of problem areas, and a detailed identification of projects.

Eight 30% designs have been completed for BMPs, four stormwater retrofit sites and four road erosion sites. These are sites where stormwater treatment structures could be added and where they would be most cost effective and efficient for sediment and phosphorus or nitrogen removal. This will enable the Town to more efficiently plan for and implement watershed management activities.

Basin wide Illicit Discharge Detection and Elimination (IDDE) Study

An IDDE study of the following 7 towns in Rutland County: Benson, Castleton, Fair Haven, Poultney, Proctor, Wallingford, and West Rutland was completed in 2014. 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 entire extents 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 participating towns.

Through these studies a number of 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).

Local planning, goal development, and implementation—Stormwater

The VDEC and local conservation partners are working together to set watershed specific priorities that ensure that expected pollutant load reductions are consistent with any load allocation for developed lands in a TMDL, and to ensure consistency with the VWQS. In order to coordinate stormwater related water quality improvement efforts identified through the basin planning process, the ACRPC, RNRCD, and RRPC have taken the lead by working closely with local communities. Examples of stormwater strategies to improve water quality include:

- Map parcels that will come under the 3-acre stormwater permit in the basin and do outreach to landowners that will be required to seek permit coverage.
- Reduce stormwater inputs into water resources in villages and town centers through SWMPs and prioritization.
- Implement high priority practices from municipal SWMPs. See VDEC's Stormwater Infrastructure Mapping directory.
- Implement practices using green infrastructure and low impact development techniques, with a focus on Rutland Town and City, West Rutland, Brandon, Bristol, Vergennes, and other high priority catchments.
- Identify towns in need of SWMPs/reports.
- Support funding of stormwater practice implementation.
- Identify and correct potentially failed septic systems identified by IDDE assessment.

Click the following hyperlink to view summary strategies to address Stormwater pollution.

C. Developed Lands--Roads

It is estimated that more than 75% of Vermont roads were constructed prior to any requirements for managing stormwater runoff (Otter Creek Basin plan, 2012). Where road networks intersect the stream network, the roads and their ditches effectively serve as an extension of the stream network (Wemple et al., 1996). Runoff from municipal roads is a source of sediment and nutrients in Basin 3 which contribute to water quality issues in the basin (Ch. 3) Specifically, road runoff loads are 5% of the estimated P loading to Lake Champlain from the Otter Creek segment (Figure 22).

This section integrates basin specific information on transportation-related water resource impairments, road erosion inventories (REIs), road practice implementation, regulatory programs, and existing partnerships to inform strategies to address transportation-related water resource impairments. The tactical basin planning approach engages local, regional, and federal partners needed to accelerate transportation-related practice implementation in the development of these strategies in order to meet the state's clean water goals including reductions needed to comply with the LC TMDL. The section is organized around the regulatory programs including the Municipal Roads General Permit (MRGP), the Transportation Separate Storm Sewer System Permit (TS4), and the Municipal Separate Storm Sewer System Permit (MS4) as these regulatory programs are the driving factor in road water quality implementation efforts in the basin.

Roads Regulatory Programs-Municipal Roads General Permit

The 2015 MRGP is a stormwater general permit for non-MS4 cities and towns signed into law as part of Act 64. The MRGP is intended to achieve significant reductions in stormwater-related erosion from paved and unpaved roads. The permit requires each municipality to conduct a REI of hydrologically connected road segments by 12/31/2020 to determine if they meet MRGP standards. A road segment is ≈ 100 meters or 328 feet in length. Hydrologically connected roads are those municipal roads within 100 feet of or that bisect a wetland, lake, pond, perennial or intermittent stream, or a municipal road that drains to one of these water resources. These road segments represent ≈ 60% of municipal roads and can be viewed using the "Municipal Road Theme" on the VANR Natural Resource Atlas. Road segments are assessed as *Fully Meeting*, *Partially Meeting*, or *Not Meeting* the MRGP standards.

MRGP standards include: road crowning, stabilizing drainage ditches and turnouts, and upgrading drainage culverts and intermittent stream culverts. VDEC has established a timeline with milestones to guide towns through the MRGP requirements (Figure 32). Towns will use the REI results to prioritize road upgrades with goal of all connected municipal roads meeting the MRGP standard by 12/31/2036.

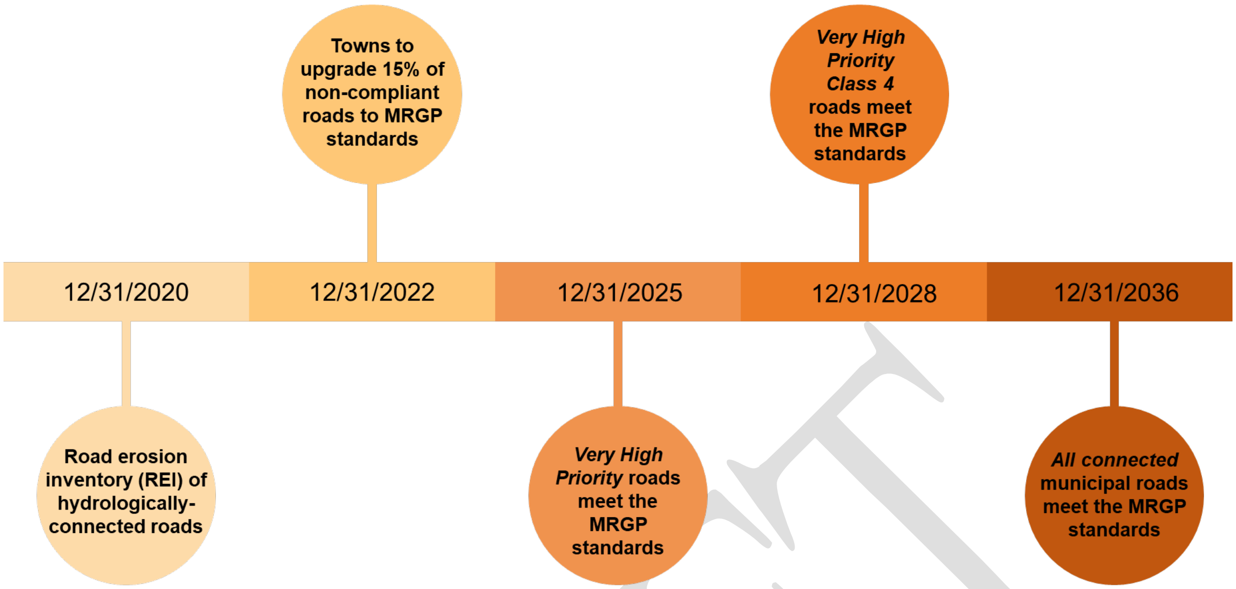


Figure 31. MRGP timeline and milestones.

This plan recommends that technical and financial assistance be prioritized for interested towns based on the water quality benefit and feasibility of a project. *Very High Priority* road segments "*Do Not Meet*" standards and have >10% slope and high erosion risk (Table 7). Resources available from the Clean Water Fund (e.g. VDEC Grants-in-Aid and VTrans Better Roads grants) assist with the completion of REIs, 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 if roads meet MRGP standards. For additional information see the VDEC Municipal Roads Program.

Table 7. Prioritization of municipal road segments based on MRGP REI and slope. Road segments that do not meet standards and are on a steep slope are priorities for water quality protection.

MRGP Status	0-4% slope or Low Road Erosion Risk	5-9% slope or Moderate Road Erosion Risk	10%+ slope or High Road Erosion Risk
Fully Meets	-	-	-
Partially Meets	Low priority	Moderate priority	Moderate priority
Does Not Meet	Moderate priority	High priority	Very High priority

VDEC has partnered with regional planning commissions to offer training, technical assistance, outreach, and funding for REIs, road upgrades, and equipment purchases to assist municipalities with the MRGP requirements. To-date these efforts have resulted in ≈57% of Basin 3 towns having completed a REI (Table 8). Results of REIs that have been uploaded to the MRGP database are now online and can be viewed by town and REI inventory status. Many towns that completed earlier inventories still need to upload the assessments into the database and all remaining towns will complete inventories by December 2020.

Table 8. Progress of Basin 3 towns toward completing Road Erosion Inventories.

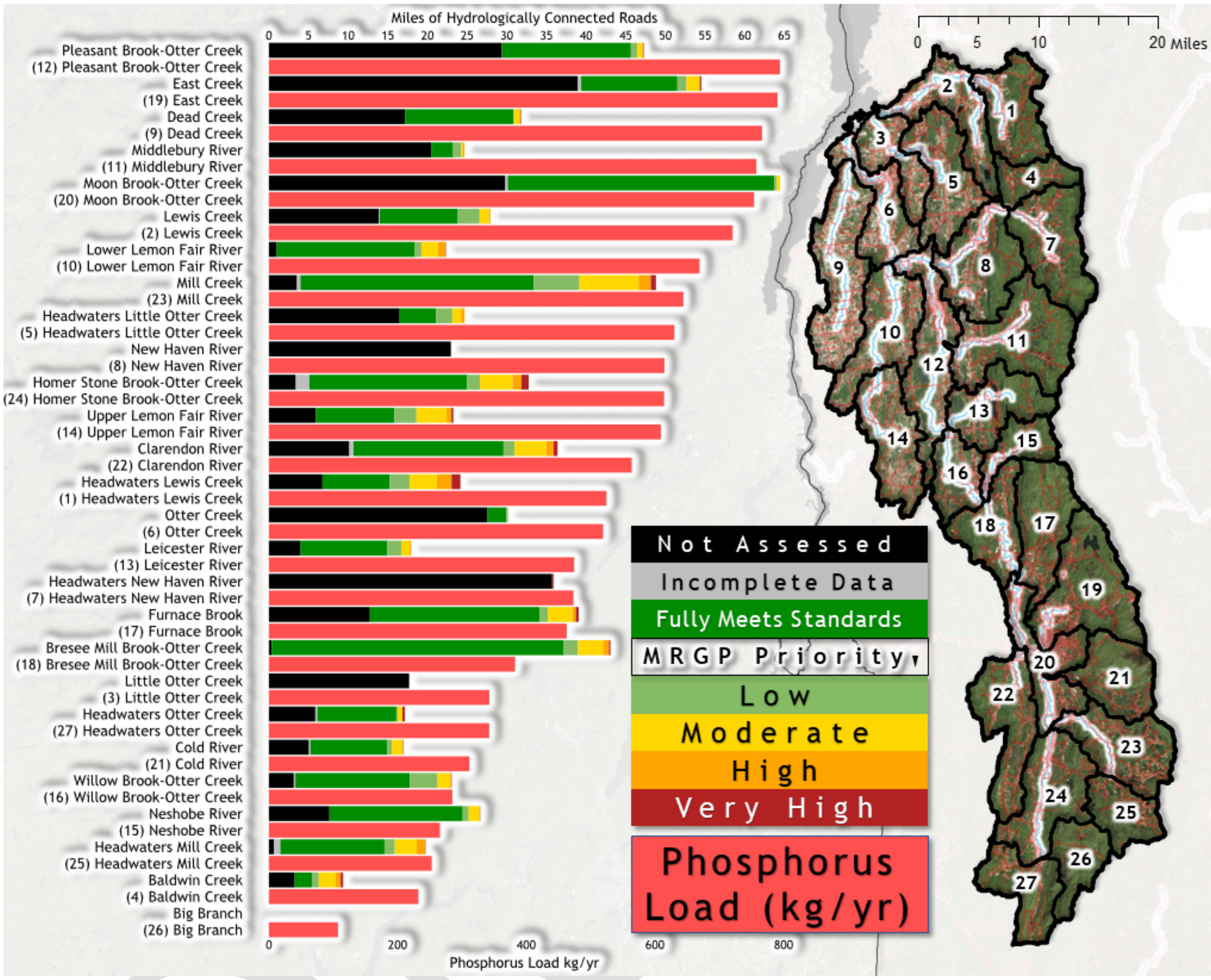
REI Status	Complete	Planned (2019)	Planned (2020)	Incomplete
Towns	Addison, Brandon, Bridport, Chittenden, Clarendon, Cornwall, Danby, Hubbardton, Ira, Leicester, Lincoln, Mendon, Monkton, Mount Holly, Orwell, Pittsford, Proctor, Salisbury, Shoreham, Shrewsbury, Starksboro, Sudbury, Wallingford, West Rutland	Bristol, Ferrisburgh, Middlebury, Mount Tabor, New Haven, Panton, Rutland City, Tinmouth, Vergennes	Goshen	Charlotte, Dorset, Hinesburg, Huntington, Killington, Ripton, Rutland Town, Waltham

EXPLANATION OF TABLE

The REI due date is 12/31/2020 and this table highlights the rapid adoption of the MRGP guidance. To date ≈57% of Basin 3 towns have completed REIs.

In order to implement the LC TMDL requirements for the roads sector, this plan identifies priority areas for road improvement projects based on available REIs and P modeling results. From the uploaded inventories, towns in the Homer Stone Brook-Otter Creek, Mill Creek, Clarendon River, Furnace Brook, and in the headwaters of the Lewis Creek watersheds have a high proportion of *Very High Priority* road segments and high modeled TP loading (Figure 33).

Figure 32. Hydrologically connected roads, their MRGP status, and modeled TP loading by HUC12 watershed in Basin 3.



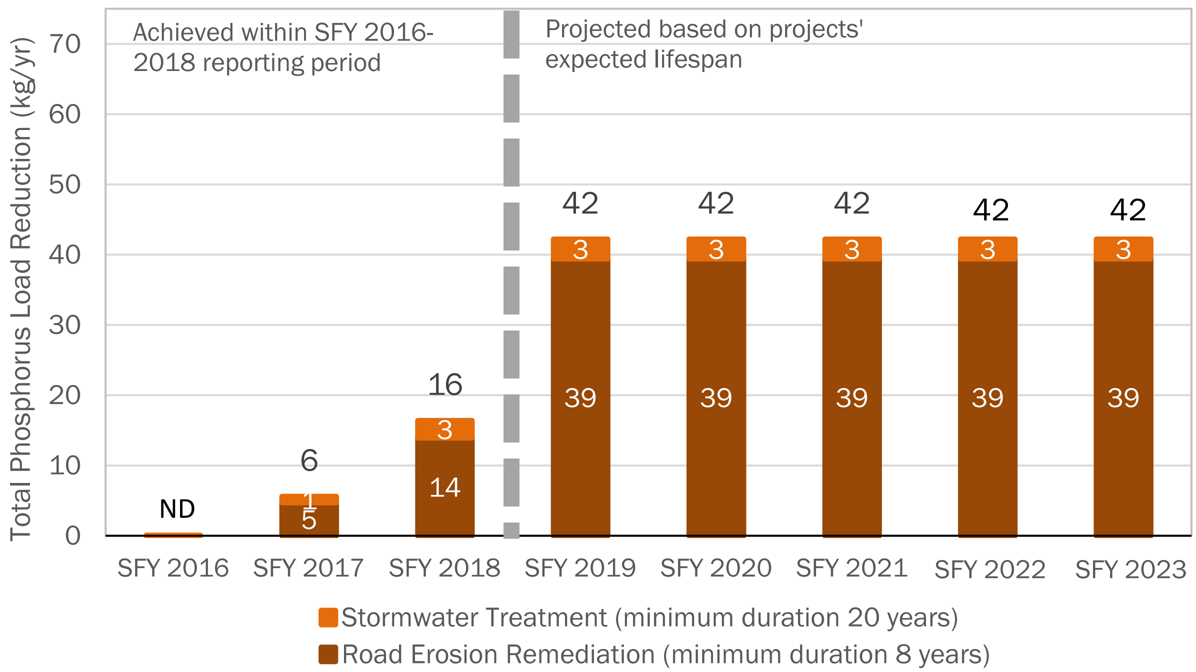
EXPLANATION OF FIGURE

Areas where *Very High Priority* road segments (**red**) are coincident with high modeled TP loading are prioritized for road improvement project implementation. Towns in the Homer Stone Brook-Otter Creek (i.e., Wallingford, Tinmouth, Danby, Mount Tabor), Mill Creek (i.e., Mount Holly, Shrewsbury), Clarendon River (i.e., Ira, Clarendon), and in the headwaters of the Lewis Creek (i.e., Hinesburg, Starksboro) watersheds have the highest #s of very high priority road segments.

As of July 2019, 47% of hydrologically connected road segments in the basin have been assessed and meet the MRGP standards. The MRGP permit mandates that, at a minimum, 15% of the non-compliant road segments need to be brought into compliance by 2023. Many towns have already begun utilizing State-funded grant programs to address non-compliant road segments. Of the 42 towns in the basin, in State Fiscal Year (SFY) 2017, 14 enrolled in Grants-in-Aid and in SFY 2018, 21 enrolled in Grants-in-Aid to receive financial support for addressing hydrologically connected roads. As a result, the miles of state-funded municipal road drainage and erosion control improvements increased nearly seven-fold from SFY 2017 to 2018.

The assessment process of the MRGP is ongoing and is expected to be finished at the end of 2020. By tracking the mileage of completed road improvements, VDEC will be able to calculate local P reductions. However, calculating TP load reductions around BMP implementation and developing the methodology to do so for roads has yet to be finalized, so this projection cannot currently be applied to P reductions. In the next basin planning cycle, when all road assessments are completed and the loading methodology is finalized, load reduction projections will be reported.

Figure 33. Annual average estimated TP load reduction (kg/yr.) achieved by state-funded stormwater treatment and road erosion remediation projects implemented/constructed, SFY 2016-2018, and projected reductions during the 5-year, Basin 3 planning cycle.



EXPLANATION OF FIGURE

P reductions increased as a result of road erosion practices installed in SFYs 2017 and 2018. Projected P reductions, based on projects' anticipated practice life (see legend), are shown to the right of the dashed line. Practices must be maintained for reductions to continue into future years.

Local planning, goal development, and implementation—Roads

Local planning efforts are enhanced through formal basin planning grant agreements which fund the ACRPC and RRPC to provide support to towns. The ACRPC developed a tablet-based application for road crews use when conducting REIs. The ACRPC natural resource and transportation committee(s) also provide technical support and training in use of the application, assistance in prioritizing road BMPs, help for towns developing Capital Improvement Plan (CIP) budgets, and applying for Better Road grants and Municipal Grants in Aid to implement projects identified in CIPs.

In 2019, a Clean Water Advisory Committee (CWAC) was established at the RRPC. This committee focuses on providing municipalities with outreach, technical and financial assistance, and additional training to assist towns with the upcoming MRGP requirements. Specifically, the CWAC is working with towns to complete REIs, develop CIP budgets, and support towns in applying for funding.

Click the following hyperlink to view summary strategies to address Runoff from Municipal Roads.

State Managed Roads (Transportation Separate Storm Sewer System General Permit – TS4)

The 2017 TS4 General Permit is a stormwater permit for all VTrans owned or controlled infrastructure. The permit requires VTrans to develop comprehensive Phosphorus Control Plans (PCPs) for their developed land in each lake segment. This includes state roads, garages, park and rides, welcome centers, airports, and sand and gravel operations. The PCPs will require inventories of all regulated surfaces, establishment of baseline phosphorus loading per lake segment, and a prioritized schedule for implementation of BMPs to achieve the lake segment percent phosphorus reductions.

VTrans will address state roads under the TS4. The permit requires VTrans to reduce the discharge of pollutants from the TS4 to the maximum extent practicable through compliance with the six minimum control measure requirements throughout the entire State.

On April 1, 2019, VTrans submitted an analysis of the P baseload from their owned and controlled land. A target of 245.96 kg/year was established for the Otter Creek lake segment basin, to be achieved by 2036. A small portion of those lands drain to the North Lake Champlain planning basin, although the exact location of P reductions will not be determined until the PCP is completed. VTrans is required to submit a generalized PCP by April 1, 2020, which will include an estimate of the area (acreage or road miles) to be treated and the extent and type of BMPs to meet the entire phosphorus load reduction. By October 1st in 2020, 2024, 2028, and 2032 each, VTrans will submit a more detailed PCP that achieves on average 25% of the total reduction to Lake Champlain in each 4-year period.

Click the following hyperlink to view summary strategies to address Runoff from VTrans Roads and Infrastructure.

Municipal Separate Storm Sewer Systems permit (MS4)

The Municipal Separate Storm Sewer System permit is a permit for municipalities with census designated urbanized areas and stormwater impaired watersheds. Both the City of Rutland and the Town of Rutland are designated MS4s due to the stormwater impairment in Moon Brook. Additional factors such as population density also require the MS4 status. Under the MS4 permit, those designated municipalities are required to develop Flow Restoration Plans (FRPs) to achieve the flow restoration targets in Moon Brook. They must also develop comprehensive PCPs to achieve required P reductions for their respective lake segment, on developed land owned or controlled by the municipality. These municipalities will not need separate permit coverage under the MRGP or the "3-acre designation," as these requirements will be incorporated into the PCPs within the municipality. The PCPs will include requirements to inventory all developed land within the municipality, estimate P loading from developed land, and identify BMPs and an implementation schedule to achieve the required reductions.

The City of Rutland has applied for an Individual MS4 permit to address both the Moon Brook Thermal TMDL and the Moon Brook Stormwater TMDL. The Town of Rutland has applied for the General MS4 permit and will be developing a PCP for municipally owned or controlled developed land by April 1, 2021.

Click the following hyperlink to view summary strategies to address Runoff from MS4 communities.

D. Wastewater

In Basin 3 there are 9 municipal wastewater treatment facilities. All of these are subject to NPDES discharge permit requirements issued by the State of Vermont (Table 9). Wastewater loads are 3% of the estimated P loading to Lake Champlain from the Otter Creek segment.

Controlling Phosphorus from Wastewater Treatment Facilities and Other Industrial Discharges

This section provides additional information regarding wastewater treatment facilities in Basin 3. As of the issuance of this Plan, all facilities are presently operating under administrative continuance of existing permits, which were issued in conformance with the allocations in place under the remanded 2002 LC TMDL. The 2016 LC TMDL did not alter the allowable P discharge loads from WWTFs that discharge to the Otter Creek segment of Lake Champlain, and as such, no specific requirements for upgrade are addressed by this plan. This does not eliminate requirements for ongoing operation and maintenance of these facilities, nor scheduled engineering performance reviews required of all VT WWTFs. The municipal wastewater discharge permits in place in the basin are shown in Table 9. As part of a necessary refinement of the facility-specific P wasteload allocations, the WSMD, with assistance from municipalities, is conducting an extensive sampling effort to document the current P loading conditions, and determine the "reasonable potential" that WWTF's have to cause or contribute to downstream water quality impairment. In addition, the approved 2016 LC TMDL presents a wasteload allocation for P loads, to which each facility in the basin will adhere (Table 3). To minimize the financial impact of WWTF WLA reductions on communities, VDEC will employ flexibility in meeting WLA targets by:

- Expressing effluent P limits in permits as total annual mass loads.
- Providing a period of time for optimization to be pursued and the corresponding load reduction results to be realized, and then commencement of the process to upgrade P treatment facilities will be required when actual P loads reach 80% of the TMDL limits.
- Establishing P compliance schedules in discharge permits that allow adequate time for planning, engineering, and municipal budgeting.
- Providing other forms of flexibility that support achieving the wasteload allocations in an optimally cost-effective manner, including P trading and integrated planning and permitting.

Facility-specific information

This section of the plan is intended to provide additional information about wastewater treatment facilities in Basin 3. As of the issuance of this Plan, all facilities are presently operating under administrative continuance of existing permits, which were issued in conformance with the allocations in place at the time of their last issuance.

Table 9. Summary of current permit requirements for the wastewater treatment facilities in Basin 3.

Facility (permit ID)	*Permit expiration (yr.)*	*Planned permit reissuance (yr.)*	*Design flow (MGD)*	*IWC* 7Q10 /LMM*	*Current permitted load (mt TP/yr.)*	*TMDL Allocated Waste load (mt TP/yr)*	*Current % of Design Flow (2017)*	*Treatment type*	*# of CSOs*	*Receiving water*
Brandon	2011	2021	0.700	0.363/0.133	0.580	0.580	59%	Extended aeration	0	Neshobe River
Middlebury	2013	2021	2.200	0.022/0.010	1.823	1.823	47%	Sequential batch reactor	4	Otter Creek
Otter Valley Union High School	2012	2021	0.025	0.369/0.137	0.173	0.173	45%	Aerated lagoons	0	Otter Creek
Pittsford	2011	2021	0.085	0.011/0.005	0.483	0.483	58%	Extended aeration	0	Furnace Brook
Proctor	2011	2021	0.325	0.006/0.002	0.359	0.359	62%	Aerated lagoons	0	Otter Creek
Rutland	2008	2021	8.100	0.152/0.069	5.634	5.634	51%	Extended aeration	5	Otter Creek
Vergennes	2009	2021	0.750	0.006/0.003	0.621	0.621	40%	Aerated lagoons	1	Otter Creek
Wallingford FD 1	2011	2021	0.120	0.013/0.004	0.829	0.829	33%	Extended aeration	0	Otter Creek
West Rutland	2011	2021	0.450	0.141/0.036	0.364	0.364	47%	Sequential batch reactor	0	Clarendon River

Instream Waste Concentration – or the proportion of river flow at lowest base (7Q10) and low median monthly (LMM) flow attributable to discharge, for the facility design flow. Note that the IWC is specific to the flow of receiving water.

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 Town of Brandon was issued a 1272 Order on March 8, 2018, addressing a recent 12-inch sewer line break in the Neshobe River. The Order required the repair of the line and an engineering inspection and evaluation within 18 months. This facility is also nearing the end of its useful lifespan having been originally constructed in 1961.

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, Otter Creek Brewing, and other industrial sources.

The Town of Middlebury received an Administrative Order on Consent from USEPA – Region 1 on April 25, 2016, to continue work to reduce wet weather overflows from the collection system. The Town submitted an Overflow Control Plan on June 26, 2018, with recommended improvements and a project timeline to reduce wet weather overflows at Pump Stations No. 3 and No. 9.

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.

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.

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

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. A project to upgrade the facility's digestors is in planning.

The City has five active CSOs. The Northwest Neighborhood Sewer Separation Project was completed in 2015. A 2017 report showed it had little effect on the incidence of CSOs, but appears to have reduced their duration and total volumes. The City recently installed advanced flow monitoring on all of its CSOs and now can report much more accurate overflow data. The development of projects to decrease the number, duration, and volumes of CSO events is ongoing.

The City of Rutland was issued a 1272 Order on May 8, 2018, requiring compliance with the applicable requirements of state and federal law, including the VWQSs. The Order required the implementation of the 9 Minimum Controls for CSOs as well as the creation of a Long-Term Control Plan (LTCP). The LTCP is due May 2020.

Vergennes

The City of Vergennes owns and operates the Vergennes Wastewater Treatment Facility which is a super-primary aerated lagoon system followed by chemical addition and filtration for phosphorus removal. The facility discharges tertiary treated, chlorinated wastewater to Otter Creek.

The City of Vergennes was issued a 1272 Order on April 20, 2018, to address the one Sanitary Sewer Overflow in the collection system. The Long-Term Control Plan with a list of projects and a timeline for implementing the projects is due by October 20, 2019.

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.

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.

Click the following hyperlink to view summary strategies to address Loading from WWTF.

E. Natural Resource Restoration--Forests

Forest lands cover 58.74% of Basin 3 and are important for safeguarding many high-quality surface waters in the basin. Management activities take place on a portion of those lands for the benefits of maintaining healthy forest communities, improving wildlife habitat, addressing non-native invasive plants, contributing to the working landscape economy, and addressing poorly designed legacy road infrastructure. Improving management and oversight of harvesting activities can help reduce sediment, nutrients, petroleum products, and woody debris that can end up in surface waters if Acceptable Management Practices (AMPs) are not followed. As the dominant land cover type in Basin 3, reducing runoff and erosion from forests is important to meeting the state's clean water goals including reductions needed to comply with the LC TMDL. Specifically, forest loads are 17% of the estimated P loading to Lake Champlain from the Otter Creek segment (Figure 22).

This section is organized around the Vermont Department of Forest, Parks, and Recreation (VDFPR) Acceptable Management Practices for Logging Jobs, Vermont Voluntary Harvesting Guidelines to protect forest health and Sustainability, local skidder bridge programs, information minimizing water quality impacts from maple sugaring operations, and forest land conservation efforts.

Forest Regulatory Programs-Acceptable Management Practices

The VDFPR updated the Accepted Management Practices (AMPs) for maintaining water quality and minimizing erosion on logging jobs in Vermont effective as of August 11, 2018. Vermont first adopted these rules 1987. The AMPs provide measures for loggers, foresters, and landowners to utilize, before, during, and after logging operations to comply with the VWQS. Specifically, their intent is to prevent any mud, petroleum products and woody debris (logging slash) from entering the waters of the State and to otherwise minimize the risks to water quality. Updates in 2018 include standards for permanent crossing on intermittent streams. Key modifications are found here.

Permits are necessary for "Heavy Cutting" of 40 acres or more. Only a small percentage of harvesting in Vermont is done through this type of cutting, so there are very few (approximately 40-50) heavy cut permits every year. Most logging operations do not require a permit. Website for heavy cut permit here: https://bit.ly/2Y4H06b. Harvesting over 2,500 feet in elevation requires an act 250 permit and harvests where biomass chips go to Vermont power plants require a chip harvest permit from Dept. of Fish and Wildlife.

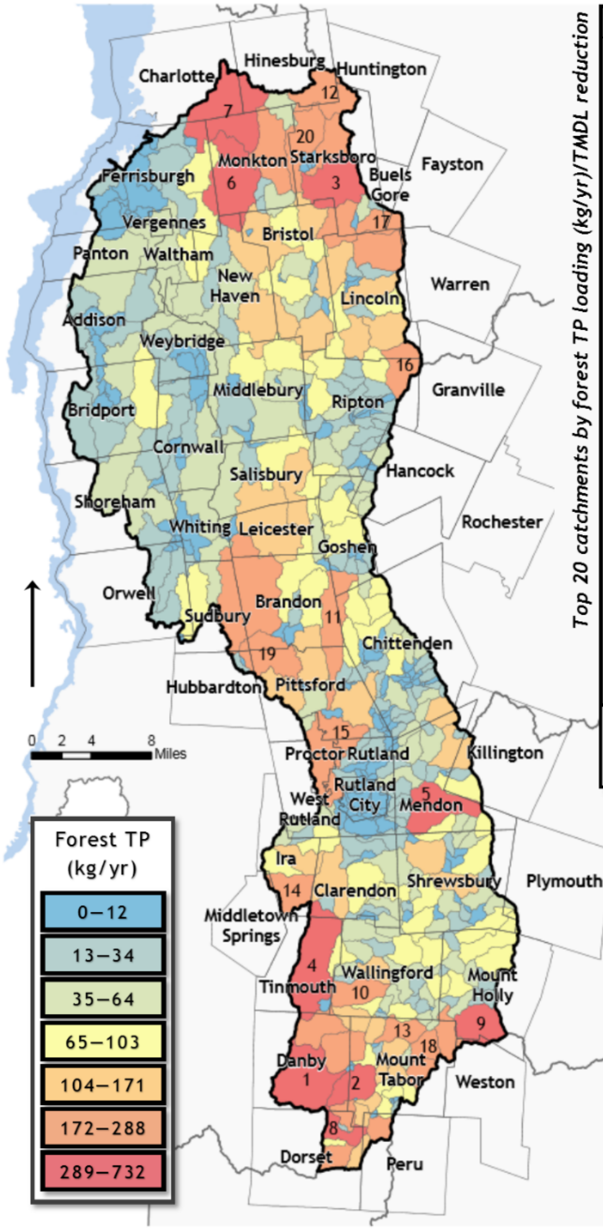
The VDFPR is promoting and demonstrating the use of portable bridge designs on timber harvesting operations throughout Vermont, including programs to rent bridges in the basin. When properly installed, used, and removed, skidder bridges minimize stream bank and stream bed disturbance as compared with alternative devices, such as culverts or poled fords. In addition, bridges reduce the occurrence of sedimentation, channeling, and any degradation of aquatic habitat, while allowing loggers to harvest timber in compliance with the AMPs.

Limiting Phosphorus Loading from Forest

For the Otter Creek Basin, an overall TP reduction target of 5% has been allocated to all forest lands. The primary sources of forest land P export are forest roads and harvest areas, which are addressed in the 2018 AMPs. Thus, EPA suggests the 5% reduction called for in the Reasonable Assurance scenario is easily supported.

Based on watershed TP modeling in support of the TMDL, Figure 31 identifies areas where forest TP export is highest. While TP loading rates are generally low in forested areas, areas with steep slopes and thin soils could be problematic for forest road building and harvest activity. These areas should receive the most oversight to control downstream effects of erosion. In addition, there is a rebuttable presumption that all lands enrolled in Vermont's Use Value Appraisal (UVA) Program, better known as the "Current Use" Program, are compliant with AMPs per the implementation of Forest Management Plans developed as a requirement of participating in the UVA Program. In Basin 3, 128,552 acres (23.7%) of forest lands are UVA Forest, 125,477 acres (23.1%) are Non-Forest UVA, and 288,583 acres (53.2%) are Non-UVA Forest.

Figure 34. Estimated forest TP loading for Otter Creek towns and HUC12 watersheds and TP load reduction potential.



Top 20 catchments by forest TP loading (kg/yr)/TMDL reduction

MapID	Town	HUC12 Name	TP	Reduction*
1	Danby	Headwaters Otter Creek	732	37
2	Mount Tabor	Headwaters Otter Creek	415	21
3	Starksboro	Headwaters Lewis Creek	361	18
4	Tinmouth	Clarendon River	353	18
5	Mendon	Cold River	343	17
6	Monkton	Headwaters Little Otter Creek	342	17
7	Charlotte	Lewis Creek	338	17
8	Dorset	Headwaters Otter Creek	320	16
9	Mount Holly	Headwaters Mill Creek	312	16
10	Wallingford	Homer Stone Brook-Otter Creek	288	14
11	Brandon	Furnace Brook	286	14
12	Hinesburg	Headwaters Lewis Creek	277	14
13	Mount Tabor	Big Branch	255	13
14	Ira	Clarendon River	234	12
15	Proctor	Moon Brook-Otter Creek	231	12
16	Ripton	Headwaters New Haven River	229	11
17	Starksboro	Baldwin Creek	227	11
18	Mount Tabor	Big Branch	227	11
19	Pittsford	Bresee Mill Brook-Otter Creek	226	11
20	Starksboro	Headwaters Lewis Creek	223	11

*TP reductions in these catchments represent 27% of total forest sector allocation

EXPLANATION OF FIGURE

Modeled TP loading is highest in the headwaters of Otter Creek (i.e., Danby and Mount Tabor) and Lewis Creek (i.e., Starksboro), which are characterized by steep slopes and erodible/thin soils. If allocated reductions were completely applied to these top 20 HUC12s, approximately 27% of the necessary reductions from forest land could be realized.

The mapped TP export shown in Figure 35 identifies the highest-loading catchments by town and lists the forest load as well as the potential P load reduction if the respective lake segment reduction targets were applied. If allocated reductions were completely applied to these top catchments, approximately 27% of the necessary P reductions from forest land could be realized.

Local planning, goal development, and implementation —Forests

The VDFPR, the VDEC, and partner organizations are offering training, technical assistance, outreach, and funding to maintain forest lands for water quality as well as many other benefits. Local planning efforts are enhanced through formal basin planning grant agreements which fund the RPCs and NRCDs to provide support to towns. For example, between 2014-2018, the RNRCD rented portable skidder bridges out on 14 different occasions. The RNRCD also provides technical support and training in use of the bridge. Continued support for this program and outreach necessary to maximize the use of the bridges will support water quality improvements in the basin. Another strategy in the plan is to support outreach to private forestland owners, foresters, and loggers on the revised AMPs and voluntary harvesting guidelines.

Click the following hyperlink to view summary strategies to address Runoff from Forest Lands.

F. Natural Resource Restoration--Lakes

Restoration of lakeshores is critical to meeting the state's clean water goals in Basin 3. In the absence of lake BMPs, developed shorelands may contribute 5% more runoff, 7% more P, and 18% more sediment than undeveloped sites.

This section includes basin specific information about lake shoreland conditions and the Lake Wise program which is the VDEC's program for restoring lakeshore habitat. Tactical basin planning supports Lake Wise assessments by identifying lakeshore problems, engaging local communities, lake and watershed organizations, and partners, especially where previously there hasn't been a great deal of local support. This section provides a summary of lake shoreland conditions in the basin, a brief update on the shoreland protection act, and a discussion of how Lake Wise restoration efforts can improve shoreland conditions in this basin.

Shoreland Condition

The Vermont Lake Score Card uses the same thresholds used by the USEPA National Lake Assessment to score a lake as good, fair or poor for lakeshore disturbance whenever possible (see Next Generation Lake Assessment). A detailed explanation of how shoreland scores are calculated can be found at: https://bit.ly/2SHDBbN. Richville Pond, Rutland City Reservoir, and Chipman Lake have poor (red) shoreland scores and 18 others have fair (yellow) shoreland scores (Table 10).

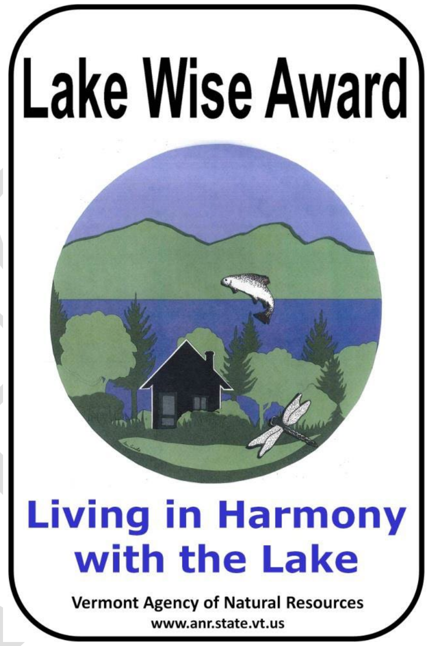
Table 10. Basin 3 Lakes with Poor or Fair Shore and Habitat Scores.

Lake Name	Town	Shore & Lake Habitat Score
Burr Pond	Pittsfield	Yellow
Cedar Pond	Monkton	Yellow
Chittenden Reservoir	Chittenden	Yellow
Danby Pond	Danby	Yellow
Danyow Pond	Ferrisburgh	Yellow
Dow Lake	Middlebury	Yellow
Lake Dunmore	Salisbury	Yellow
Elfin Lake	Wallingford	Yellow
Emerald Lake	Dorset	Yellow
Fern Lake	Leicester	Yellow
Hallock Lake	Starksboro	Yellow
Silver Lake	Leiceseter	Yellow
South	Chittenden	Yellow
Star Lake	Mount Holly	Yellow
Patch Pond	Rutland City	Yellow
Porter Pond	Ferrisburgh	Yellow
Winona	Bristol	Yellow
Walker	Hubbardton	Yellow
Richville	Shoreham	Red
Rutland City	Rutland Town	Red
Chipman Lake	Tinmouth	Red

The largest fair or poor lakes are Lake Dunmore in Salisbury, Chittenden Reservoir in Chittenden, Winona Lake in Bristol, Richville Pond in Shoreham, and Silver Lake in Leicester. Fifteen out of 36 lakes assessed in the basin have good condition shorelands with the largest being Wallingford Pond in Wallingford, Lefferts Pond in Chittenden, and Spring Pond in Shrewsbury.

Effective July 1, 2014, the Vermont Legislature passed the Shoreland Protection Act which regulates shoreland development within 250 feet of a lake's mean water level for all lakes greater than 10 acres in size. The Act's intent 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. Shoreland developed prior to July 1, 2014, is not required to retroactively meet standards.

Lake Wise Program



The Lake Wise Program, an VANR initiative that awards lake-friendly shoreland properties, is available to lakeshore owners and Lake Associations to assess shorelands for improvements that benefit water quality and wildlife habitat. Lakes with a poor or fair shoreland score will benefit from implementing Lake Wise Program BMPs. The program provides on-site review of shoreland conditions and recommendations for lessening the impact of existing shoreland development on a lake. Lake Wise participants passing all four categories for driveway; structures and septic systems; recreation areas; and shorefront receive the Lake Wise Award, which can include a sign that can be displayed on the property. Lake Associations are also awarded the "Gold Award," depending on the percentage of shoreland owners participating in Lake Wise. Landowners wishing to retrofit their property to meet Lake Wise standards are given a list of BMPs that can be easily implemented. Participation is tracked and a cumulative benefit of the program in terms of improved property management can be calculated. To date, Fern Lake and Lake Dunmore are the only lakes with Lake Wise assessments in the basin.

The VDEC is developing a Lake Wise master planning process where coordinated Lake Wise assessments catalogue potential BMP projects and landowner interest in implementing these. The BMPs will be prioritized based on their ability to reduce nutrient runoff and improve habitat conditions along lakes and landowner interest in implementing BMPs. Chipman Lake and Richville Pond are priorities for Lake Wise master planning.

Click the following hyperlink to view summary strategies to address Runoff from Lakeshore Properties.

Aquatic Invasive Species

Of the 30 lakes and ponds assessed for AIS in the basin, 11 have identified AIS. They are Beaver Pond (Proctor), 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). Strategies to support AIS spread prevention efforts include:

- Regular and expanded AIS monitoring,
- Initiating AIS Greeter Programs, and
- AIS spread prevention through signage or Vermont Invasive Patroller program.

Click the following hyperlink to view summary strategies to address Aquatic Invasive Species.

G. Natural Resource Restoration--Rivers

Rivers constantly balance the energy they produce and the work that must be done to carry the water, sediment, and woody material produced in their watersheds. A change in any of these factors will cause adjustments of the other variables until the river system comes back into equilibrium. These changes can be caused by natural events and by human activity. Human activities can disrupt the balance by changing flow inputs to the channel (e.g., by deforestation, increasing impervious surfaces and runoff, or water withdrawals) or by changing sediment regime (e.g., dams, dredging, or in response to intensified erosion). In Basin 3, changes are frequently caused by natural flood events, increases in impervious surfaces and runoff, channel straightening, berming, and dams. The impact of these actions may be seen immediately or for decades after the activity occurred.

The VDEC has a goal of managing rivers to protect and restore their equilibrium condition. Stream 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. The degraded geomorphic condition of some of the basin's streams has the following consequences:

- impacts to wildlife and fish habitat (e.g., riparian buffer removal reduces shading and habitat for insects and fish, channel alteration destroys aquatic habitat),
- public safety (e.g., loss of floodplains that store floodwaters, accelerated streambank erosion leading to infrastructure damage, and channel straightening that increases flow velocity during rain events), and
- water quality (e.g., higher *E. coli* populations caused by increased fine sediment resuspension and bank soil erosion, and nutrient and sediment runoff from encroachment of impervious surfaces and agricultural land).

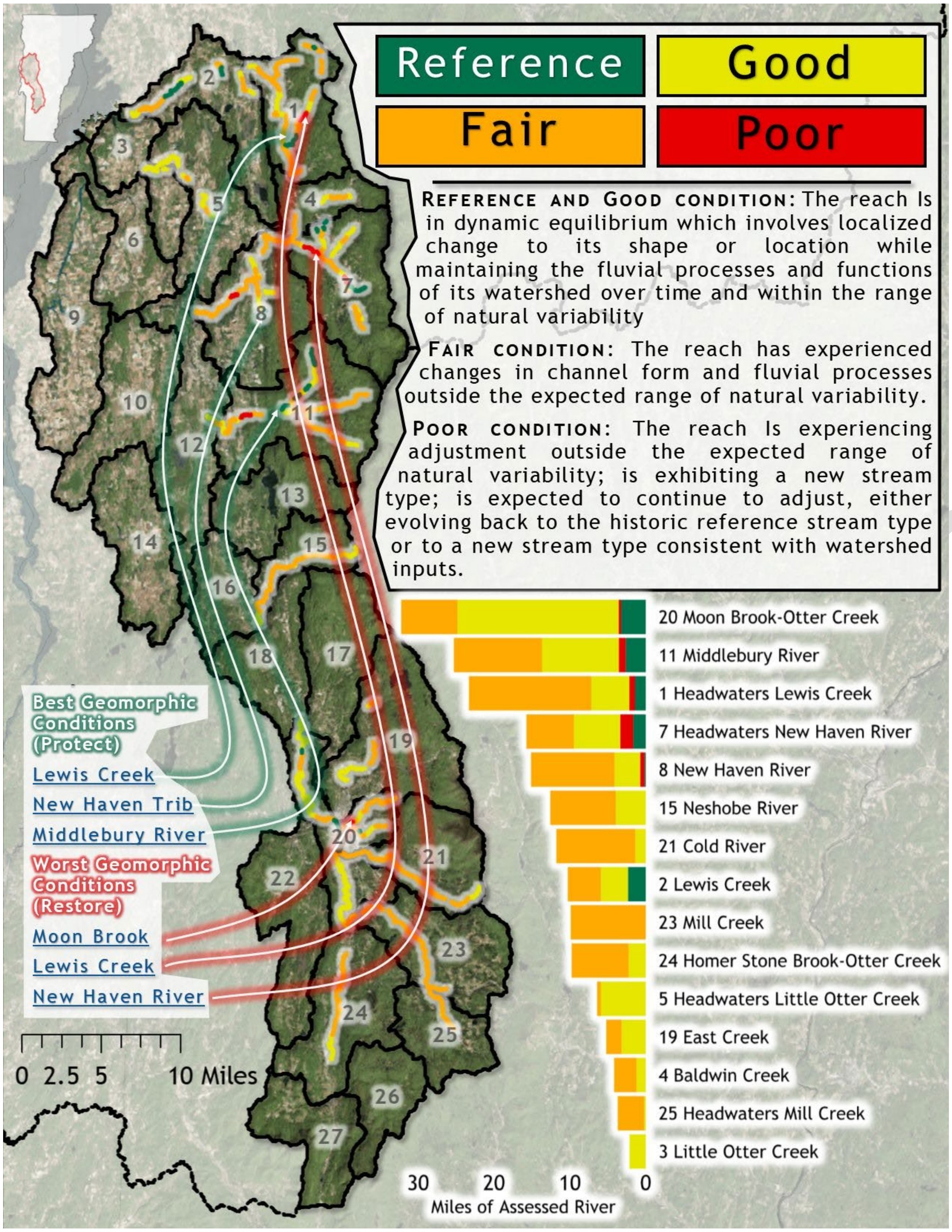
This section includes basin specific information on how to improve river connectivity in the basin. River connectivity means that a river is connected longitudinally, laterally, vertically, and temporally to support stream equilibrium and riparian habitat. A connected river freely flows from upstream to downstream, meanders and exchanges water with lands, vegetation, and waterbodies alongside its path, freely accesses its floodplain, and cycles through its seasonal flow pattern. The tactical basin planning approach engages local, regional, and federal partners in the development of strategies needed to accelerate practices to increase river connectivity and meet the state's clean water goals including reductions to support the LC TMDL. This section provides an overview of Basin 3 SGAs, aquatic organism passage (AOP) and geomorphic status of culverts and bridges, dams, and community efforts to regulate floodplain and river corridor development, which together guide implementation efforts in the basin to increase river connectivity.

Stream Geomorphic Assessments

Stream geomorphic assessments help us understand the physical integrity of rivers and develop management strategies in support of stream equilibrium. The final products of the assessment are the condition of each reach, the channel adjustment process that may be underway, and the sensitivity of the reach to change from anthropogenic and/or natural sources. Phase 1 and Phase 2 SGAs have been completed on many Basin 3 streams (Figure 36). All final assessment reports are available at the following link. These assessments identify good conditions in some reaches of the Lewis Creek, the New Haven River, and the Middlebury River. Poor conditions are found in Moon Brook, Lewis Creek, and New Haven River tributaries. Data gaps exist in the Lower Otter Creek, which has a Phase 1 SGA, but a Phase 2 lite assessment would be valuable. The highest priority stream segments in the basin have SGAs and will be revisited as needed. Data gaps will be addressed during this 5-year planning cycle.

Additional project development is needed to advance restoration of floodplain access and stream stability through active projects such as: floodplain excavation, berm removal, channel restoration, and/or river corridor easements where feasible. These projects will be key to restoring stream stability and water quality, especially in subwatersheds where nutrient and/or sediment impairment is of concern.

Figure 35. Geomorphic Conditions of Basin 3 rivers and streams.



EXPLANATION OF FIGURE

Lewis Creek, the New Haven River, and the Middlebury River have some of the best geomorphic conditions in the basin, whereas poor conditions are found in reaches of Moon Brook, Lewis Creek, and New Haven River tributaries. Data gaps exist in the Lower Otter Creek, which has a Phase 1 SGA, but a Phase 2 lite assessment would be valuable.

Reducing Phosphorus from Unstable Stream Channels

The Lake Champlain Phase I Implementation Plan recognizes that it is impossible to achieve the P load reduction targets for unstable streams by restoration activities alone. If the river corridors along incised and straightened stream channels are not protected from encroachment, they will be developed and the potential for cost-effective restoration will be lost. River corridor and floodplain protection ensures that the desired channel evolution, stream equilibrium, and natural floodplain function can take place whether it be from restoration activities or through the natural channel forming processes that occur during floods. Further, the estimation of subwatershed P loading from stream channels would be a scientifically tenuous proposition at any scale smaller than that established by the TMDL. As such, this plan relies on the identification of high priority subwatersheds where SGAs indicate the highest likelihood for P reductions through the pursuit of dynamic stream equilibrium.

Measuring Phosphorus Reductions from Stream Channels

VDEC has developed a methodology to document long-term achievement of the LC TMDL allocation for stream channels. Approved by EPA, the methodology still needs to be piloted and a database developed to support it. The Stream Equilibrium (SE) Tracking Method starts by establishing a total watershed deficit where the existing condition is subtracted from the ideal condition and a total watershed sum is derived by adding the deficit that is calculated for each reach in the watershed. The deficit for each reach is comprised of two components, one to track restoration activities and another to track corridor and floodplain protection activities. This is a novel approach because most tracking tools focus entirely on activities that manipulate the environment to achieve restoration. The total watershed deficit is envisioned to be calculated as follows.

Reach Deficit Score Data							
Phase 2 Incision ratio	Phase 2 Entrenchment	Floodprone to Belt Width Ratio	Phase 2 Channel Evolution Stage	Overall Segment Depature Score	Segment Equilibrium Deficit Score	Segment Protection Deficit Score	Total Deficit Score
1.5	2.5	0.46	IV	90	50	20	70.0
1.5	5.9	0.93	III	110	70	20	90.0
1.5	2.1	0.41	III	125	75	30	105.0
1.6	4.5	0.64	III	120	80	20	100.0
1.6	5.5	1.26	II	130	90	20	110.0
1.6	10.2	1.50	III	120	80	20	100.0
1.7	4.3	0.68	III	125	85	20	105.0
1.7	1.7	0.31	II	150	110	20	130.0
2.1	1.1	0.15	II	185	135	30	165.0
2.4	1.3	0.27	II	200	160	20	180.0
2.6	1.6	0.24	II	200	160	20	180.0
2.6	1.2	0.27	II	200	160	20	180.0
2.9	1.5	0.34	III	200	160	20	180.0
				3760	**2290**	**815**	**3117**

Parameters used for developing Reach Deficit Score:

- **Incision Ratio** – looking at how connected reach is to the floodplain
- **Confinement** – Entrenchment and Flood-prone to Belt-width ratio – determining how much floodplain is available compared to what should be available
- **Channel Evolution Stage** – Determine how far from equilibrium the reach is
- **Protection** – Consideration for ability of stream to obtain/maintain equilibrium over time

Data to support the scoring is largely available in the VT SGA database. The land protection scoring will be developed from existing GIS data layers, and finally, a restoration practice scoring matrix will be developed to score each type of project pursued by the VANR and its partners.

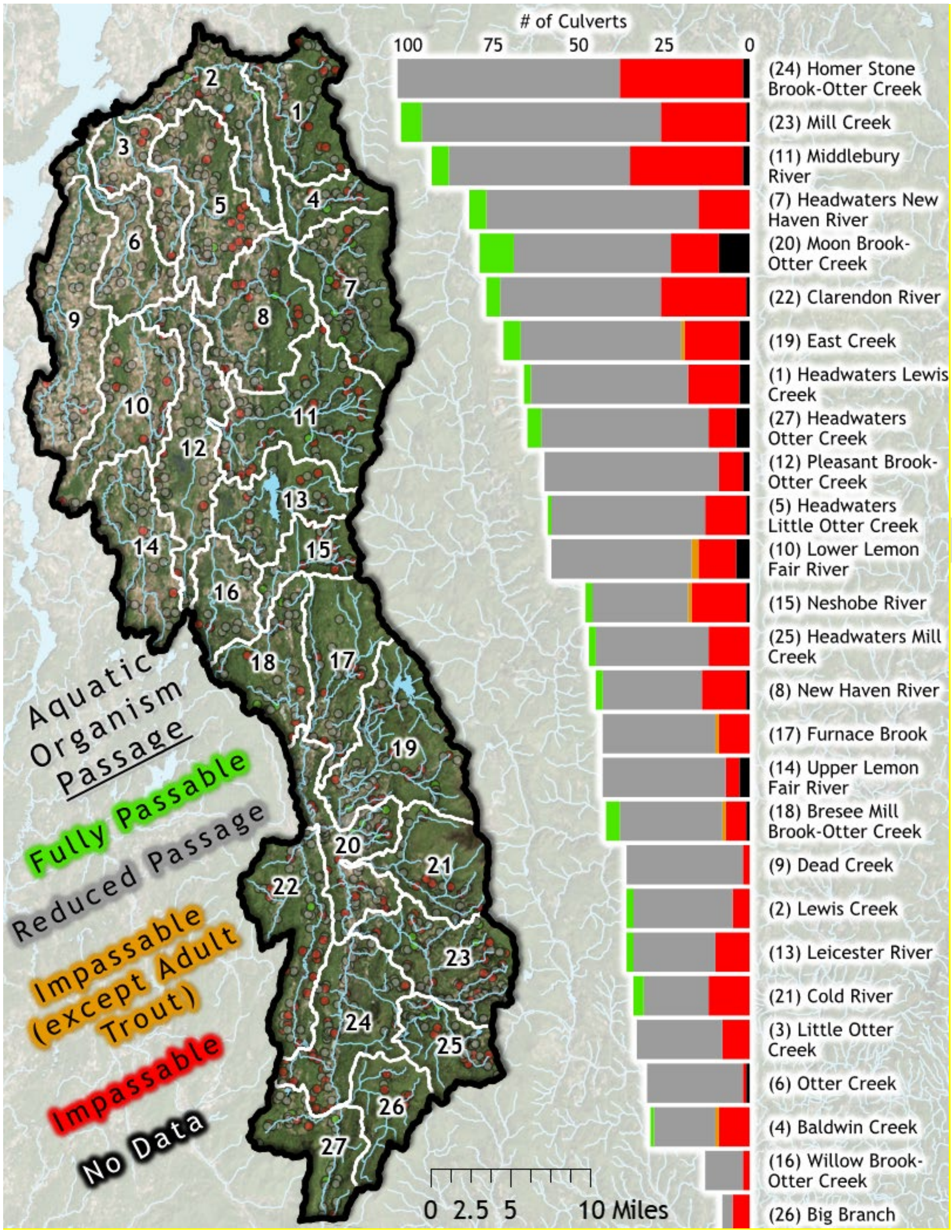
Aquatic Organism Passage (AOP) and Geomorphic Compatibility

Vermont Fish and Wildlife Department have completed VANR Bridge and Culvert assessments of most culverts in Basin 3. Undersized or poorly installed culverts can increase sediment loading and pose a risk to public health when they fail or act as a barrier to sediment movement, which causes erosion downstream of the structure. Culverts can also act as a barrier to AOP, which can negatively affect fish and other species that need to move to gain access to colder water habitats, feeding and spawning locations, and for natural dispersal. The VANR developed a bridge and culvert assessment and screening tool to identify infrastructure in need of replacement or retrofit to restore AOP (Table 11) or address geomorphic issues (Table 12). In addition, a guide for Implementing AOP Enhancement Projects in Vermont (Kirn, 2016) is available and a new culvert mapping tool has been developed by the WSMD MAPP assessment program and can be viewed at http://arcg.is/19eqSD0.

Table 11. Screening criteria for Aquatic Organism Passage.

VT Aquatic Organism Passage Coarse Screen	
Fully Passable for all organisms	No outlet drop or obstructions to culvert with sediment through structure and depth at outlet greater than 0.3ft.
Reduced Passage for all organisms	Cascade at culvert outlet and sediment not present throughout structure and depth at outlet greater than 0.3ft.
Impassable except adult salmonids	Free fall between 0 and 1 ft, or with downstream pool greater than 1 ft depth, and depth at outlet greater than 0.3ft.
Impassable for all aquatic organisms	Free fall greater than 1 ft, or less than 1 ft with downstream pool present or outlet less than 0.3 ft deep

Figure 36. Aquatic organism passage assessment results for Basin 3 bridges and culverts.



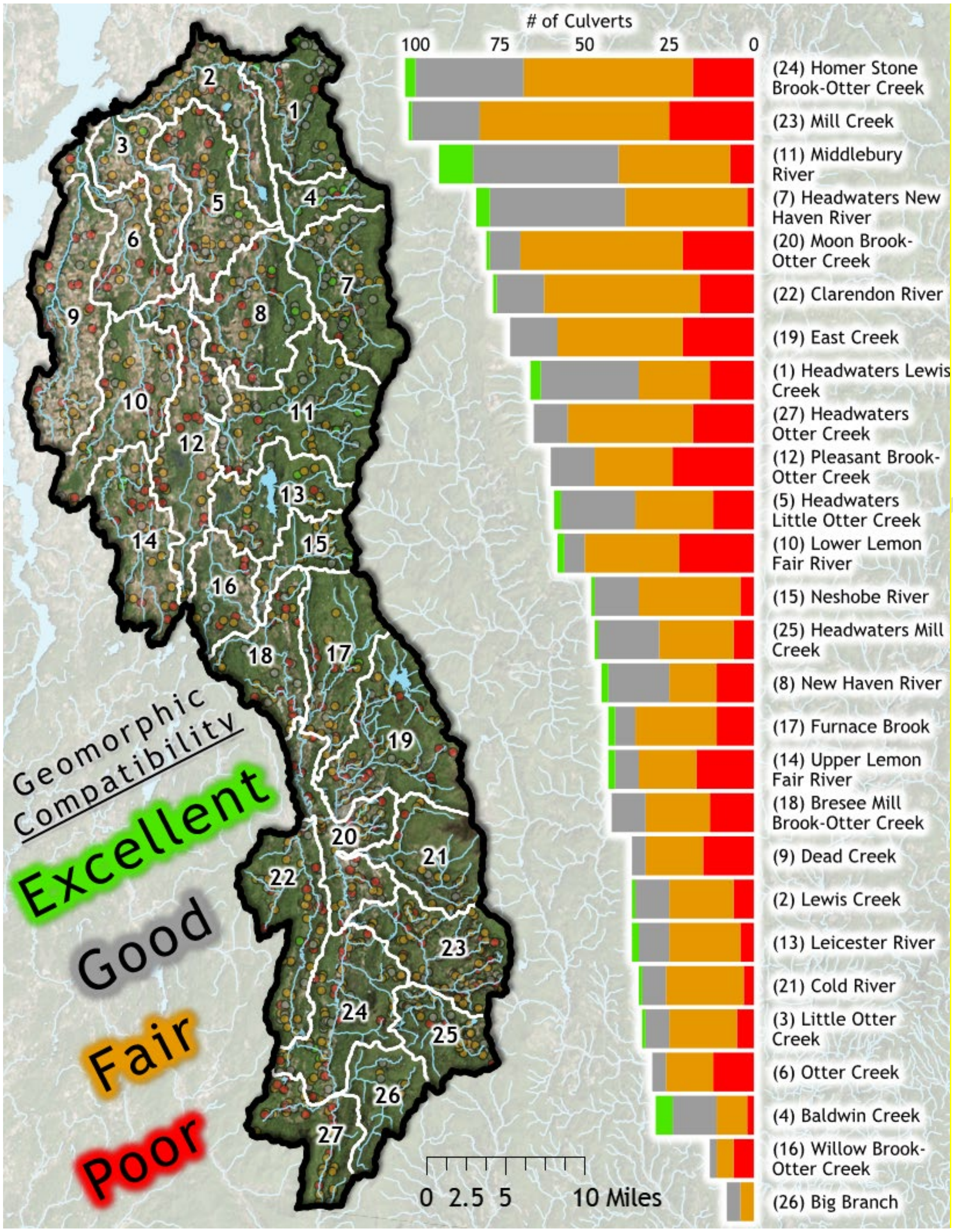
EXPLANATION OF FIGURE

In Basin 3, AOP of 1,439 bridges and culverts was assessed. 69% have reduced AOP, 0.5% as passable only by adult trout, and 23% impassable. As little as 4 % provide full AOP. Areas with the most impassable culverts are: Homer Stone Brook-Otter Creek, Middlebury River, Mill Creek, and Clarendon River. Moon Brook-Otter Creek, Upper and Lower Lemon Fair, and Headwaters of Otter Creek watersheds have the largest data gaps.

Table 12. Screening criteria for Geomorphic Compatibility.

Vermont Geomorphic Compatibility Screen	
Fully Compatible	Structure fully compatible with natural channel form and process. There is a low risk of failure. No replacement anticipated over the lifetime of the structure. A similar structure is recommended when replacement is needed.
Mostly Compatible	Structure mostly compatible with current channel form and process. There is a low risk of failure. No replacement anticipated over the lifetime of the structure. Minor design adjustments recommended when replacement is needed to make fully compatible.
Partly Compatible	Structure compatible with either current form or process, but not both. Compatibility likely short term. There is a moderate risk of structure failure and replacement may be needed. Re-design suggested to improve geomorphic compatibility.
Mostly Incompatible	Structure mostly incompatible with current form and process, with a moderate to high risk of structure failure. Re-design and replacement planning should be initiated to improve geomorphic compatibility.
Fully Incompatible	Structure fully incompatible with channel and high risk of failure. Re-design and replacement should be performed as soon as possible to improve geomorphic compatibility.

Figure 37. Geomorphic compatibility assessment of Basin 3 bridges and culverts



EXPLANATION OF FIGURE

An assessment of geomorphic compatibility of Basin 3 bridges and culverts shows just 3% are fully compatible, 27% are mostly compatible, 48% partly compatible, and 22% are incompatible. Areas with the lowest geomorphic compatibility are: Homer Stone Brook-Otter Creek, Mill Creek, Moon Brook-Otter Creek, and Clarendon River.

For Basin 3, it is a priority to provide this information to towns as part of the road inventory and capital budget process and to assist in identifying grant funding to address the most significant AOP and geomorphically incompatible structures. These screening tools are a desktop analysis used to flag incompatible culverts and bridges that are the need for replacement or retrofit to restore AOP or address geomorphic issues. Follow-up field visits are needed to fully assess their condition along with coordination with road commissioners to match town priorities with potential funding.

Dams of Basin 3

Dams are the most important channel modifications in Basin 3. There are 103 dams of different types, sizes, and condition in the basin compared with over 1,000 statewide. While dams provide renewable energy and recreational opportunities such as boating, fishing, and swimming, they can also:

- impede a stream's ability to transport flow and sediment;
- cause streambank erosion and flooding problems;
- degrade and alter fisheries habitat;
- create barriers to AOP;
- alter downstream temperature
- degrade water quality; and
- impede river-based recreational activity.

Of the 103 inventoried dams, 95 are in-service, 6 are fully breached, 1 has been removed, and 1 is partially breached. Approximately 50% of the dams in Basin 3 are privately owned. Twenty-two are owned by the VDFW WMA and 14 are hydroelectric dams. The VDEC reviews hydroelectric generating dams as a flow alteration activity and issues a certification pursuant to Section 401 of the federal Clean Water Act (CWA) that the project as operated meets the VWQS. The surface waters impounded by and downstream of these facilities are classified to maintain designated uses at a Class B(2) level of quality. Water quality issues related to hydroelectric dams include flow modification as documented along: East Creek (Chittenden Reservoir, Glen dam, and Patch dam) (Figure 17), and the Leicester River (Salisbury dam) and Lake Dunmore (Figure 16). A tributary to East Creek (Hydro bypass) is also listed as impaired by low DO. A detailed list of known active and historic dams in the basin can be found in Appendix C.

Dam owners are improving management during federal relicensing or by working with partners to remove dams. Dam removal activity in Basin 3 has increased since 2012. An example of a recent dam removal project is the 2014 Kendrick Pond project on Sugar Hollow Brook in Pittsford. It restored 10 miles[2] of stream habitat, which supports brown, brook, and rainbow trout (see sidebar below and Flow Blog post at: https://bit.ly/2WZ9VHP). SGAs and site assessments have identified several other dams as priorities for removal in the basin. One of the highest priorities is the Dunklee Pond Dam on Tenney Brook in Rutland City. The privately-owned dam is rated as "failing" and threatens 2 adjacent homes and Route 7, and blocks AOP. The dam impounds ≈ 10,000 cubic yards of accumulated sediment upstream and a catastrophic failure would release these sediments into

Tenney Brook. This would adversely affect water quality and habitat in Tenney Brook, Otter Creek, and Lake Champlain.

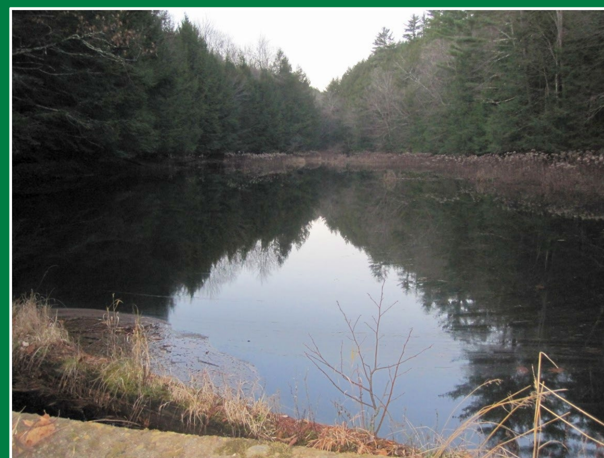
The owners support removal of the dam and the City of Rutland is interested in the project as a flood resiliency initiative to increase public safety. An important co-benefit to the Rutland community is the opportunity for progressive habitat management in an urban environment. Restoration of the impounded area will restore an urban setting to a "natural" state and increase longitudinal river connectivity and ultimately AOP.

The phased dam removal project began in 2019 with ERP funding for the *Phase I Dam Removal Design,* which will result in a 100% design plan for the dam removal and regulatory authorization in local, state, and federal permitting programs in the 2019-2020 timeframe. Phases 2-4 include: removal funding (2020), implementation (2021), and site revegetation (2021-2024).

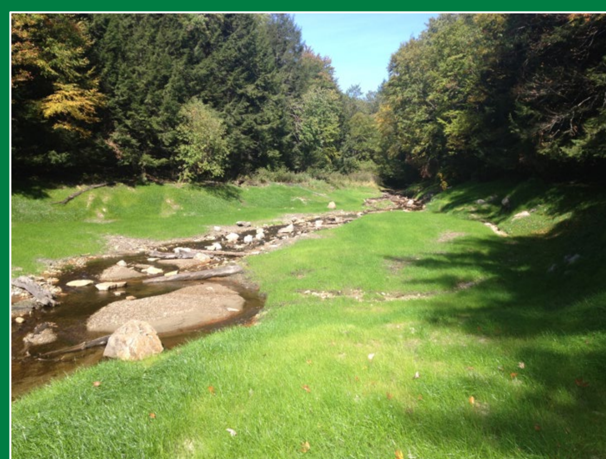
On January 18, 2018, H.554 or Act 161, the Dam Safety bill, passed the Vermont House of Representatives and received final approval on May 10th, 2018. The bill was developed collaboratively with the VDEC, Vermont Natural Resources Council, Vermont Trout Unlimited, the Vermont Section of the American Society of

Project Spotlight: 2014 Kendrick Pond Dam Removal

a)



b)



a) Before and b) after photos of the Kendrick Pond dam removal site, Pittsford, VT

The removal of the Kendrick Pond Dam (circa 1870) restored 10 square miles of stream habitat in Sugar Hollow Brook. The removal of 12,600 cubic yards of accumulated sediment restored 10 square miles of stream habitat in Sugar Hollow Brook and restored natural sediment transport. The project was a collaborative effort between the Town of Pittsford, the USFWS, and the VANR. The funding was secured from the Eastern Brook Trout Joint Venture Program, the WSMD's ERP, and the VT Watershed Grant Program.

Civil Engineers, and other partners. The bill addresses gaps in inspection requirements for hundreds of small dams. Under the bill, VDEC will be required to maintain an inventory of all dams in the state and develop rules that will require all dams to be regularly inspected.

Floodplain Management

VDEC's efforts to help towns improving flood resilience includes identifying flood attenuation zones, e.g., floodplains, river corridors, forests and wetlands, and recommending actions and policies to towns that will protect these functions and reduce the risks facing existing development. The Flood Ready website hosts supportive materials for municipal officials including community data on the River Corridor Protections Summary Report and Expanded Community Reports.

VDEC River Corridor and Floodplain Protection Program has prepared model flood hazard bylaws to assist municipalities in the development of their flood hazard regulations. These bylaws have been pre-reviewed by the Federal Emergency Management Agency (FEMA) and meet or exceed the requirements of the National Flood Insurance Program (NFIP). In addition, adoption and enforcement of Section D, River Corridors, qualifies communities for enhanced cost share under the Emergency Relief and Assistance Fund (ERAF).

ERAF provides State funding to match Federal Public Assistance after federally declared disasters. Eligible public costs are reimbursed by federal taxpayers at 75%. As of October 23, 2014, the State of Vermont contributes an additional 7.5% toward the costs. For communities that take specific steps to reduce flood damage the State will contribute 12.5% or 17.5% of the total cost. Only 5 Basin 3 towns qualify for the 17.5% contribution. However, all towns except Killington and Mount Tabor are participating in the National Flood Insurance Program. All towns except Rutland City have adopted the Town Road and Bridge Standards and most (81%) have adopted a Local Hazard Mitigation Plan (Figure 39).

Towns that meet ERAF criteria protect water quality while protecting themselves financially. Questions regarding the model flood hazard bylaws and ERAF should be directed to the appropriate DEC Regional Floodplain Manager: https://bit.ly/2L2rc0e.

Municipal Protections—Zoning and Town Plans

Local zoning and town plan policies can provide community specific protections and guidance to maintain and enhance local water resources. Local protections also afford benefits to downstream communities and water resource users. Although a town may have bylaws or town plan policies it does not mean their resources are afforded the strongest protection. Communities should work with their RPCs to identify opportunities that provide their constituents with the highest level of natural resource protection within their means. Towns with high development pressure, significant impervious surface cover including roads, and extensive development within proximity to water resources are a high priority for protection, as well as those areas with deficiencies related to their protective policies.

- Protecting river corridors helps protect roads and structures from erosive damage, improves water quality, moderates flooding, and enhances wildlife habitat. River corridor protection, limits development close to stream and river channels to allow the channel to establish and maintain a least-erosive path through the valley lessening the need to armor channel edges. In recognition of historic settlement patterns, the DEC model river corridor bylaw provides for infill and redevelopment in designated centers and densely developed areas provided that new development does not further encroach on the river relative to pre-existing development.
- Local stormwater regulations prevent runoff of pollutants from hard surfaces into wetlands, rivers and lakes. Stormwater management also slows flow into waterbodies during some flood events.
- Smart planning and design for development through Local Hazard Mitigation Plans (LHMP), floodplain bylaws, and ERAF attainment in towns and villages saves money and lowers the risk of significant loss during flood events, while protecting water quality as an added benefit.
- Limiting development on steep slopes, ridgelines, and landslide hazard areas can protect high quality water resources and prevent excessive erosion and sedimentation to streams and lakes that impacts water quality and aquatic habitat.

Recommendations for local water resource protection goals are illustrated in Figure 39. For detailed information on municipal protectiveness for towns in Basin 3, please see the Basin 3 Plan webpage.

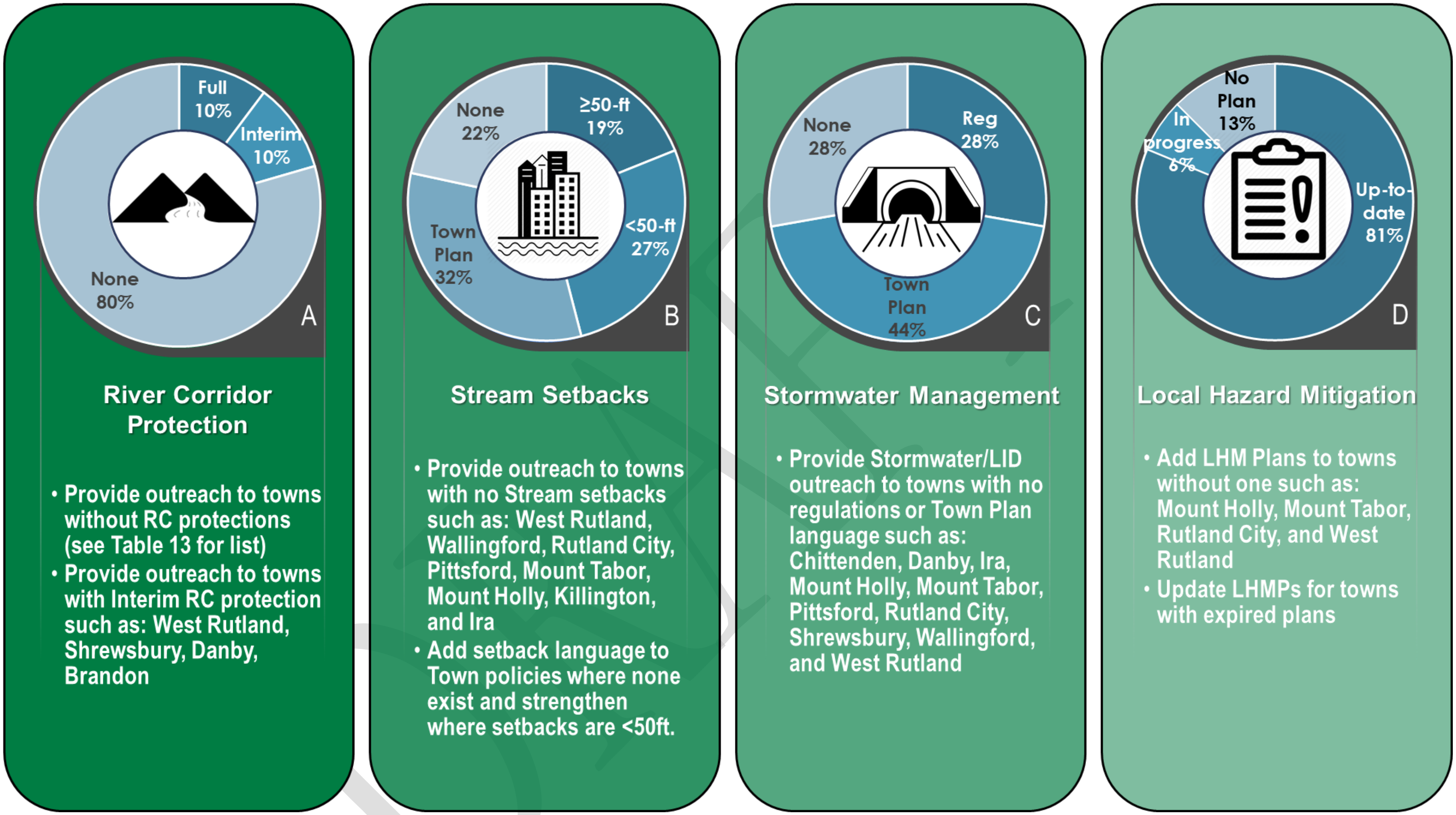


Figure 38. Municipal protection goals for towns and status of local protections in Basin 3.

Local planning, goal development, and implementation —River Connectivity

Accelerated completion of priority projects, both protection and restoration, reflect an increasing interest in partners over the last 10 years to become involved in project planning and implementation (see Clean Water Board Reports). Community support of river corridor protection and restoration projects has multiple benefits including: flood resilience, outdoor recreational opportunities, and habitat function as well as nutrient and sediment reduction. The interest has led to municipally supported projects over the last 5 years in Brandon, Clarendon, and Rutland City where flood resilience was a primary focus. The VANR contributed technical assistance and funding required to enhance flood resilience through actions including the construction of flood benches and the removal of berms and dams. Moreover, VANR continues to provide technical assistance to encourage towns to protect river corridors through municipal zoning, over lays, and conservation.

Berms, or earthen levees, are a common concern in the basin. Substantial berming along portions of the Otter Creek and its tributaries prevent the stream from accessing the adjacent floodplain. One example of berming is along the Cold River in North Clarendon. A project between the VDEC Rivers program and the RNRCD determined berm removal options, assessed alternative scenarios, and modeled their outcomes. The modeling showed that removing specific berms would allow the flood water to spill onto the floodplain, thereby reducing flood flows and damages downstream. They are currently working to remove as much of the berm as possible to reconnect the floodplain for flood water and nutrient storage.

Another berm removal study in 2019 assessed alternatives for berm removal on Homer Stone Brook in South Wallingford. The alternatives included property buyouts, which would remove residential infrastructure from the hazard area and could reduce or eliminate the risk to life and private property. Additionally, by reducing the need to actively manage the channel to protect homes, Homer Stone Brook could begin to naturally adjust in order to achieve equilibrium and reduce erosion.

Click the following hyperlink to view summary strategies to address River Connectivity.

H. Natural Resource Restoration—Wetlands

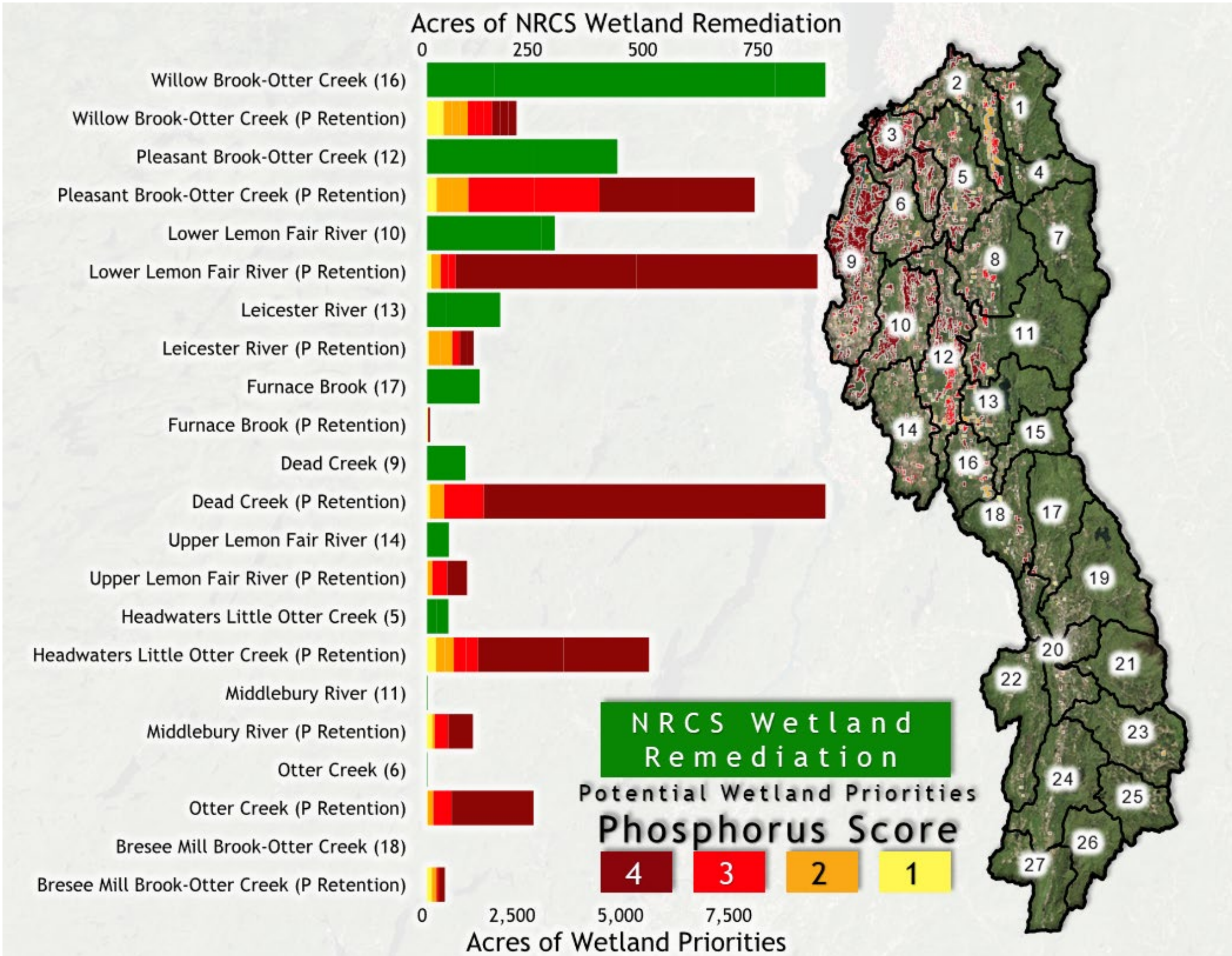
Wetlands cover 11.04% of Basin 3 and are important for safeguarding many high quality surface waters in the basin. As recently as the 1950s, wetlands were seen as obstacles to development, agriculture, and transportation, and consequently, were systematically drained and altered. These losses and alterations compromise the important benefits provided by wetlands including attenuating sediment and nutrients, providing habitat for a wide variety of plants and animals, and reducing flood damage. While protecting remaining wetland resources is an important strategy in the basin (see Ch. 2), restoring degraded wetlands is essential to improving water quality. Many Basin 3 wetlands are candidates for restoration to rehabilitate them to approximate pre-disturbance condition. As the third dominant land cover type in Basin 3, reducing P export from wetlands is important to meeting the state's clean water goals including reductions needed to comply with the LC TMDL.

This section is organized around the VDEC Wetlands Program Restoration Initiative, identifying sites with the greatest potential for P removal through wetland restoration and conservation.

Wetland Restoration

The 2007 VT Agency of Natural Resources' Lake Champlain Basin Wetland Restoration Plan and 2017 updates includes the identification and prioritization of wetlands in the VT portion of the Lake Champlain Basin (LCB) with the greatest potential for P removal through restoration. While the modeling exercise identified highly-ranked sites in all sub-basins in the Vermont LCB, sites in the Otter Creek sub-basin had the highest mean restoration scores. These scores reflected a high proportion of agricultural land in close proximity to surface waters draining clay soils (i.e., in soil hydrologic groups C and D, which are characteristic of these sub-basins). The high ranking of sites in the Otter Creek sub-basin suggests that it would be an appropriate target for initial wetland restoration efforts (Figure 40). Based on this model, highest priority sites are being selected for contractor outreach and partner collaboration. Funding priorities will be given to projects in the LCB that have high P rank scores (https://bit.ly/2RnprMc).

Figure 39. Priority wetland restoration areas based on P retention potential and previous NRCS wetland remediation areas.



EXPLANATION OF FIGURE

The figure shows an assessment of Basin 3 wetlands with the greatest potential to retain P. Dead Creek, Lower Lemon Fair, and Pleasant Brook-Otter Creek are the highest priority wetlands for potential P retention. Moreover, 2012-2018 NRCS data suggest these areas have not yet been the focus of much wetland remediation.

Wetland Conservation Easements

A new initiative is in progress for the protection of wetlands in Vermont. The state is currently developing a Wetlands Easement calculator to evaluate the value of wetlands for protection through the easement process. River Corridor Easements are used by the state and partner organizations to purchase channel management and development rights in the most sensitive and important areas along stream channels to encourage stream equilibrium, sediment and nutrient attenuation, and flood protection. The wetland conservation easements will be used in a similar way to protect and restore wetlands with significant function and values related to water quality, flood protection, climate change mitigation and wildlife habitat.

Click the following hyperlink to view summary strategies to address Wetland Restoration.

Chapter 5 -The Basin 3 Implementation Table

The Basin 3 Plan addresses all impaired, stressed, and altered waters in the basin as well as protection needs for high quality waters. The list of strategies in the Implementation Table (Table 13) and the Monitoring and Assessment Table (Table 14) cover future assessment and monitoring needs, as well as projects that protect or restore waters and related education and outreach.

The Implementation Table Summary is a list of 55 priority strategies to be used to guide efforts toward watershed practice implementation. A list of related, individual project entries is found in the online Watershed Projects Database (WPD). The projects vary in level of priority based on the strategies outlined in the summary. Not all the WPD projects are expected to be completed over the next five years, but each strategy is expected to be pursued and reported upon in the following plan and updated in the WPD.

As projects are developed, priority for CWIP funding will be given to those projects that achieve the highest water quality benefits. Additionally, projects that provide cumulative benefits (i.e. flood resiliency, water quality improvement, water resource protection, AOP) will receive additional consideration for prioritization.

Table 13 is organized by land use or pollutant sectors described in Chapter 4 and can be accessed directly by clicking on the bookmarks below:

A) Runoff from Agricultural Lands
B) Runoff from Developed Lands -- Stormwater
C) Runoff from Developed Lands -- Roads
D) Wastewater Treatment Facilities
E) Natural Resource Restoration -- Forest Lands
F) Natural Resource Restoration -- Lakes
G) Natural Resource Restoration -- River connectivity
H) Natural Resource Restoration –Wetlands

Table 14 provides a list of monitoring and assessment recommendations for Basin 3 in the next 5 years.

A. Basin 3 Implementation Table Summary

Table 13. Summary implementation actions for the Basin 3 tactical basin plan.

Strategy	Priority Area	Town(s)	Partners (see Partners)	Funding
Strategies to address pollution from Agricultural lands.				
1. Support meetings and workshops between ACRWC, VAAFM, UVM Ext., CVFC, and local farmers	Lewis Creek, Little Otter, Middlebury River, Dead Creek, Lemon Fair	Middlebury, Panton, Ripton, Cornwall, Bristol, Starksboro, and Ferrisburgh	ACRWC, CFVC, UVM ext., VACD, VAAFM, NRCS, VDEC	ACWIP, TBP, VAAFM
2. Host annual workshops on improving soil and water health, RAPs, implementing conservation tillage and cover cropping practices.	Basin wide with focus on Lewis Creek, Little Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair	All towns	VACD, ACRWC VAAFM, NRCS, VDEC, UVM ext.	RCPP, USDA, ACWIP
3. Support farmers in developing NMPs through UVM Extension's Digging In course and the development of NMPs for all certified farms through NRCS CAPS funding.	Basin wide with focus on Lewis Creek, Little Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair	All towns	VACD, VAAFM, NRCS, UVM ext.	RCPP, EQIP, ACWIP
4. Support the development of NMPs for certified farms that are not interested in Digging in Course through NRCS CAPS funding.	Basin wide with focus on Lewis Creek, Little Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair	All towns	VACD, VAAFM, NRCS, UVM ext.	RCPP, EQIP, ACWIP
5. Track # of NMPs developed and implemented in priority sub-	Basin wide with focus on Lewis Creek, Little	All towns	VACD, VAAFM, NRCS	RCPP, EQIP, ACWIP

Strategy	Priority Area	Town(s)	Partners (see Partners)	Funding
basins	Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair			
6. Track and inspect CSFOs that need NMPs or that have up-to-date NMPs, schedule to keep these up-to-date.	Basin wide	All towns	UVM Ext., VACD, VAAFM, USDA-NRCS, VDEC	RCPP, CWIP
7. Rank, develop, and install practices on agricultural lands that will reduce runoff in areas where bacteria and nutrient levels are above the VWQS and/or have been identified in NMP or LTPs.	Lewis Creek, Little Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair	All towns	VACD, VAAFM, UVM ext., NRCS	RCPP, USDA, ACWIP, VAAFM BMP
8. Provide educational courses and workshops for farmers on agronomic practices, tile drains, and buffer planting	Basin wide with focus on Dead Creek, Lemon Fair, Otter Creek, and Lewis Creek	All towns	VACD, VAAFM, NRCS, UVM ext.	VACD, CREP, ACWIP
9. Provide technical assistance to farmers to ensure tile drain systems comply with RAPs.	Basin wide	All towns	VACD, VAAFM, NRCS, UVM ext.	VACD, EQIP, ACWIP
10. Implement regional equipment sharing programs to support the implementation of conservation practices.	Basin wide	All towns	VAAFM, NRCS, UVM ext.	ACWIP, EQIP, RCPP, VAAFM BMP
11. Establish vegetated riparian buffers and/or filter strips above and beyond existing compliance standards (i.e.,	Basin wide	All towns	VACD VAAFM, NRCS, VDEC	ACWIP, CREP, RCPP, Woody Buffer Block Grants

Strategy	Priority Area	Town(s)	Partners (see Partners)	Funding
RAPs or shoreline protection).				
12. Target BMP implementation to highest priority sub-basins and ground truth to reconcile modeled P source areas with field data	Dead Creek, Otter Creek, Lemon Fair, and New Haven River	All towns	VACD VAAFM, VDEC, NRCS, UVM ext.	LaRosa, ACWIP, TBP
13. Develop practical stormwater BMPs for farms and provide technical and financial support for farms to implement these to address stormwater runoff from impervious surfaces in farm production areas.	Basin wide	All towns	UVM Ext., VACD, VAAFM, USDA-NRCS	ACAP, EQIP, RCPP, VAAFM BMP, CWIP
14. Complete water quality monitoring on/near farms to help identify source areas and evaluate nutrient reductions achieved through BMP implementation.	Lewis Creek, Little Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair	All towns	ACRWC, UVM Ext.	LaRosa, ACWIP, TBP
15. Conduct outreach to farmers with potential natural resource protection opportunities (river corridor or wetlands)	Lewis Creek, Little Otter, Middlebury River, Upper Otter, Dead Creek, Lemon Fair, Clarendon River	All towns	VACD, RNRCD, VAAFM, NRCS, VDEC, UVM ext.	VANR F&W, VANR DEC, ACWIP
16. Analyze LCBP 1m data to identify agricultural lands lacking riparian buffers and use these to prioritize BMP implementation and outreach on RAPs.	Basin wide	All towns	UVM Ext., VACD, RNRCD, RRPC, VAAFM, USDA-NRCS, VDEC	VACD, ACWIP, NRCS, UVM ext., TBP

Strategy	Priority Area	Town(s)	Partners (see Partners)	Funding
17. Provide technical support to farmers and assistance tracking BMP practices implemented with(out) state or federal funding.	Basin wide	All towns	UVM Ext., VACD, RNRCD, RRPC, VAAFM, USDA-NRCS, VDEC	VACD, ACWIP, NRCS, UVM ext., TBP
18. Publish success stories where farmers have installed BMP practices and seen improved farm operations and improved water quality conditions.	Basin wide	All towns	ACRWC, UVM Ext., VACD, VAAFM, USDA-NRCS, VDEC	VACD, ACWIP, NRCS, UVM ext., TBP
Developed Lands—Stormwater				
19. Develop stormwater master reports or plans.	Basin wide	Addison, Bridport, Chittenden, Cornwall, Goshen, Leicester, Mendon, Mount Tabor, Monkton, New Haven, Panton, Ripton, Shrewsbury, Salisbury, Tinmouth, Waltham, Weybridge, Whiting	ACRPC, RRPC, RNRCD, Towns	DEC CWF Grant
20. Outreach to landowners that will come under the 3-acre stormwater permit	Basin wide	Rutland city, Rutland town, and Middlebury	ACRPC, RRPC, RNRCD, Towns	Watershed Grant, VDEC Contracts
21. Determine if high priority practices identified in Stormwater Mapping Reports should be carried out singularly or through multi-town Stormwater Master Planning.	Basin wide	Bristol, Charlotte, Danby, Dorset, Ferrisburgh, Hinesburg, Ira, Killington, Lincoln, Mount Holly, Pittsford, Proctor, Orwell, Shoreham	ACRPC, RRPC, RNRCD, Towns	VDEC Contract, DEC CWF Grant
22. Develop and implement GSI practices at local schools.	Basin wide	All towns	Local school administrations and	CWIP

Strategy	Priority Area	Town(s)	Partners (see Partners)	Funding
			towns, VDEC, ACRPC, RRPC, RNRCD	
23. Provide outreach and education for development of stormwater bylaws	Basin wide	All towns	ACRPC, RRPC, RNRCD, Towns	Municipal Planning Grant
Developed Lands—Roads				
24. Complete REIs for remaining 5 towns in the basin by 12/31/2020.	Basin wide	Charlotte, Dorset, Hinesburg, Huntington, Killington	ACRPC, VTrans, RRPC, Municipalities	VTrans Better Roads Grant, Grant-In-Aid
25. Provide support to towns to upload REI data into MRGP database by 2020.	Basin wide	All towns	VDEC, VTrans, Towns, ACRPC, RRPC	TPI, TBP
26. Implement high priority road projects across the basin to meet MRGP requirements.	Basin wide	All towns	ACRPC, RRPC, Municipalities	VTrans Better Roads Grant, Grant-In-Aid
27. Provide technical assistance to towns for developing project proposals, budgets, and funding opportunities for implementing priority projects that have the largest water quality benefits.	Basin wide	All towns	VDEC, VTrans, ACRPC, RRPC, Vermont Local Roads	TPI, TBP
28. Host workshops and peer to peer sharing on best practices for using new equipment to meet MRGP standards and support equipment purchase.	Basin wide	All towns	VDEC , VTrans, RRPC, ACRPC, municipalities	TPI, TBP,
29. Create an equipment sharing program and track use of equipment used to meet MRGP requirements.	Basin wide	All towns	RRPC, ACRPC, municipalities	Equipment grant

Strategy	Priority Area	Town(s)	Partners (see Partners)	Funding
30. Support the development and implementation of Phosphorus Control Plans and the Flow Restoration Plans.	MS4 entities	MS4 entities	VDEC, RRPC	CWIP
31. Implement six minimum control measures required in the State TS4 permit	Basin wide	All towns	VTrans	VTrans
Wastewater Treatment Facilities				
32. Reissue permits to 9 WWTFs in the basin in 2021 that meet the P limits. Support municipalities pursuing P optimization, expansion projects, and upgrades	Basin wide	Brandon, Middlebury, Otter valley Union High School, Pittsford, Proctor, Rutland, Vergennes, Wallingford, West Rutland	VDEC, municipalities	USDA-Rural Development, Clean Water State Revolving Funds
Natural Resource Restoration—Forests				
33. Increase education and outreach on minimizing water quality impacts of maple sugaring operations.	Basin wide	All towns	VACD, RNRCD, VFPR	CWIP
34. Use Lidar data to identify gullies that may have been caused by historical logging operations to evaluate restoration potential.	Basin wide	All towns	VACD, RNRCD, VFPR	CWIP, ERP
35. Continue to support local skidder bridge rental program and increase usage of bridges.	Basin wide	All towns	VACD, RNRCD, VFPR	CWIP, ERP

Strategy	Priority Area	Town(s)	Partners (see Partners)	Funding
36. Map and assess access networks on state lands.	Basin-wide	Towns with state lands	VDEC, VFPR, VFW	
37. Natural resource assessments of state lands should explicitly identify flood resiliency as a management objective and be included in Long Range Management Plans.	Basin-wide	Towns with state lands	VDEC, VFPR, VFW	
Natural Resource Restoration—Lakes				
38. Provide outreach to communities around Chipman Lake and Richville Pond to generate interest in Lake Wise Program.	Chipman Lake, Richville Pond	Tinmouth, Shoreham	VDEC, Local Lake Wise Partners	CWIP
39. Complete Lake Wise planning for lakes where there is community support for such efforts.	Chipman Lake, Richville Pond	Tinmouth, Shoreham	VDEC, Local Lake Wise Partners	CWIP
40. Implement priority projects identified in Lake Wise assessments.	Chipman Lake, Richville Pond	Tinmouth, Shoreham	RRPC, VDEC	CWIP
41. Establish Lay Monitor on lakes recommended by the Lakes and Ponds Program (e.g., on lakes with significant shoreline development and potential water quality issues)	Cedar Lake, Silver Lake, Winona Lake	Monkton, Leicester, Bristol	VDEC Lakes & Ponds, VDEC Basin Planner, RNRCD, Lakes Associations	VDEC Staff Time, VDEC Contract

Strategy	Priority Area	Town(s)	Partners (see Partners)	Funding
42. Recruit greeter and initiate AIS Greeter Program	Beaver Pond, Cedar Lake, Chipman Lake, Lake Dunmore, Fern Lake, Porter Lake, Richville Pond, Rutland City, Star Lake, Vergennes Watershed, and Winona Lake	Proctor, Monkton, Tinmouth, Salisbury, Leicester, Ferrisburgh, Shoreham, Rutland, Mount Holly, Bristol	VFPR, Lake Community, municipality, RNRCD	Grant-in-aid Program, Watershed Grant
43. Initiate VIP where there is interest in priority towns.	Beaver Pond, Cedar Lake, Chipman Lake, Lake Dunmore, Fern Lake, Porter Lake, Richville Pond, Rutland City, Star Lake, Vergennes Watershed, and Winona Lake	Proctor, Monkton, Tinmouth, Salisbury, Leicester, Ferrisburgh, Shoreham, Rutland, Mount Holly, Bristol	RNRCD, Municipalities, Lake and Pond Communities	Grant-in-aid Program, Watershed Grant
Natural Resources Restoration—Rivers				
44. Implement high priority projects recommended in the Moon Brook River Corridor Plan	Moon Brook	Rutland City and town	VDEC Rivers, VACD, RRPC, VDEC Basin Planner	DEC CWF Grants
45. Develop and implement priority river corridor protection projects and floodplain/channel restoration projects where there is landowner support	Basin wide	All towns	VDEC, RRPC, ACRPC, towns	CWIP, UCM&E, EQIP
46. Provide information on the benefits of the NFIP program and technical support for towns that are interested in joining	Basin-wide	Tinmouth, Mount Tabor, Killington	VDEC, ACRPC, RRPC, Towns	TBP

Strategy	Priority Area	Town(s)	Partners (see Partners)	Funding
the program.				
47. Work with towns to retrofit or replace culverts and/or bridges to restore AOP and geomorphically incompatible infrastructure	Basin wide	All towns	RRPC, ACRPC, towns, VTrans	CWIP, UCM&E, Better Roads, SWIG
48. Strategic additions of large wood material to restore aquatic habitat in streams which were historically impacted by logging operations.	USFS lands in the Green Mtn. National Forest identified in the next Integrated Resource Project (IRP)	The IRP will include the Basin 3 towns of Chittenden, Mendon, and Goshen	USFS, VFW, TNC, TU	CWIP, UCM&E
49. Continue and expand riparian buffer programs. Prioritize buffer plantings based upon recommendations in completed River Corridor Plans, P reduction potential, and known water quality issues.	Basin wide	All towns	RNRCD, VACD, USFS, USFWS, VDEC	USFS Grants, USFWS Cost-Share, Woody Buffer Block Grants, Private Foundation Grants
50. Continue work on dam removal prioritization, design, and implementation on high priority sites	Basin wide	All towns	VDEC Rivers, VRC, USFWS, VFWD, towns	CWIP, LCBP, Watershed Grant
51. Continue monitoring popular swimming areas for the protection of public health	Middlebury River, New Haven River	Middlebury, New Haven	ACRWC	LPP Monitoring Grant
Natural Resources Restoration—Wetlands				
52. Identify high priority sites for wetland restoration based on P reduction ranking	Dead Creek, Lower Lemon Fair, and Pleasant Brook-Otter Creek watersheds	Brandon, Pittsford, Addison, Bridport, Panton, Cornwall, Shoreham, Weybridge	VDEC Wetlands	CWIP, VDEC contract
53. Reclassify wetlands	Otter Creek Wetland	Cornwall, Salisbury,	TNC, ACRPC, local	VDEC, TNC

Strategy	Priority Area	Town(s)	Partners (see Partners)	Funding
recommended for Class 1 status to protect their key functions and values	Complex	Middlebury, Sudbury, Whiting, Leicester, Brandon	Steering Committee composed of Middlebury, Cornwall and Salisbury CC members and other local citizens, VDEC	
54. Outreach to landowners of wetlands identified as restoration priorities– with a focus on lands with new landowners, actively being conserved or where landowners are making changes in land management	Basin-wide	All towns	USDA-NRCS, VACD	WREP, CREP, CWIP, LCBP
55. Review new natural resource mapping and make recommendations for improving wetland mapping in target towns	Basin-wide	All towns	VDEC Wetlands, UVM	CWIP, VDEC contract

*List of partner acronyms below.

B. Coordination of Basin 3 Partners:

Partnerships are crucial in carrying out non-regulatory actions to improve water quality. Several Basin 3 organizations undertake watershed monitoring, assessment, protection, restoration, and education and outreach projects. These partners are non-profit, private, state, and federal organizations working on both private and public lands. Addison County Regional Planning Commission, Addison County River Watch Collaborative, Otter Creek Natural Resource Conservation District, Panton Planning Commission, Rutland Regional Planning Commission, Rutland Natural Resource Conservation District, 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, and stream channel habitat restoration);
- developing stormwater projects (e.g., stormwater master plans, road erosion inventories, implementation of town road BMPs);
- and monitoring water quality (e.g., lay monitoring program on lakes, *E. coli* and nutrient monitoring in rivers).

Partners actively working with farms in the basin developing and implementing BMPs for water quality include Natural Resource Conservation Service, Vermont Agency Agriculture Food and Markets, Addison County River Watch Collaborative, Champlain Valley Farmers Coalition, Otter Creek Natural Resource Conservation District, Rutland Natural Resource Conservation District, VDEC, and University of Vermont Extension Service. The large amount of work that is necessary to meet water quality targets in this basin require collaborations among all these groups to maximize the effectiveness of watershed partners. Without funding or partners, little of this work would be possible.

Partner Acronyms:

VAAFM	VT Agency of Agriculture Food & Markets	**RRPC**	Rutland Regional Planning Commission
CC	Conservation Commission	**TRORC**	Two Rivers-Ottauquechee Regional Commission
CWIP	Clean Water Initiative Program	**USFS**	United States Forest Service

ACRWC	Addison County River Watch Collaborative	**USFWS**	United States Fish & Wildlife Service
CVFC	Champlain Valley Farmers Coalition	**VDEC**	Vermont Department Environmental Conservation
ACRPC	Addison County Regional Planning Commission	**VDFW**	Vermont Department Fish and Wildlife
RRPC	Rutland Regional Planning Commission	**VDFPR**	Vermont Department of Forests Parks and Recreation
LCA	Lewis Creek Association	**VRC**	Vermont River Conservancy
MAPP	Monitoring Assessment and Planning Program	**RNRCD**	Rutland Natural Resource Conservation District
PPC	Panton Planning Commission	**TNC**	The Nature Conservancy

C. Monitoring Priorities

This section identifies monitoring priorities for Basin 3 across several monitoring programs during the next planning cycle. As described in the "What is a Tactical Basin Plan?" section – the planning process is a 5-year cycle and Basin 3 is targeted for monitoring in 2021. While 2021 is the target year for monitoring, several programs monitor water quality in the basin on an ongoing basis. There are a wide variety of monitoring programs that are supported by the VDEC and its partners which are described in detail in the Water Quality Monitoring Program Strategy. Monitoring programs in this basin include the Biomonitoring and Aquatic Studies Section (BASS)– that monitors macroinvertebrate and fish communities as well as targeted temperature monitoring and water chemistry sampling around WWTF or other pollution concerns. BASS also provides support for the LaRosa volunteer water quality monitoring program (https://bit.ly/2HtZQ0l). The VDFW supports fish assessments, extensive temperature monitoring, and the evaluation of streams in need of habitat restoration (i.e., large wood additions). The LPP supports the spring P monitoring and lay monitoring programs, which evaluate nutrient conditions and trends on lakes. The LPP also monitors shoreland condition and conducts in-depth lake assessments in addition to AIS surveys. Finally, the Rivers Program supports SGAs that evaluate geomorphic and habitat conditions on our rivers and the Wetlands programs has a wetlands assessment program.

The Lake Champlain Basin Program-(LCBP) supports Long-Term Water Quality and Biological Monitoring Project, including cyanobacteria monitoring (http://dec.vermont.gov/watershed/lakes-ponds/monitor/lake-champlain). The LCBP program supports the monitoring of progress towards attainment of the LC TMDL goals for each lake segment with biweekly lake and tributary monitoring. These sampling efforts allow for the evaluation of flow-normalized loading and concentration trends which are presented biannually in the state of the lake report produced by the Lake Champlain Basin Program. These water quality sampling efforts have been on-going since 1992 and will continue with the support of the Lake Champlain Basin Program, the States of Vermont and New York, and the USGS.

The common goals for monitoring efforts across programs include:

1) Confirming of biological and water quality conditions that support reclassification of surface waters to a higher level where data are not sufficient or are too old to support reclassification, which is a focus for the BASS and VDFW programs.
2) Understanding biological and water quality conditions where these are unknown, such as streams or lakes that have not been sampled or assessed or where assessments may be out of date.
3) Understanding biological and water quality conditions where there is a known water quality problem – to evaluate if the problem has worsened or to evaluate the effectiveness of restoration efforts (e.g., BMP implementation).
4) Understanding pollution trends and source areas that may be contributing to water quality issues such as P loading in support of implementing the LC TMDL.

5) Evaluation of biological and water quality changes over time – as supported by sentinel monitoring network on lakes and streams.

Table 14 is an initial list of water quality monitoring priorities to guide monitoring over the next 5 years. This list has more sites than there is capacity to sample and as a result, will need further prioritization. This will occur during a monitoring summit before the 2021 field season.

Table 14. Basin 3 priorities for monitoring and assessment.

Waterbody	Assessment Goal	Priority	Location (Latitude or River Mile)	Location (Longitude)	Partner(s)	Monitoring action
1. **Macdonough Creek**	No Data		44.16853036	-73.25727211	BASS	Data gap - collect new data to determine condition
2. **Maple Creek**	No Data		44.12531553	-73.25975668	BASS	Data gap - collect new data to determine condition
3. **Maple Brook**	No Data		44.10950137	-73.2567733	BASS	Data gap - collect new data to determine condition
4. **Dog Team Stream**	No Data		44.06630451	-73.18595209	BASS	Data gap - collect new data to determine condition
5. **Fire Brook**	No Data		43.9910432	-73.0384936	BASS	Data gap - collect new data to determine condition
6. **Beaver Brook Trib 1**	No Data		43.97994513	-73.11442761	BASS	Data gap - collect new data to determine condition
7. **Dragon Brook**	No Data		43.9789255	-73.05320669	BASS	Data gap - collect new data to determine condition
8. **Beaver Brook Upper**	No Data		43.97931551	-73.11428277	BASS	Data gap - collect new data to determine condition
9. **Middlebury Trib 1**	No Data		43.96727813	-73.15540633	BASS	Data gap - collect new data to determine condition
10. **Beaver Brook Lower**	No Data		43.96585433	-73.12381273	BASS	Data gap - collect new data to determine condition
11. **Hale Brook**	No Data		43.95438207	-73.02682284	BASS	Data gap - collect new data to determine condition
12. **Brandy Brook**	No Data		43.95323359	-73.00064937	BASS	Data gap - collect new data to determine condition
13. **Crystal Brook**	No Data		43.94363521	-72.9674627	BASS	Data gap - collect new data to determine condition
14. **Halnon Brook Trib 3**	No Data		43.94740439	-73.12616689	BASS	Data gap - collect new data to determine condition
15. **Dunmore North**	No Data		43.91240834	-73.07818515	BASS	Data gap - collect new data to determine condition

Waterbody	Assessment Goal	Priority	Location (Latitude or River Mile)	Location (Longitude)	Partner(s)	Monitoring action
16. **Voters Brook**	No Data		43.9140338	-73.04003557	BASS	Data gap - collect new data to determine condition
17. **Barnard Brook**	No Data		43.89242969	-73.02340722	BASS	Data gap - collect new data to determine condition
18. **Gould Brook North**	No Data		43.87212712	-73.00491701	BASS	Data gap - collect new data to determine condition
19. **Basin Brook**	No Data		43.81874594	-73.02351987	BASS	Data gap - collect new data to determine condition
20. **Beaudry Brook**	No Data		43.77708206	-72.96848928	BASS	Data gap - collect new data to determine condition
21. **Kiln Brook**	No Data		43.75396601	-72.96719263	BASS	Data gap - collect new data to determine condition
22. **Sugar Hollow Trib. 1**	No Data		43.74795377	-73.0149588	VFWD	Data gap - collect new data to determine condition
23. **Holden Brook**	No Data		43.74001123	-72.97786577	BASS	Data gap - collect new data to determine condition
24. **Mendon Brook**	Update Data		43.57394133	-72.90946183	BASS	Old sampling data should be updated
25. **Robinson Brook**	No Data		43.560995	-72.85121704	BASS	Data gap - collect new data to determine condition
26. **North Branch Neshobe River**	No Data		43.84184395	-73.03118215	BASS	Data gap - collect new data to determine condition
27. **Willow Brook**	Update Data		43.80640242	-73.14992478	BASS	Old sampling data should be updated
28. **Baker Brook**	Update Data		43.77893109	-72.97037312	BASS	Old sampling data should be updated
29. **Steam Mill Brook**	No Data		43.77893684	-72.97011166	BASS	Data gap - collect new data to determine condition
30. **Sugar Hollow Trib 2**	No Data		43.76318805	-73.02216379	BASS	Data gap - collect new data to determine condition
31. **Bresee Mill Brook**	Update Data		43.75905942	-73.07749582	BASS	Old sampling data should be updated
32. **Little Brook**	Update Data		43.71657448	-73.0045102	BASS	Old sampling data should be updated
33. **Smith Pond Brook**	Update Data		43.71597361	-73.05461723	BASS	Old sampling data should be updated

Waterbody	Assessment Goal	Priority	Location (Latitude or River Mile)	Location (Longitude)	Partner(s)	Monitoring action
34. **Pondy Brook**	No Data		43.70459279	-73.0071035	BASS	Data gap - collect new data to determine condition
35. **Sugar Hollow Brook**	Reclassification		43.69479933	-73.02343393	BASS	Reclass data update needed
36. **North Branch Cold River**	No Data		43.56959024	-72.91880159	BASS	Data gap - collect new data to determine condition
37. **Cold River Lower**	Reclassification		43.56923023	-72.92007184	BASS	Have data at RM 1.4 from 2012; could be reclass candidate with more data
38. **Cold River Lower 1**	No Data		43.56751471	-72.9195516	BASS	Data gap - collect new data to determine condition
39. **Gould Brook Upper**	No Data		43.54160875	-72.85935166	BASS	Data gap - collect new data to determine condition
40. **Gould Brook Lower**	No Data		43.53914252	-72.87326145	BASS	Data gap - collect new data to determine condition
41. **Cold River Upper**	No Data		43.53887669	-72.87348013	BASS	Data gap - collect new data to determine condition
42. **Russell Brook**	No Data		43.47782116	-72.85463376	BASS	Data gap - collect new data to determine condition
43. **Freeman Brook**	No Data		43.4740334	-72.87646633	BASS	Data gap - collect new data to determine condition
44. **Mount Holly Trib Upper**	No Data		43.44806821	-72.84067227	BASS	Data gap - collect new data to determine condition
45. **Mount Holly Trib Lower**	No Data		43.44985333	-72.87428741	BASS	Data gap - collect new data to determine condition
46. **Feller Brook**	No Data		43.43972124	-72.86568991	BASS	Data gap - collect new data to determine condition
47. **Mill River**	No Data		43.44015093	-72.86549909	BASS	Data gap - collect new data to determine condition
48. **Quaker Creek**	No Data		44.07765001	-73.23830942	BASS	Data gap - collect new data to determine condition
49. **Sparks Brook**	No Data		43.97568381	-73.03137612	BASS	Data gap - collect new data to determine condition
50. **North Branch Middlebury**	No Data		43.97549779	-73.06206229	BASS	Data gap - collect new data to determine condition

Waterbody	Assessment Goal	Priority	Location (Latitude or River Mile)	Location (Longitude)	Partner(s)	Monitoring action
River						
51. **Middle Branch Middlebury River**	No Data		43.97394702	-73.03518236	BASS	Data gap - collect new data to determine condition
52. **South Branch Middlebury River**	Update Data		43.97384958	-73.03547315	BASS	Old sampling data should be updated
53. **Goshen Brook 1st/2nd**	No Data		43.9603929	-73.02786903	BASS	Data gap - collect new data to determine condition
54. **Halnon Brook**	No Data		43.95274653	-73.13420113	BASS	Data gap - collect new data to determine condition
55. **North Branch Sucker Brook**	No Data		43.9094446	-73.0477125	BASS	Data gap - collect new data to determine condition
56. **Sucker Brook Lower**	No Data		43.90547077	-73.06876066	BASS	Data gap - collect new data to determine condition
57. **Sucker Brook Upper**	No Data		43.9023858	-73.04045214	BASS	Data gap - collect new data to determine condition
58. **Lewis Creek**	Reference Site Update		RM 10.6, 3.5, 7.5, 21.4			Data update needed
59. **Hogback Brook**	Reclassification		RM 1.7			Reclass data update needed
60. **Willow Brook**	Update data		RM 2.4			Old sampling data should be updated
61. **Furnace Brook**	Update Data		RM 5.3 and 6.3			Sample ab/bl hatchery. Future data throughout stream could also support reclassification.
62. **Baker Brook**	Reclassification		RM 2.7			Reclass data update needed
63. **Cold River**	Reclassification		RM 6.8			Reclass data update needed
64. **Seymour Brook**	Reclassification		RM 3.2			Reclass data update needed
65. **Button Brook**			RM 0.1			Reclass data update needed

Waterbody	Assessment Goal	Priority	Location (Latitude or River Mile)	Location (Longitude)	Partner(s)	Monitoring action
66. **Blue Bank**	Reclassification		RM 1.7, 0.2			Must be monitored during 2021 to remain reclass. candidates
67. **High Knob Brook**	Reclassification		RM 0.7			Reclass data update needed
68. **Hillsboro Brook**	Reclassification		RM 0.5			Reclass data update needed
69. **Hollow Brook**	Reclassification		RM 2.5, 0.9			Reclass data update needed
70. **New Haven River Trib. 27**	Reclassification		RM 0.5			Reclass data update needed
71. **Sugar Hollow Brook**	Reclassification		RM 4.2, 3			Reclass data update needed
72. **Upper Lewis Creek**	Reclassification		RM 26.4, 24			Reclass data update needed
73. **Warner Brook**	Reclassification		RM 1.3, 0.5			Reclass data update needed
74. **McGinn Brook**	Reclassification		RM 0.7			Reclass data update needed
75. **Mendon Brook**	Reclassification	Moderate	RM 1.8, 2.5			The post Irene monitoring event illustrated recovery at RM 2.5, but unsure of 1.8.
76. **New Haven River**	Reclassification/Update data		RM 21.8, 20.9			Reclass data update needed
77. **Middlebury River**	Use Support	Moderate	RM 4.0-9.0			Aquatic life support is listed as stressed, biological data is required to evaluate this listing
78. **Beaver Brook & Ledge Creek**		Moderate	RM 1.6			Requires further assessment to partition impacts of low flow due to upstream impoundment and nutrient pollution
79. **Clarendon River**		Moderate	RM 1.8, 1.7			Aquatic life support below the West Rutland WWTF has been indeterminate

Waterbody	Assessment Goal	Priority	Location (Latitude or River Mile)	Location (Longitude)	Partner(s)	Monitoring action
80. **East Creek Trib.**		High				Iron precipitate reported in this reach, WQ data is required to assess VWQS compliance
81. **Cedar Lake Trib. to Lewis Creek**		High	RM 0.1			Tributary was identified as a potential source of E. coli to the Lewis Creek Contact Recreation impairment
82. **Trib. 2 to Clarendon River**		High	RM 0.1			This tributary provides the ecosystem service of dilution for the West Rutland WWTF. The health of this must be assessed and protected
83. **Clarendon River**		High	RM 0.1			The Clarendon River is listed as stressed for urban and industrial runoff. The current monitoring locations do not capture these sources.
84. **Clarendon River**		High	RM 2.5			The Clarendon River is listed as stressed for agricultural runoff. The current monitoring locations do not capture these sources.
85. **Neshobe River**		High	RM 0.9-3.6			The aquatic life score significantly decreases between 3.6 and after 0.9, likely due to the Brandon WWTF. A site above the WWTF and below 3.6 should be assessed
86. **Mill River**		High	RM 3.9			This reach failed to support aquatic life in 2016 and should be reassessed.
87. **Lemon Fair River**		High	74 Bridge to 125 Bridge			Of all the water quality data in this reach, the greatest increase in TP occurs between these sites. More sites should be added.
88. **S. Branch, Middlebury River (1.4 mi.)**			RM 5.8, below Snowbowl facility			Aquatic Life is listed as not supported in this reach. No data to prove this.

Waterbody	Assessment Goal	Priority	Location (Latitude or River Mile)	Location (Longitude)	Partner(s)	Monitoring action
89. **East Creek**			RM 8.0-11.0, From Glen Dam to 3.0 mi. downstream			Aquatic Life is listed as not supported in this reach. No data to prove this.
90. **Otter Creek**			From Pulp Mill Bridge to the Middlebury River			The most recent monitoring in 2015 was above VWQS for *E. coli*. But, this site was above all CSO discharges. Monitoring should identify manure sources.
91. **Halnon Trib 10**		High	RM 0.1, Salisbury			This site is adjacent to the Salisbury fish hatchery and it has not been monitored since 2012. Immediate monitoring is recommended.

D. List of Acronyms

319	Federal Clean Water Act, Section 319
604(b)	Federal Clean Water Act, Section 604b
VAAFM	Vermont Agency of Agriculture, Food, and Markets
AAPs	Accepted Agricultural Practices
ACWIP	Agricultural Clean Water Initiative Grant Program
AIS	Aquatic Invasive Species
AMA	Agricultural Management Assistance Program
AMPs	Acceptable Management Practices (for logging)
ANS	Aquatic Nuisance Species
AOP	Aquatic Organism Passage
BASS	VDEC Biomonitoring and Aquatic Studies Section
BBR	Better Backroads program
BMP	Best Management Practices
CREP	Conservation Reserve Enhancement Program
CWI	Clean Water Initiative Grant Funding
CWIP	Clean Water Initiative Program
CWSRF	Clean Water State Revolving Fund
DPW	Department of Public Works
DWSRF	Drinking Water State Revolving Fund
EBTJV	Eastern Brook Trout Joint Venture
EQIP	Environmental Quality Incentive Program
ERAF	Emergency Relief and Assistance Fund
ERP	Ecosystem Restoration Program
FAP	Farm Agronomic Practices
FEH	Fluvial Erosion Hazard
FERC	Federal Energy Regulatory Commission
FOVLAP	Federation of Vermont Lakes and Ponds
FSA	Farm Service Agency (USDA)
GIS	Geographic Information System
GSI	Green Stormwater Infrastructure
IDDE	Illicit Discharge Detection (and) Elimination
LFO	Large farm Operation
LID	Low Impact Development
LiDAR	Light Detection and Ranging
LIG	Local Implementation Grants (LCBP)
LIP	Landowner Incentive Program
LTP	Land Treatment Plan
LWD	Large Woody Debris
LPP	Lakes and Ponds Program

MAPP	Monitoring, Assessment and Planning Program
MFO	Medium Farm Operation
MPG	Municipal Planning Grant
MRGP	Municipal Roads General Permit
NEMO	Nonpoint Education for Municipal Officials
NFIP	National Flood Insurance Program
NMP	Nutrient Management Plan
NPDES	National Pollution Discharge Elimination System
NPS	Non-point source pollution
NRCD	Natural Resource Conservation District
NRCS	Natural Resources Conservation Service
ORW	Outstanding Resource Water
PDM	Pre-Disaster Mitigation
PFW	Partners for Fish and Wildlife
RAP	Required Agricultural Practices
RTE	Rare, Threatened and Endangered Species
RCP	River Corridor Plan
RCPP	Regional Conservation Partnership Program
RMP	River Management Program
RPC	Regional Planning Commission
SFO	Small Farm Operation
SGA	Stream Geomorphic Assessment
SPA	Source Protection Area
SWG	State Wildlife Grants
SWMP	Stormwater master plans
TBP	Tactical Basin Plan
TFS	Trees for Streams
TMDL	Total Maximum Daily Load
TNC	The Nature Conservancy
TS4	Transportation Separate Storm Sewer System General Permit
TU	Trout Unlimited
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USFS	United States Forest Service
USGS	United States Geological Survey
UVA	Use Value Appraisal program, or Current Use Program
UVM ext.	University of Vermont Extension
VACD	Vermont Association of Conservation Districts
VANR	Vermont Agency of Natural Resources
VDEC	Vermont Department of Environmental Conservation

VDFPR	Vermont Department of Forests, Parks and Recreation
VDHP	Vermont Department of Historic Preservation
VDH	Vermont Department of Health
VEM	Vermont Emergency Management
VFB	Vermont Farm Bureau
VFWD	Vermont Fish and Wildlife Department
VHCB	Vermont Housing and Conservation Board
VIP	Vermont Invasive Patrollers
VLCT	Vermont League of Cities and Towns
VLRP	Vermont Local Roads Program
VLT	Vermont Land Trust
VTrans	Vermont Agency of Transportation
VRC	Vermont River Conservancy

References

Agency of Agriculture Food & Markets. (2016, May 13). *Required Agricultural Practices (RAPs).* Retrieved from Vermont.gov: http://agriculture.vermont.gov/water-quality/regulations/rap#Q16.

Agency of Natural Resources. (2015, December). Riparian Management Guidelines for Agency of Natural Resources Lands. Montpelier, VT.

Arnold, C., & Gibbons, C. (1996). Impervious surface coverage: the emergence of a key environmental indicator. *American Planners Association Journal*, 243-258.

Bear Creek Environmental and Lamoille County Planning Commission. (2009, October 30). *Elmore Branch River Corridor Plan: Wolcott and Elmore*. Middlesex, VT.

Bear Creek Environmental and Lamoille County Planning Commission. (2009, October 30). *Gihon River Corridor Plan: Johnson, Hyde Park, & Eden, Vermont*. Middlesex, VT.

Bear Creek Environmental and Lamoille County Planning Commission. (2010, March 18). *Wild Branch Corridor Plan: Wolcott, Craftsbury and Eden, Vermont*. Middlesex, VT.

Bear Creek Environmental and Lamoille County Planning Commission. (2010, March 18). *Wild Branch Corridor Plan: Wolcott, Craftsbury and Eden, Vermont*. Middlesex, VT.

Bear Creek Environmental and Lamoille County Planning Commission. (2010, February 2010). *Centerville Brook Corridor Plan: Hyde Park, VT*. Middlesex, VT.

Butler, B. (2016, May 25). *Local Project to Use LiDAR to Map Private Forest Roads*. Retrieved from VTDigger.org: http://vtdigger.org/2016/05/26/local-project-to-use-lidar-to-map-private-forest-roads/

Caledonia County NRCD. (2009, February). *Upper Lamoille River Stream Geomorphic Assessment Phase 2 Report: Greensboro and Hardwick, VT*. St. Johnsbury, Vermont.

Deacon, J. S. (2006). *Assessment of total nitrogen in the Upper Connecticut River Basin in New Hampshire, Vermont, and Massachusetts, December 2002–September 2005*. U.S. Geological Survey Scientific Investigations Report. Retrieved from https://pubs.usgs.gov/sir/2006/5144/pdf/sir2006-5144.pdf

Department of Forests, Parks and Recreation. (2015, April). 2015 Vermont Forest Fragmentation Report. *Report to the Vermont Legislature*. Montpelier, VT: Agency of Natural Resources.

Environmental Compliance Services, Inc. (2016, January 15). Waterville VOCs, Route 109, Waterville, VT. *Supplemental Site Investigation and Corrective Action Feasibility Investigation Report* . Waterbury, VT.

Environmental Protection Agency. (2008, March). *Handbook for Developing Watershed Plans to Restore and Protect Our Waters.* Retrieved from US Environmental Protection Website: https://www.epa.gov/sites/production/files/2015-09/documents/2008_04_18_nps_watershed_handbook_handbook-2.pdf

Fitzgerald Environmental Associates. (2013, March 15). *Brewster River Phase 1 & 2: Stream Geomorphic Assessment Summary*. Colchester, VT.

Fitzgerald Environmental Associates, LLC. (2015, July 31). *Brewster River Corridor Plan*. Colchester, VT.

Freeman, M. C., Pringle, C. M., & Jackson, C. R. (2007, January 26). Hydrologic Connectivity and the Contribution of Stream Headwaters to Ecological Integrity at Regional Scales. *Journal of the American Water Resources Association*, pp. 5-14.

Galford, G. L., Carlson, S., Ford, S., Nash, J., Palchak, E., Pears, S., . . . Baker, D. V. (Eds.). (2014). Considering Vermont's Future in a Changing Climate: The First Vermont Climate Assessment. 219.

IPCC. (2014). *Summary for Policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change* .

JJ Environmental. (2015). *Final Report - Low Cost Retrofits for Nitrogen Removal at Wastewater Treatment Plants in the Upper Long Island Sound Watershed.* NEIWPCC. Retrieved from http://click.neiwpcc.org/neiwpcc_docs/LIS%20Low%20Cost%20Retrofit%20Final%20Report%20-%20March%202015%20(revised).pdf

Kirn, R. (2016, April 29). *Implementing AOP Enhancement Projects in Vermont.* Retrieved from VT Fish and Wildlife: http://www.vtfishandwildlife.com/common/pages/DisplayFile.aspx?itemId=111522

Kirn, R. (2016, April 29). *Implementing AOP Enhancement Projects in Vermont.* Retrieved from VT Fish and Wildlife: https://vtfishandwildlife.com/sites/fishandwildlife/files/documents/Learn%20More/Library/REPORTS%20AND%20DOCUMENTS/AOP/IMPLAMENTING%20AOP%20PROJECTS%20IN%20VT.pdf

Lamoille County Planning Commission. (2010, September). *Phase I & II Geomorphic Assessment: Foote Brook, Johnson, Vermont.* Johnson, VT.

Lamoille County Planning Commission. (2012, September). *Phase 1 Stream Geomorphic Assessment: Green River Watershed, Lamoille County, Vermont*. Morrisville, VT.

MacKenzie, C. (2016, February). Lake Champlain Lake Sturgeon Recovery Plan. Montpelier, VT: Vermont Fish and Wildlife Department.

Richard Bridge Moore, C. M. (2004). *Estimation of Total Nitrogen and Phosphorus in New England Streams Using Spatially Referenced Regression Models.* U.S. Geological Survey. Retrieved from https://pubs.usgs.gov/sir/2004/5012/SIR2004-5012_report.pdf

State of Vermont Treasurer. (2019). *Clean water Report Required by Act 64 of 2015.* Montpelier, VT. Retrieved from https://dec.vermont.gov/sites/dec/files/wsm/erp/docs/2019-01-15%20Vermont%20Clean%20Water%20Investment%20Report%20SFY2018_Revised%202019-02-01.pdf

Stone Environmental, Inc. (2014, July 11). Detecting and Eliminating Illicit Discharges to Improve Water Quality in the Lamoille River Basin. Montpelier, VT.

Tetra Tech, Inc. (2015, April). *Lake Champlain BMP Scenario Tool: Requirements and Design.* Boston, MA: US Environmental Protection Agency.

Tetra Tech, Inc. (2016, March). Lake Champlain BMP Scenario Tool. Boston, MA, New England.

The Nature Conservancy. (2012). *Lamoille Basin 2012 Geomorphic Compatibility and Aquatic Organism Passage Culvert Assessment: Town of Belvidere, Vermont.* Montpelier: The Nature Conservancy.

U.S. Environmental Protection Agency. (2016, June 17). *Phosphorus TMDLs for Vermont Segments of Lake Champlain.* Boston, MA, New England: USEPA.

USEPA. (2008, March). *Handbook for Developing Watershed Plans to Restore and Protect Our Waters.* Retrieved from US Environmental Protection Website: https://www.epa.gov/sites/production/files/2015-09/documents/2008_04_18_nps_watershed_handbook_handbook-2.pdf

USEPA. (2016, June 17). *Phosphorus TMDLs for Vermont Segments of Lake Champlain.* Boston, MA, New England: USEPA.

USEPA. (2016). *Climate change indicators in the United States, 2016. 4th Edition.* Retrieved from https://www.epa.gov/climate-indicators

USEPA. (2016). *National Lakes Assessment 2012: A Collaborative Survey of Lakes in the United States.* Washington DC: U.S. Environmental Protection Agency. Retrieved from https://nationallakesassessment.epa.gov/

VAAFM. (2018, November 23). *Required Agricultural Practices (RAPs).* Retrieved from Vermont.gov: https://agriculture.vermont.gov/rap

VDEC. (2015). *Water Quality Monitoring Program Strategy Interim Update – May 2015*. Montpelier: VTDEC. Retrieved from https://dec.vermont.gov/sites/dec/files/documents/WSMD_MonitoringStrategy2015.pdf

VDEC. (2015). *Water Quality Monitoring Program Strategy Interim Update – May 2015*. Montpelier: VDEC. Retrieved from https://dec.vermont.gov/sites/dec/files/documents/WSMD_MonitoringStrategy2015.pdf

VDEC. (2016, March). *Vermont Surface Water Assessment and Listing Methodology*. Montpelier, Vermont: Agency of Natural Resources.

VDEC. (2016, March). *Vermont Surface Water Assessment and Listing Methodology*. Montpelier, Vermont: Agency of Natural Resources.

VDEC. (2016, March). *Vermont Surface Water Assessment and Listing Methodology*. Montpelier, Vermont: Agency of Natural Resources.

VDEC. (2016, March). *Vermont Surface Water Assessment and Listing Methodology*. Montpelier, Vermont: Agency of Natural Resources.

VDEC. (2016). *State of Vermont 2016 Stressed Waters List*. Montpelier, VT: State of Vermont.

VDEC. (2016, August 5). *Vermont Surface Water Management Strategy*. Retrieved from VDEC Website: http://dec.vermont.gov/watershed/map/strategy

VDEC. (2017, January 15). *Vermont Water Quality Standards Environmental Protection Rule Chapter 29A*. VT: State of Vermont.

VDEC. (2018, September). Part A. Impaired Surface Waters in Need of TMDL. *State of Vermont 2018 303(d) List of Impaired Waters - Draft*. Montpelier, VT: State of Vermont.

VDEC. (2018). Part B. Impaired Surface Waters - No Total Maximum Daily Load Determination Required. *State of Vermont 2018 List of Priority Surface Waters*. Montpelier, VT: State of Vermont.

VDEC. (2018). Part D. Impaired Surface Waters with Completed and Approved TMDLs. *State of Vermont List of Priority Surface Waters*. Montpelier, VT: State of Vermont.

VDEC. (2018). Part E. Suface Waters Altered by Invasive Aquatic Species. *State of Vermont 2018 List of Priority Surface Waters*. Montpelier, VT: State of Vermont.

VDEC. (2018). Part F. Surface Waters Altered by Flow Regulation. *State of Vermont 2018 List of Priority Surface Waters*. Vermont: State of Vermont.

VDEC. (2019, January 2). *The Passumpsic Watershed Water Quality Assessment Report 2018*. Montpelier, VT: State of Vermont. Retrieved from https://dec.vermont.gov/content/passumpsic-river-watershed-assessment-report-2018

Vermont Agency of Natural Resources and Vermont Agency of Agriculture, Food, and Markets. (2015, August). *Vermont Lake Champlain Phosphorus TMDL Phase 1 Implementation Plan.* Montpelier, VT: State of Vermont.

Vermont Clean Water Act, VT No. 64 (H.35) (June 16, 2015).

Vermont Department of Environmental Conservation. (2001, February). *Basin 7 - Lamoille River Watershed Water Quality and Aquatic Habitat Assessment Report.* Montpelier, VT: State of Vermont.

Vermont Department of Environmental Conservation. (2009, February). *Lamoille River Basin Water Quality Management Plan - Draft.* Montpelier, VT: State of Vermont.

Vermont Department of Environmental Conservation. (2014). Part F. Surface Waters Altered by Flow Regulation. *State of Vermont 2014 List of Priority Surface Waters* . Vermont: State of Vermont.

Vermont Department of Environmental Conservation. (2016, February). *Lamoille River Watershed: Updated Water Quality/Aquatic Habitat Assessment Report.* Montpelier, VT: State of Vermont.

Vermont Department of Environmental Conservation. (2016). *State of Vermont 2016 Stressed Waters List - DRAFT.* Montpelier, VT: State of Vermont.

Vermont Department of Environmental Conservation. (2016). *Vermont Water Quality Standards: Environmental Protection Rule Chapter 29A - DRAFT.* Montpelier, VT: State of Vermont.

Vermont Department of Environmental Conservation. (2016, May). Part A. Impaired Surface Waters in Need of TMDL. *State of Vermont 2016 303(d) List of Impaired Waters - Draft.* Montpelier, VT: State of Vermont.

Vermont Department of Environmental Conservation. (2016, May). Part B. Impaired Surface Waters - No Total Maximum Daily Load Determination Required. *State of Vermont 2016 List of Priority Surface Waters - Draft.* Montpelier, VT: State of Vermont.

Vermont Department of Environmental Conservation. (2016). Part D. Impaired Surface Waters with Completed and Approved TMDLs. *State of Vermont List of Priority Surface Waters - DRAFT.* Montpelier, VT: State of Vermont.

Vermont Department of Environmental Conservation. (2016). Part E. Suface Waters Altered by Invasive Aquatic Species . *State of Vermont 2016 List of Priority Surface Waters - DRAFT.* Montpelier, VT: State of Vermont.

Vermont Department of Environmental Conservation. (2016). Part F. Surface Waters Altered by Flow Regulation. *State of Vermont 2016 List of Priority Surface Waters - DRAFT* . Montpelier, VT: State of Vermont.

Vermont Department of Environmental Conservation. (2016, August 5). *Vermont Surface Water Management Strategy*. Retrieved from VT Department of Environmental Conservation Website: http://dec.vermont.gov/watershed/map/strategy

Vermont Department of Environmental Conservation. (2017, January 15). *Vermont Water Quality Standards Environmental Protection Rule Chapter 29A*. VT: State of Vermont.

Vermont Lakes and Ponds Program. (2012). *Best Lakes*. Montpelier, Vermont: Vermont Agency of Natural Resources.

VT Association of Conservation Districts. (2015, May). *Regional Conservation Patnership Program.* Retrieved from USDA Natural Resource Conservation Service Vermont: http://www.nrcs.usda.gov/wps/portal/nrcs/main/vt/programs/farmbill/rcpp/

VT Department of Forest, Parks and Recreation. (2010, March 31). *Use Value Appraisal Program Manual*. Vermont: Agency of Natural Resources.

VT Department of Forests, Parks and Recreation. (2016, August 11). *Skidder Bridges*. Retrieved from Vermont.gov: http://fpr.vermont.gov/forest/your_woods/harvesting_your_woodlots/skidder_bridge

VTANR & VAAFM. (2015, August). *Vermont Lake Champlain Phosphorus TMDL Phase 1 Implementation Plan*. Montpelier, VT: State of Vermont.

VTANR. (2015, December). Riparian Management Guidelines for Agency of Natural Resources Lands. Montpelier, VT.

Weston Solutions, Inc. (2015, October). Sampling and Analysis Plan for the Vermont Asbestos Group Mine Site Eden and Lowell, Vermont. (E. P. 2014, Compiler)

Wipfli, M. S., Richardson, J. S., & Naiman, R. J. (2007, February). Ecological Linkages Between Headwaters and Downstream Ecosystems: Transport of Organic Matter, Invertebrates, and Wood Down Headwater Channels. *Journal of the American Water Resources Association*, pp. 72-85.

Glossary

Please see: https://bit.ly/2YtMxYf for an alphabetized glossary of key terms used in this plan.

Appendix A. 2012 Basin 3 Report Card

Work completed in Basin 3 since the 2012 Plan has allowed several assessments and efforts to support the implementation of specific actions. This includes mapping and assessing road and stormwater infrastructure, rivers and streams, agricultural land, and wetlands. This work was done in partnership with the ACRPC, RRPC, the RNRCD, the OCNRCD, the ACRWC, non-profits, and other divisions of state and federal government as well as landowners to protect and restore Basin 3 lakes, rivers, and wetlands. Conservation projects and especially buffer projects have increased the total land under conservation, and towns and villages are working to increase flood preparedness, reduce erosion and green their infrastructure for better water quality. Table A1 below is organized in four columns, the first of which describes the action, the second lists the key players, the third includes the funding sources, and the fourth includes the priority and status of the action.

Table A1. 2012 Basin 3 report card with 2019 updates from partners.

Objective 1: Reduce levels of Non-Point Source Pollution from developed lands and the working landscape				
Action	**Partners**	**Funding**	**Status**	**Priority/Update**
1. Encourage municipal zoning to protect riparian buffer zones and minimize the amount of new impervious surfaces from new development. Promote LID concepts and practices.	VLCT, RPC's, towns	EPA pass-through 604(b)	In progress, see Municipal Protectiveness Table on the Basin 3 Plan webpage.	H/Outreach to towns without river corridor protections or stream setbacks that are highlighted as priorities in Ch. 4 of this plan.
2. Develop demonstration projects for techniques to address stormwater and erosion control from homes, businesses, and construction sites.	VANR, NRCDs	EPA 319, Ecosystem Restoration Funds	Complete	M/Rooftop disconnect of 14 homes by RNRCD and several demo GSI in the basin (see VT Guide to SW Management at https://bit.ly/2QvzXjW)
3. Work with State and Federal transportation agencies on implementing water quality BMPs for road infrastructure construction and maintenance.	VTrans, VANR	EPA 319, AOT structures, Better Backroads	In progress	M/Multiple BBR and Better Roads project completed and/or underway. Strategy 31. Implement six minimum control measures required in the State TS4 permit.
4. Identify retrofit opportunities and/or potential new stormwater controls for older developed areas and seek to upgrade or install new controls.	VANR, towns	EPA pass-through 319, Ecosystem Restoration Funds	In progress	H/SWMPs have ID'ed projects in Basin 3 towns, Strategy 19. Develop stormwater master reports or plans

5. Encourage local municipal regulations for erosion and sediment control during new construction that fall outside of the scope of state stormwater regulations.	RPCs, VLCT	EPA pass-through 604(b), Municipal Planning Grants	2019 B03 plan	H/Will follow-up with RPCs during next planning cycle
6. Develop a LID building applicant checklist that could be considered by town ZA's and DRB's as a precursor to issuing a general construction permit.	VDEC, RPCs, VLCT	EPA pass-through 604(b), Municipal Planning Grants	Complete	M/Developed GSI handbook that includes GSI BMPs for multiple project types (see VT Guide to SW Management at https://bit.ly/2QvzXjW)
7. Development standards should encourage minimization of impervious surfaces and use of open vegetated channels for stormwater runoff. Provisions for narrower streets, shorter or shared driveways, smaller parking spaces, and reduced setback distances from roads should be part of urban or suburban zoning regulations. Alternative modes of transportation such as mass transit, bike paths, and commuter parking areas should also be encouraged in order to reduce the need for new roads and parking..	VANR, VTrans, private consultants	EPA 319, SIWRF (for Moon Brook only), Municipal Planning Grants, Ecosystem Restoration Funds	In progress	H/New programs should help going forward – Complete streets, DTF, Better Connections
8. Increase the infiltration of stormwater flows in conjunction with the traditional detention methods used to treat stormwater	VANR, private consultants	Ecosystem Restoration Funds, EPA 319	In progress	H/SWMPs identify opportunities for increased infiltration of SW flows where possible
9. Promote residential practices, especially lawn and garden-related practices that promote the Low Input Lawn Care outreach and demonstration campaign	RNRCD, UVM Sea Grant, VDEC	Lake Champlain Sea Grant	Complete	H/2009-2011 RNRCD interns worked w/ private landowners and lawn care businesses on low input lawn care

10. Provide outreach to landowners about impacts of over-fertilizing lawns and the importance of establishing and maintaining buffer strips along streams and ponds to reduce NPS pollution. Distribute "Don't P on the Lawn" brochure.	VANR, Lake Champlain Sea Grant, RSEP	Lake Champlain Sea Grant	Complete	H/Outreach focused on areas in the Moon Brook
11. Work with the local community and partners to address major sources of phosphorus identified in watershed survey. Likely efforts will include working with watershed residents to improve riparian management practices, improve roads and driveways to reduce erosion, reduce the use of fertilizer, and continued work with the agricultural community to reduce phosphorus loading.	VDEC, NRCS, NRCDs, town Select board, Planning Commissions, and Road Commissioner	Existing staff and resources	2019 B03 plan	M/ Most via SWMPs and REIs , Ch. 4 and 5 of this plan
12. Review layouts of municipal garages in the watershed with each municipality to control runoff from salt and sand piles at municipal garages. Develop a set of cost effective management practices and municipal garage layouts that minimize erosion runoff and assist towns in completing these improvements.	Road Commissioners , select board members, Local Roads Program, VTrans	DEC Stormwater program, Existing staff and resources	In Progress	M/Working with RPCs and their planners to implement BMPs at municipal garages
Working Lands – Forests				
13. Build 2-3 portable skidder bridges for loan to timber harvesting projects in the Otter Creek watershed	VANR, NRCDs	Ecosystem Restoration Funds	Complete	H/ RNRCD completed the build-out of skidder bridges and lends these upon request
14. Increase logger education on water quality issues through the VT Family Forests, the LEAP program and the Vermont Loggers Association's Forestry	NRCS, FPR, Vermont Coverts, VFF, LEAP program	ANR Watershed Forestry Program, Ecosystem	In Progress	H/These programs are ongoing – VFF is very strong in the lower Otter Creek Basin

Academy to encourage good forestry practices in the watershed.		Restoration Funds		
15. Promote educational workshops for forest landowners and forestry consultants via Vermont Coverts. Promote erosion control techniques for skidder trails, stream and river access points, and proper bridge and culvert construction. Develop a proposal to use a VYCC watershed crew to restore impacted sites including project development and implementation. Identify sensitive areas where access should be limited.	NRCS, FPR, LEAP Program, VFF, VYCC	ANR Watershed Forestry Program, Ecosystem Restoration Funds	In Progress	H/NRCDs will work with VYCC crews as projects are identified
16. Encourage landowners to develop long term management plans for woodlands with the assistance of a forester. The management plan should prominently include AMPs and provide educational materials that promote responsible management of forest resources.	NRCS, DFPR, Vermont Coverts, VFF, LEAP program	Existing staff and resources	In Progress	M/ All lands in UVA
17. Locate local tree stock appropriate for riparian buffer plantings and engage local volunteers to complete riparian buffer plantings along the Otter Creek and its tributaries.	DEC, NRCS, NRCDs, TNC (Native Plant Nursery), watershed groups, RPCs	Existing staff and resources	In Progress	M/ CREP/ TNC's native plant nursery taken over by PMNRCD
Objective 2: Reduce levels of Non-Point Source Pollution from developed lands and the working landscape River Corridors				
18. Based on geomorphic assessments of the Otter Creek, select riparian restoration projects have been identified and prioritized to restore stream equilibrium and minimize erosion. Using geomorphic-based solutions, to the greatest extent	VANR - RMP, VLT, towns, watershed organizations	Ecosystem Restoration Funds, RCCE Dev. and Implementation grants	In Progress	H/M16/17 Lewis Creek, M06B Middlebury River

possible, restore sections of major tributaries identified in stream geomorphic assessments as being unstable. Promote passive restoration principles and corridor/floodplain avoidance where appropriate.				
19. Expand land use practices and programs (Best Management Practices and Accepted Agricultural Practices) that provide a greater emphasis on riparian corridor restoration and protection activities. Encourage stream channel adjustment processes towards a stable regime and improve riparian buffers.	VAAFM, VANR	Woody Buffer Block grants, VAAFM BMP grants	In Progress	H/ Update w-RAPs, SFO inspections, high priority sub-basins to target for assessments and BMP implementation
20. Conduct detailed river geomorphic assessments and corridor planning on priority sub-basins in the Otter Creek watershed	VANR - RMP	ERP	Complete	H/ Pond Brook was looked at more closely, but no SGA since it's wetland dominated, see Figure 36 in this plan and SGA and river corridor final reports at: https://anrweb.vt.gov/DEC/SGA/finalReports.aspx
21. Use the assessment data to 1) identify opportunities for projects that will increase river stability, 2) evaluate landowner-proposed channel management activities, and 3) target related local, state and federal programs to increase river stability	VANR - RMP, NRCS, NRCDs		In Progress	H/Working with River Program staff to identify projects, also Functioning floodplain initiative is coming online
22. Work with willing landowners, municipalities, regional/watershed conservation organizations, and others to design and implement river corridor protection projects consistent with increasing overall river stability	VANR, NRCDs, watershed organizations	Ecosystem Restoration Funds	In Progress	H/ RNRCD completed Moon and Mussey Brook, Cold River, Mill River, and Neshobe RCPs and is prioritizing and implementing projects from these
23. Provide enhanced incentives and resources for municipalities to permanently protect riparian corridors	VANR, RPCs, VRC	Ecosystem Restoration Program,	In Progress	H/ Strategies 45 and 49 in this plan include working with RPCs and municipalities to

from new development and to restore existing corridors through municipal land use ordinances and conservation easements		conservation easements		increase riparian corridor protection and restoration
24. Establish vegetated buffers and/or filter strips along rivers, streams, and lake shorelines	VANR, NRCDs, VRC, towns	Ecosystem Restoration Program, Woody Buffer Block Grant	In Progress	H/ RNRCD completed partial buffer assessments along Otter Creek and Neshobe River (2004) and will revisit
25. Modify existing state and federal programs, or create new ones, to more effectively support riparian corridor protection and restoration, e.g., impacts of ditching and tile drainage	VANR, VAAFM, EPA, VT Legislature	Ecosystem Restoration Program, conservation easements, VAAFM-BMPs	In Progress	H/ Focus on Dead, Lewis, Lemon Fair, Little Otter, Otter Creeks
26. Use all available good quality data on the physical, chemical, and biological values of the waters, and collect any additional necessary data in the watershed to establish reference reaches.	VANR - RMP	Existing staff and budget resources – as function of tactical basin planning process going forward	In Progress	H/ Ongoing as part of the TBP processes of identifying reclassification candidates (Figure 11) and determining monitoring priorities (Table 14)
27. Protect land along the rivers and streams where there are existing riparian buffers, significant wetlands, or where land is important to maintaining the rivers stability as determined by the geomorphic assessments and future river corridor plan.	RMP, private landowners, VLT, MALT municipalities, NRCDs, CCs, VRC	Ecosystem Restoration Funds , VHCD	In Progress	H/Working to reclassify Otter Creek Wetland Complex and establishing River Corridor Easements where possible
28. Create minimum consistent zoning that would protect rivers in the watershed through setbacks and riparian buffer ordinances, and flood hazard zones and overlay districts.	VLCT, RMP, RPCs, Towns, DEC, select boards, VRC	Municipal Planning Grants	In Progress	H/Working with RPCs and municipalities to include zoning for stream setbacks, riparian buffers, and flood hazard areas.

Objective 3: PROTECT AND RESTORE THE NATURAL ENVIRONMENTS OF WETLANDS, LAKES AND PONDS IN THE BASIN TO SUPPORT WATER QUALITY, RECREATION AND AESTHETICS Wetlands and Floodplain Protection and Restoration				
29. Using the new Lake Champlain Basin Wetland Restoration Plan as a guide, work with willing landowners to identify opportunities to restore and conserve wetlands and their role in improving water quality	VANR, VAAFM, NRCS (WRP)	WRP, WHIP, EQIP, Ecosystem Restoration Program	In Progress	H/Highest priority sites identified per the Lake Champlain Basin Wetland Restoration Plan (and verified) – will cross-reference with SGA/ RCP.
30. Class Three wetlands are not within state jurisdiction and should be addressed under municipal regulations. Municipalities were given a responsibility in the 1986 wetland legislation to notify the state about developments in wetlands in 24 V.S.A. §4409. Encourage municipal oversight and stewardship efforts.	RPC's, towns, VLCT, DEC Wetlands Program, NRCS	EPA pass-through 604(b), Municipal Planning Grants	In Progress	M/Will target town plan and zoning rewrites and revisions
31. Work with conservation commissions to map existing wetlands and wetland functions and values for willing towns in the watershed. Use this information to prioritize the protection or restoration of wetlands in the watershed.	Conservation Commissions, VT Wetlands Section	Watershed Grant	In Progress	M/ Ongoing as part of the TBP processes of identifying restoration candidates (Figure 40)
32. Communities should consider adopting flood hazard area regulations that are more stringent than the minimum requirements of participation in the NFIP.	VANR, RPCs	EPA 604(b), Municipal Planning Grants	In Progress	M/ Working with RPCs and municipalities to focus on river corridor adoption and ERAF eligibility of towns
33. Encourage municipal adoption of a Fluvial Erosion Hazard overlay district as one of the best avoidance strategies for fluvial erosion hazard mitigation. An overlay district is an additional zoning requirement placed on a specific	VANR, RPCs	ANR – RMP existing staff and resources, Ecosystem Restoration	In Progress	H/ Working with RPCs and municipalities to identify where adoption of a Fluvial Erosion Hazard overlay district is needed

geographic area (in this case the FEH zone) without changing the underlying zoning.		Funds , EPA 604(b), Municipal Planning Grants		
34. Protect floodplains identified through the geomorphic assessments as important for maintaining the stability of rivers and streams. Work with land trusts to include language in conservation easements that protect floodplains and buffers for maintaining or restoring stream stability.	VLT, MALT, RMP, VRC, conservation commissions	VHCB, Ecosystem Restoration Funds	In Progress	H/ Functioning floodplains initiative will replace
Lake and Pond Protection and Restoration				
35. Hold a Vermont Invasive Patrollers (VIPs) workshop in the Basin and form survey groups to patrol the watershed to identify and control invasive riparian or aquatic species populations before they are well established	Lake/river associations, VANR, FOVLAP	ANC, Watershed Grants, LCBP	In Progress—where receptive	H/ See Strategy 43-- focus on Beaver Pond, Cedar Lake, Chipman Lake, Lake Dunmore, Fern Lake, Porter Lake, Richville Pond, Rutland City, Star Lake, Vergennes Watershed, and Winona Lake
36. Encourage the development of locally-run public access "greeter" programs to prevent aquatic invasive species from entering or leaving a lake or pond, and support general public education and outreach about this topic	Lake associations, VDEC, DFW, DFPR, FOVLAP	ANC, Watershed Grants, LCBP	In Progress—where receptive	H/ See Strategy 42—focus on Beaver Pond, Cedar Lake, Chipman Lake, Lake Dunmore, Fern Lake, Porter Lake, Richville Pond, Rutland City, Star Lake, Vergennes Watershed, and Winona Lake
37. Increase the level of communication between lake associations and residents to prevent spread of invasive species into or within the watershed. Distribute information to lake and pond residents about invasive species and other common lake and pond	FOVLAP, VDEC - AIS, VDEC	ANC, local fundraising	In Progress	M/ Ongoing throughout the basin in coordination with LPP and FOVLAP. Also, social media reboot may be useful.

issues, using modern approaches (social media sites, online forums, etc.)				
38. Continue to support lake - lay monitoring programs in the watershed.	Lake/river associations, VDEC, LaRosa	LMP and LaRosa Program	In Progress	H/See Strategy 41—focus on Cedar Lake, Silver Lake, Winona Lake
39. Maintain existing shoreline vegetation through the creation of shoreline zoning with vegetated buffers for all watershed towns.	State of Vermont, Planning commissions, VLCT	N/A	In Progress	H/ N/A the Shoreland Protection Act
40. Hold a workshop or series of workshops on lakeshore management to cover such topics as buffer restoration and low impact lawn care and landscaping. In addition, continue to promote LID concepts for camp conversions or replacement.	Lake Associations, Land Trusts, VDEC, RPCs, and planning commissions	Watershed Grant, 604(b), Municipal Planning Grants	In Progress	M/Several examples including the NSEC
41. Maintain signs encouraging invasive species spread prevention actions at all public launches in the Basin to prevent spread to or from the waterbody. Include what aquatic invasive species are present.	VDEC, DFW, DFPR	Existing staff and resources	In Progress – where updated information exists	H
General Water Quality Issues and Protection				
42. Include riparian area protection within town plans. Develop riparian area protection language within town zoning regulations.	VLCT, RPCs, towns	EPA 604(b), Ecosystem Restoration Funds , existing staff and resources	In Progress—where receptive	H/ Working with RPCs and municipalities to develop riparian area protection language within zoning
43. Identify surface waters with regular or episodic elevations in pathogens and disseminate this information to the public. Correct obvious runoff issues	VANR, towns, watershed groups	Existing staff and budget resources	In Progress	M/via ACRWC outreach materials-- Focus on these TMDL watersheds: Lewis Creek, Little Otter Creek, Middlebury River, Otter Creek

that may be contributing to this problem.				
44. Provide results of water quality testing and information about the water quality of the watershed to the public through towns, schools, the web, and the local library.	VDEC Towns, school, libraries, local media	DEC MAPP, Watershed grants	In progress	M/via RRPC CWAC and ACRPC Natural Resources Committee meetings and ACRWC outreach materials
45. Expand the capacity of volunteer monitoring programs with minimum monthly sampling on all high priority waterbodies throughout the watershed (as resources allow).	ACRWC, UOCWC, VDEC LaRosa, EPA	DEC – LaRosa, EPA	In Progress	M/ Expand monitoring on rotational, priority basis as ACRWC currently administers and also with UOCWC
46. Make annual water quality data easily accessible online and linked to RPC, lake/ watershed association, and town web sites.	VDEC, RPCs, ACRWC, UOCWC, towns	EPA 604(b), watershed grants, Ecosystem Restoration Funds	In Progress	H/ ACRWC and UOCWC monitor and disseminate their data online
47. Protect and provide public access to unique features throughout the watershed. The Otter Creek and its tributaries have many waterfalls, historical mill sites, and beautiful areas where it is important to maintain public access to help keep people connected with these resources.	VDEC, VRC, MALT, VLT, LARC	VHCB	In Progress	H/Can be identified through existing uses tables in Appendix B and communicated during public meetings.
48. Complete a demonstration project along the New Haven River on control methods for Japanese knotweed, including the proper disposal of Knotweed, to prevent its spread. Encourage landowners to mow or cut areas of knotweed on private property.	TNC, NHRAA, towns, CCs	Watershed Grants, Ecosystem Restoration Funds	Discontinued	M
Objective 4: MINIMIZE CONFLICTS BETWEEN STREAMS' NATURAL FUNCTIONS AND TRANSPORTATION INFRASTRUCTURE				

49. Conduct comprehensive assessments when replacing infrastructure that is in conflict with natural stream processes, utilizing the recently updated ANR/AOT bridge and culvert assessment protocols	VANR, VTrans, towns	Existing staff and budget resources	In Progress	H/ Mostly completed through TNC, VDFW
50. Hold a series of Local Roads workshops in the Basin to increase awareness of maintenance measures that will reduce gravel road erosion. Encourage the participation of all town highway managers and road crews in the watershed.	VT Local Roads Program, VT Better Backroads Program, RPCs, RMP, towns	Better Backroads	In Progress	H/ Monthly road commissioner workshops/ luncheons
51. Develop capital road improvement budgets for all towns in the Otter Creek Basin.	Town select boards, road commissioners	Better Backroads, Grants in Aid	2019 B03 plan	M/ MRGP will require and RPCs will assist
52. Identify Better Backroad grant opportunities by touring watersheds with road commissioners from each town. Apply for Better Backroad grants in all watershed towns to conduct road inventories and address the most serious road-related erosion problems.	VDEC, road commissioners, select boards, Local Roads Program	Better Backroads grants, municipal stormwater mitigation grants, town highway funds	In Progress	M/ RPCs will assist
53. Compile guidance on winter sanding and salt application and distribute to towns in the Basin to encourage the development of policies that will reduce salt and sand application in the watershed. Provide outreach to the general public on the impacts of salt and sand application to reduce the pressure for their expanded use.	Road commissioners, VTrans, Local Roads Program, VDEC		Discontinued	M/ Article on this topic in Vermont Local Road News.
54. Work with road crews in the watershed to put in a grant for a hydroseeder that	NRCDs, Road crews and	Ecosystem Restoration	Complete	H/ RNRCD shares hydroseeder with PMNRCD, ACRPC and Cornwall have

could be used by all towns in the watershed and possibly landowners to stabilize ditches.	commissioners, CCs, select board members, VTrans	Funds, Municipal Stormwater Mitigation Grant, Better Backroads grant		developed such a program in Addison County
55. Work with all municipalities in the watershed to adopt and actively implement the following programs or standards: **A. Town road and bridge standards consistent with or exceeding those listed per Act 110: http://www.leg.state.vt.us/reports/2011ExternalReports/265312.pdf** **B. Driveway/highway access (curb cut) construction ordinances meeting the standards outlined in the Highway Access Policy and Program Guidance and Model Ordinance, VT Local Roads Program, May 1997.**	Road crews and commissioners, CCs, and select board members, VTrans	Town Funds - Increased state match for class 2 road projects and reimbursement for disaster relief	In Progress	H/ongoing as part of TBP process to identify Act 110 compliant towns and target those towns that need updating, especially mountain towns and those affected by Tropical Storm Irene, Req. by Title 19
56. Compile available bridge and culvert survey data in the basin and present this information to watershed towns and develop a list of priority culverts for replacement based on likelihood of culvert failure, geomorphic impacts and aquatic species passage concerns.	Road crews and commissioners, CCs, select board members, VTrans, RPCs, RMP, DFW	Better Backroads	2019 B03 plan	H/See Figures 37 and 38 of this plan
57. Work with town road commissioners and select board members to replace top priority culverts in each town.	Road crews, CCs, and select board members,	Better Backroads	2019 B03 plan	H/ See Figures 37 and 38 of this plan

	VTrans, RPCs, RMP, DFW			
Identify non-functioning dams and prioritize for removal, partial breaching, and/or improved fish passage. Address effects of hydro-modification.				
58. Identify existing dams which are no longer used in the watershed and are candidates for removal. Remove one dysfunctional dam in the Basin and restore the natural flows and riverine habitat.	Dam Task Force, Hydrology Program, private dam owners	USGS grants	2019 B03 plan	H/working to identify willing owners of failing dams that have disrupted sediment regimes and fish passage (e.g., Dunklee Pond Dam and Halnon (?))
59. Review any large water withdrawal proposals in the watershed to ensure that they do not reduce fish passage, alter sediment regimes, or reduce flows or groundwater levels to significantly impact aquatic habitat.	VDEC Hydrology program, NRCS, NRCDs, Stream Alteration Engineer, DFW	ERP, Better Backroads grant, Watershed grant	Complete	High/ project proposal by NVDA to work with one or two towns in 2018 on class 4 assessments. Town not yet selected.

Appendix B. Existing Uses in Basin 3

During the Basin 3 planning process, the VANR documented existing uses for swimming (contact recreation), fishing, and boating on flowing waters. All surface waters used as public drinking water sources were also identified. The VANR presumes that all lakes and ponds in the basin have existing uses of fishing, swimming (contact recreation), and boating, because of the extensive use of waters based upon their intrinsic qualities. The VANR recognizes that fishing activities in streams and rivers are widespread throughout the basin and can be too numerous to document. Also, streams too small to support significant angling activity provide spawning and nursery areas, which contribute to fish stocks downstream where larger streams and rivers support a higher level of fishing activity. As such, these small tributaries are considered supporting the use of fishing and are protected at a level commensurate with downstream areas. This presumption may be rebutted on a case-by-case basis during the VANR's consideration of a permit application, which might be deemed to affect these uses.

The following tables are not intended to represent an exhaustive list of all existing uses, but merely an identification of well-known existing uses. Additional existing uses of swimming (contact recreation), boating, and fishing on/in flowing waters may be identified during a permit application or during future basin planning efforts.

Table B-1. Determination of existing uses of waters for swimming in Basin 3.

Surface Water	Location of Use	Watershed	Town	Basis for Determining the Presence of an Existing Use
Emerald Lake	Emerald Lake State Park	Otter mainstem	Dorset	Public (State) beach and attractive recreation site
Elfin Lake	Elfin Lake Municipal Swimming Beach	Unnamed tributary	Wallingford	Public (municipal) beach and attractive recreation site
Griffith Lake	USFS – Green Mountain National Forest	Big Branch	Peru, Mount Tabor	USFS Public waterbody and attractive recreation site (hikers/ campers only)
Little Rock Pond	USFS – Green Mountain National Forest	Homer Stone Brook	Wallingford	USFS Public waterbody and attractive recreation site (hikers/ campers only)
Mill River (1)	Swinging Bridge	Mill River	Clarendon	Locally used swimming hole at public recreation area (Long Trail/ Appalachian Trail)
Clarendon Gorge (1)	Clarendon Gorge – multiple swimming areas	Mill River	Clarendon	Popular Swimming hole

Spring Lake	Spring Lake local access area	Mill River	Shrewsbury	Private (local) access and attractive recreation site with public swimming usage permitted upon request
Chittenden Reservoir/ Lefferts Pond	USFS – Green Mountain National Forest	East Creek	Chittenden	Green Mountain National Forest – CVPS Public access area. USFS designated access to Sugar Hill Reservoir, Silver Lake, and Falls of Lana.
Lake Dunmore/ Fern Lake/ Falls of Lana/ Silver Lake/ Sugar Hill Reservoir	USFS – Green Mountain National Forest, Branbury State Park	Sucker Brook, tributary to the Leicester River	Salisbury/ Leicester	Green Mountain National Forest, Branbury State Park. USFS designated access to Sugar Hill Reservoir, Silver Lake, and Falls of Lana (1).
High Pond	TNC protected land	Willow Brook	Sudbury	Protected access and attractive recreation site
Middlebury Gorge (1)	Middlebury River – Route 125 pull-off access points	Middlebury River	East Middlebury	Public (local) access and attractive recreation site. Popular and well-known swimming location with easy access from State Route 125.
New Haven Gorge – Bartlett Falls (1)	New Haven River – Lincoln Mountain Road – multiple pull-off access points.	New Haven River	Bristol	Public (local) access and attractive recreation site. Popular and well-known swimming location with easy access from the Bristol-Lincoln Road.
New Haven River – Sycamore Park	New Haven River – municipal park off State Route 116	New Haven River	Bristol	Public (municipal) access and attractive recreation site. Popular and well-known swimming location with easy access from State Route 125.
Monkton Pond	Cedar Lake	Lewis Creek	Monkton	

Table B-2. Determination of existing uses of waters for fishing in Basin 3.

Surface Water	Watershed	Town	Basis for Determining the Presence of an Existing Use
Otter Creek WMA	Otter Creek	Danby/ Mount Tabor	Otter Creek WMA F&W access, special use regulations and stocking
Danby Pond	Mill Brook	Danby	State designated "carry-in" access to Pond, warm-water fishery.
Emerald Lake	Emerald Lake State Park	Dorset	Public (State) beach and attractive recreation site, State designated "carry-in" access to Lake, warm-water fishery.
Tinmouth Pond	Clarendon River	Tinmouth	State designated "car-top" access to Pond, warm-water fishery.
Star Lake	Mill River	Mount Holly	State designated "trailer" access to Lake, mixed water fishery.

Little Rock Pond	Homer Stone Brook	Wallingford	USFS Public waterbody and attractive recreation site (hikers/ campers only), cold water fishery.
Wallingford Pond	Mill River	Wallingford	USFS Public waterbody and attractive recreation site (hikers/ campers only), designated "carry-in" access to Pond, warm-water fishery.
Spring Lake	Mill River	Shrewsbury	Public (local) beach and attractive recreation site, cold-water fishery.
Chittenden Reservoir/ Lefferts Pond	East Creek	Chittenden	Green Mountain National Forest – CVPS Public access area. State designated "trailer" access to Lake, mixed water fishery, special use regulations and stocking.
Sutherland Falls	Otter Creek	Proctor	Public (municipal) access and attractive recreation site below falls.
Otter Creek	Otter Creek	Proctor/ Pittsford	Gorham Covered Bridge, State designated "car-top" access to Creek, mixed-water fishery. State designated special use regulations and stocking.
Furnace Brook	Furnace Brook	Chittenden Pittsford	State designated special use regulations and stocking.
Neshobe River	Neshobe River	Goshen Brandon	State designated special use regulations and stocking.
Otter Creek	Otter Creek	Brandon	State designated "trailer" access to Creek, mixed water fishery, special use regulations and stocking.
Otter Creek	Otter Creek	Salisbury	State designated "car-top" access to Creek, mixed-water fishery.
Lower Otter Creek WMA	Otter Creek	New Haven	Lower Otter Creek WMA F&W access, special use regulations and stocking
Richville Pond – Richville WMA	Lemon Fair River	Shoreham, Orwell	Richville WMA F&W access, special use regulations and stocking. State designated "car-top" access to Pond, warm-water fishery.
Lake Dunmore/ Fern Lake/ Falls of Lana/ Silver Lake/ Sugar Hill Reservoir	Leicester River	Salisbury/ Leicester	Green Mountain National Forest – and State DFW Public access areas. USFS designated access to Sugar Hill Reservoir, Silver Lake, and Falls of Lana.
Middlebury River	Middlebury River	East Middlebury	State designated special use regulations and stocking. Access from Route 125

New Haven River	New Haven River	Lincoln, Bristol, New Haven	State designated special use regulations and stocking.
New Haven River	New Haven River	New Haven - Brooksville	Public (local) access and attractive recreation site. Popular and well-known fishing location at the site of the former Dog Team Tavern.
Dead Creek WMA	Dead Creek	Addison, Panton	State designated "car-top" access to Creek, warm-water fishery, special use regulations and stocking.
Bristol Pond	Pond Brook – Lewis Creek	Bristol	State designated "trailer" access to Pond, warm-water fishery, special use regulations and stocking.
Monkton Pond	Lewis Creek	Monkton	State designated "trailer" access to Pond, warm-water fishery, special use regulations and stocking.
Lewis Creek WMA	Lewis Creek	Ferrisburgh	State designated "trailer" access to Creek, mixed water fishery, special use regulations and stocking.
Otter Creek	Otter Creek	Weybridge	State designated "trailer" access to Creek, mixed water fishery, special use regulations and stocking.
Otter Creek	Otter Creek	Ferrisburgh	Fort Cassin - State designated "trailer" access to Creek, warm-water fishery, special use regulations and stocking.
Little Otter Creek WMA	Little Otter Creek	Ferrisburgh	State designated "trailer" access to Creek, mixed water fishery, special use regulations and stocking.

Table B-3. Determination of existing uses of waters for pubic water supplies in Basin 3.

Surface Water	Watershed	Town	Basis for Determining the Presence of an Existing Use
Unnamed Pond	Middlebury River	Ripton	The Middlebury College Breadloaf Campus water system in Ripton: An unnamed pond as an Inactive, Emergency source
Furnace Brook **Kiln Brook**	Furnace Brook	Chittenden	The Proctor Water Department in Proctor: Furnace Brook as an Active, Permanent source

			Kiln Brook as an Active, Permanent source
Mendon Brook **East Creek**	Mendon Brook East Creek	Mendon Chittenden	The Rutland City Water Department in Rutland: Mendon Brook in Mendon as an Active, Permanent source East Creek in Chittenden as an Inactive, Emergency source
Roaring Brook	Roaring Brook	Wallingford	The Wallingford Fire District #1 water system in Wallingford: Roaring Brook as an Inactive, Emergency source
Unnamed tributary (A2)	Cold River	Killington	City of Rutland water supply. Unnamed tributary to Cold River and all waters within its watershed upstream of its diversion into the Mendon Brook watershed in the town of Killington.
Mendon Brook (A2) ***Previously mentioned***	Mendon Brook	Killington Mendon	City of Rutland water supply. Mendon Brook and all waters within its watershed upstream of the water intake just south of Meadow Lake Drive in the Town of Mendon.
Tenney Brook (A2)	Tenney Brook	Mendon Rutland Town	Rutland-Mendon Town water supply. Tenney Brook and all waters with its watershed upstream of and including a small intake impoundment.
Rutland City Reservoir (A2)	East Creek	Rutland Town	City of Rutland water supply. Rutland City Reservoir in Rutland Town and all waters within its watershed in Rutland Town and Mendon.
Moon Brook (A2)	Moon Brook	Mendon	Rutland-Mendon F.D. #2 water system. (Gleason Road System - now abandoned.) Moon Brook and all waters within its watershed in Mendon upstream of and including a small intake impoundment.
Unnamed Tributary to Tenney Brook (A2)	Tenney Brook	Mendon	Rutland F.D. #2 (Gleason Road) water system. Unnamed tributary to Tenney Brook and all waters within its watershed in Mendon upstream of the water intake.

Young's Brook (A2)	Clarendon River	West Rutland Ira	Village of West Rutland water supply. (No longer used). Young's Brook and reservoir and all waters within its watershed in West Rutland and Ira upstream of the water intake.
Furnace Brook and Kiln Brook (A2) ***Previously mentioned***	Furnace Brook	Chittenden	Village of Proctor water supply. (Kiln Brook in the main source, with Furnace Brook used as a backup). Furnace Brook and Kiln Brook and all waters within their watersheds in Chittenden upstream of their confluence.
Sugar Hollow Brook (A2)	Sugar Hollow Brook	Goshen Chittenden	Town of Brandon water supply. (No longer used). Sugar Hollow Brook and all waters within its watershed in Goshen and Chittenden upstream of the water intake.
Leicester Hollow Brook (A2)	Neshobe River	Leicester	Town of Brandon Water Supply. (No longer used). Leicester Hollow Brook and all waters within its watershed in Leicester upstream of the water intake.
Brandy Brook (A2) ***Previously mentioned***	Middlebury River	Ripton	Now or former water supply for Breadloaf School. Brandy Brook and all waters within its watershed.
Unnamed tributary to Beaver Meadow Brook (A2)	New Haven River	Lincoln	Village of Bristol water supply. Unnamed tributary to Beaver Meadow Brook and all waters within its watershed upstream of the water intake in Lincoln.
Unnamed tributary to Lewis Creek (A2)	Lewis Creek	Starksboro	Village of Starksboro water supply. (No longer used). Unnamed tributary to Lewis Creek and all waters within its watershed in Starksboro upstream of the water intake.
Two unnamed tributaries to Little Otter Creek (A2)	Little Otter Creek	Monkton Bristol	City of Vergennes water supply. (Not used since 1973). Two unnamed tributaries to Little Otter Creek and all waters within their watersheds in Monkton and Bristol upstream of two water intakes.
Notch Brook (A2)	New Haven River	Bristol	Village of Middlebury water supply. (Reserved for emergency use). Notch Brook and all waters within its

			watershed upstream of the water intake in Bristol.
Roaring Brook ***Previously mentioned***	Roaring Brook	Wallingford	Wallingford F.D. #1 water supply. Roaring Brook and all waters within its watershed upstream of the water intake.

Table B-4. Determination of existing uses of waters for recreational boating in Basin 3 – Flat water.

Surface Water	Location of Use	Watershed	Town	Basis for Determining the Presence of an Existing Use
Emerald Lake	Emerald Lake State Park	Otter mainstem	Dorset	Public (State) beach and attractive recreation site
Elfin Lake	Elfin Lake Municipal Swimming Beach	Unnamed tributary	Wallingford	Public (municipal) beach and attractive recreation site
Otter Creek mainstem	Otter Creek	Otter Creek	Dorset to Ferrisburgh	Multiple Otter Creek F&W and other access areas
Danby Pond	Danby Pond	Mill Brook	Danby	State designated “carry-in” access to Pond
Tinmouth Pond	Baker Brook	Danby/ Tinmouth		
Spring Lake	Spring Lake local access area	Mill River	Shrewsbury	Private (local) access and attractive recreation site
Chittenden Reservoir/ Lefferts Pond	USFS – Green Mountain National Forest	East Creek	Chittenden	Green Mountain National Forest – CVPS Public access area. USFS designated access to Sugar Hill Reservoir, Silver Lake, and Falls of Lana.
Lake Dunmore/ Fern Lake/ Falls of Lana/ Silver Lake/ Sugar Hill Reservoir	USFS – Green Mountain National Forest, Branbury State Park	Sucker Brook, tributary to the Leicester River	Salisbury/ Leicester	Green Mountain National Forest, Branbury State Park. USFS designated access to Sugar Hill Reservoir, Silver Lake, and Falls of Lana (1).
Lake Winona	F&W access area	Pond Brook	Bristol	State F&W access area
Monkton Pond	Cedar Lake F&W access area	Lewis Creek	Monkton	Swimming listed as a present use in
Star Lake	Belmont – Star Lake	Mill River	Mount Holly	State designated “trailer” access to Lake
Little Otter Creek	Little Otter Creek WMA	Little Otter Creek	Ferrisburgh	State designated “trailer” access to Creek

Table B-5. Determination of existing uses of waters for recreational boating in Basin 3 – White water.

Surface Water	Watershed	Town	Basis for Determining the Presence of an Existing Use
Clarendon Gorge to Route 7	Mill River	Clarendon	Multiple access locations
New Haven River	New Haven River	Lincoln, Bristol	Bristol - Lincoln Mountain Road – multiple pull-off access points.
Middlebury Gorge	Middlebury River	Middlebury, Ripton	East Middlebury - Multiple access locations - Route 125 pull-off access points
Furnace Brook	Furnace Brook	Chittenden Pittsford	Multiple access locations

Neshobe River	Neshobe River	Goshen Brandon	Multiple access locations
Otter Creek Gorge and Falls	Otter Creek	Middlebury, Weybridge	Multiple access locations
Cold River	Cold River	Shrewsbury	Multiple access locations
Roaring Brook	Roaring Brook	Wallingford	Multiple access locations
Big Branch	Big Branch	Mount Tabor	Multiple access locations
Danby Slides	Mill Brook	Danby	Multiple access locations

(1) Jenkins and Zitka, The Waterfalls, Cascades, and Gorges of Vermont, VTANR, 1988.

Table B-6. Determination of waterbodies not considered as Existing Use – Fishing in Basin 3.

Surface Water	Watershed	Town	Basis for Existing Use exclusion
Moon Brook	Moon Brook	Rutland – Rutland City	No stocking, use regulations, or access areas
Willow Brook	Otter Creek	Sudbury	No stocking, use regulations, or access areas
Muddy Branch	New Haven River	Middlebury	No stocking, use regulations, or access areas
Pond Brook	Lewis Creek	Monkton	No stocking, use regulations, or access areas
Beaver Pond	Mendon Brook	Mendon	Future milfoil management uncertain, ownership and contracted use in jeopardy

Appendix C. Dams in Basin 3

Table C1. Active dams in Basin 3 organized by town name. These dams are either in service, partially breached, or drained.

State ID	Dam Name	Town	Stream	Dam Status	TNC Rank	Dam Hazard Class	Comments
31.07	Bristol	Bristol		Breached			
26.01	Blair	Brandon	Arnold Brook-TR	In Service			
54.02	Norinberg	Cornwall	Beaver Brook	In Service	Medium	Medium	
54.03	Kirk	Cornwall	Beaver Creek-TR	In Service	Low	Low	
167.01	Bread Loaf	Ripton	Brandy Brook	In Service	Medium	Medium	
99.05	Walker Pond	Hubbardton	Bresee Mill Brook-TR	In Service	Medium	Medium	Pond with recreation site
99.06	Mudd Pond	Hubbardton	Bresee Mill Brook-TR	In Service	Medium	Medium	
54.01	Cornwall-1	Cornwall	Cedar Swamp-TR	In Service	Low	Low	
149.01	Stone Bridge	Panton	Dead Creek	In Service	High	High	VDFW WMA
1.01	Farrel	Addison	Dead Creek-TR	In Service	Low	Low	VDFW WMA
1.02	Woodcock Site 2	Addison	Dead Creek-TR	In Service	Low	Low	VDFW WMA
1.04	Woodcock Site 4	Addison	Dead Creek-TR	In Service	Low	Low	VDFW WMA
1.05	Woodcock Site 3	Addison	Dead Creek-TR	In Service	Very Low	Very Low	VDFW WMA
1.06	Jerome	Addison	Dead Creek-TR	In Service	Medium	Medium	VDFW WMA
1.17	Woodcock Site 1	Addison	Dead Creek-TR	In Service	Low	Low	VDFW WMA
1.18	Farrell North	Addison	Dead Creek-TR	In Service	Low	Low	VDFW WMA

State ID	Dam Name	Town	Stream	Dam Status	TNC Rank	Dam Hazard Class	Comments
82.02	Stewart	Goshen	Dutton Brook-TR	In Service	Low	Low	Pond with homes
1.08	Brilyea East	Addison	East Branch Dead Creek	In Service	High	High	VDFW WMA
1.10	Tetreault	Addison	East Branch Dead Creek-TR	In Service	Medium	Medium	VDFW WMA
49.01	Chittenden Reservoir	Chittenden	East Creek	In Service	High	High	Hydropower
49.02	Lefferts Pond West	Chittenden	East Creek	In Service	High	High	USDA-FS recreation site
49.03	Lefferts Pond East	Chittenden	East Creek	In Service			
154.05	East Pittsford	Pittsford	East Creek	Breached	Very Low	Very Low	Appears to be gone
173.01	Patch Pond	Rutland City	East Creek	In Service	High	High	Hydropower
174.03	Glen	Rutland Town	East Creek	In Service	High	High	Hydropower
174.04	Rutland City Reservoir	Rutland Town	East Creek-TR	In Service			
174.06	Rutland-6	Rutland Town	East Creek-TR	In Service			
174.07	Rutland-7	Rutland Town	East Creek-TR	In Service	Very Low	Very Low	Pond with homes
174.08	Rutland City Reservoir Dike	Rutland Town	East Creek-TR	In Service			
76.07	Jackman	Ferrisburgh	East Slang	In Service			
76.01	Harris	Ferrisburgh	East Slang-TR	In Service	Medium	Medium	VDFW WMA
76.02	Robinsons Slang	Ferrisburgh	East Slang-TR	In Service	Medium	Medium	VDFW WMA
76.08	Goose Creek	Ferrisburgh	Goose Creek	In Service	Low	Low	VDFW WMA
219.02	Quinn Lower	Wallingford	Homer Stone Brook	In Service	Low	Low	

State ID	Dam Name	Town	Stream	Dam Status	TNC Rank	Dam Hazard Class	Comments
26.03	Jones Mill	Brandon	Jones Brook	In Service	Medium	Medium	State-owned
54.05	Perry-Jackson	Cornwall	Ledge Creek	In Service	Medium	Medium	
180.01	Lake Dunmore	Salisbury	Leicester River	In Service	Medium	Medium	Lake with homes
180.03	Salisbury	Salisbury	Leicester River	In Service	Medium	Medium	Hydropower
189.01	Richville Pond	Shoreham	Lemon Fair River	In Service	High	High	VDFW WMA
46.02	Scott Pond	Charlotte	Lewis Creek	In Service	Very High	Very High	Waterfalls immediately u/s and d/s
197.01	Baldwin Pond	Starksboro	Lewis Creek-TR	In Service	Medium	Medium	
197.03	Clifford	Starksboro	Lewis Creek-TR	In Service	Medium	Medium	
197.06	Common Ground Pond	Starksboro	Lewis Creek-TR-Offstream	In Service			
76.03	Turner	Ferrisburgh	Little Otter Creek	Breached	Medium	Medium	
31.01	Norton Brook	Bristol	Little Otter Creek-TR	In Service	Low	Low	
76.04	Callery	Ferrisburgh	Little Otter Creek-TR	In Service	Medium	Medium	
76.06	Bergh	Ferrisburgh	Little Otter Creek-TR	In Service	Medium	Medium	
76.06	Bergh	Ferrisburgh	Little Otter Creek-TR	In Service	Medium	Medium	VDFW WMA
1.11	Warner Site 2	Addison	Middle Branch Dead Creek	In Service			
1.12	Warner Site 3	Addison	Middle Branch Dead Creek-TR	In Service	Low	Low	VDFW WMA
125.05	East Middlebury	Middlebury	Middlebury River	Breached			

State ID	Dam Name	Town	Stream	Dam Status	TNC Rank	Dam Hazard Class	Comments
135.02	Star Lake	Mount Holly	Mill River-TR	In Service	Medium	Medium	Community recreation site
173.03	Combination Pond	Rutland City	Moon Brook	In Service	Low	Low	Active removal project
173.07	Piedmont Pond	Rutland City	Moon Brook	In Service	Very Low	Very Low	Included in Moon Bk. TMDL analysis
125.03	Dow Pond	Middlebury	Muddy Branch	In Service	High	High	
125.04	Middlebury Reservoir	Middlebury	Muddy Branch-TR	In Service	Low	Low	
125.06	Wood	Middlebury	Muddy Branch-TR	In Service	Medium	Medium	
125.07	Pomainville	Middlebury	Muddy Branch-TR	In Service	Low	Low	
173.04	Lower Eddy Pond	Rutland City	Mussey Brook	Breached	Medium	Medium	
174.05	Upper Eddy Pond	Rutland Town	Mussey Brook	In Service	Medium	Medium	
26.05	Brandon (Upper)	Brandon	Neshobe River	In Service	Low	Low	
26.06	Brandon (Lower)	Brandon	Neshobe River	In Service	Low	Low	
82.03	Kingsland	Goshen	Neshobe River	In Service	High	High	
31.04	Bartletts Falls	Bristol	New Haven River	Breached			
114.03	Senk	Lincoln	New Haven River - TR	In Service	Very Low	Very Low	Farm pond
114.02	Lincoln-2	Lincoln	New Haven River-OS	In Service	Low	Low	Pond with homes
114.01	Goeselt	Lincoln	New Haven River-	In Service	Low	Low	Pond with home

State ID	Dam Name	Town	Stream	Dam Status	TNC Rank	Dam Hazard Class	Comments
			TR				
60.01	Emerald Lake	Dorset	Otter Creek	In Service	High	High	State park
125.01	Middlebury Upper	Middlebury	Otter Creek	In Service	Low	Low	Natural barrier
125.02	Middlebury Lower	Middlebury	Otter Creek	In Service	Low	Low	Hydropower
140.01	Huntington Falls	New Haven	Otter Creek	In Service	Low	Low	Hydropower
140.02	Beldens	New Haven	Otter Creek	In Service	Very Low	Very Low	Hydropower
160.04	Proctor	Proctor	Otter Creek	In Service	Low	Low	Hydropower
173.06	Ripley Mills	Rutland City	Otter Creek	In Service	Medium	Medium	Mainstem dam
174.09	Center Rutland	Rutland Town	Otter Creek	In Service	Medium	Medium	Hydropower
213.01	Vergennes No. 9	Vergennes	Otter Creek	In Service	Low	Low	Hydropower
240.01	Weybridge	Weybridge	Otter Creek	In Service	Medium	Medium	Hydropower
1.19	DuBois Manure Pit	Addison	Otter Creek-OS	In Service			
125.09	Buttolph	Middlebury	Otter Creek-OS	In Service	Low	Low	Pond with homes
154.02	Smith Pond	Pittsford	Otter Creek-OS	In Service	High	High	Pond with homes
26.02	Adams Brook	Brandon	Otter Creek-TR	In Service	Medium	Medium	
76.05	Danyow	Ferrisburgh	Otter Creek-TR	Breached	Medium	Medium	
125.08	Middlebury Industrial Park	Middlebury	Otter Creek-TR	In Service	Very Low	Very Low	Industrial park site

State ID	Dam Name	Town	Stream	Dam Status	TNC Rank	Dam Hazard Class	Comments
160.01	Beaver Pond	Proctor	Otter Creek-TR	In Service			
160.02	Olympus Pool	Proctor	Otter Creek-TR	In Service			
160.03	Reynolds Reservoir	Proctor	Otter Creek-TR	In Service	Low	Low	
189.02	Pomainville	Shoreham	Perry Brook	In Service	Low	Low	
31.02	Lake Winona	Bristol	Pond Brook	In Service	High	High	VDFW access area
129.01	Vermont Kaolin Corporation	Monkton	Pond Brook-TR	In Service	Medium	Medium	
26.04	Goodnew	Brandon	Smalley Swamp-TR	In Service	Low	Low	
82.01	Sugar Hill Reservoir	Goshen	Sucker Brook	In Service	High	High	Hydropower
180.02	Sucker Brook	Salisbury	Sucker Brook	In Service	High	High	Hydropower
111.01	Silver Lake	Leicester	Sucker Brook-TR	In Service	Medium	Medium	Hydropower/USDA-FS recreation site
173.02	Dunklee Pond	Rutland City	Tenney Brook	In Service	Medium	Medium	Previously identified, City interested in removal
124.05	Ballantyne	Mendon	Tenney Brook-TR	In Service	Medium	Medium	
207.01	Chipman Lake	Tinmouth	Tinmouth Channel-TR	In Service	Medium	Medium	Lake with homes
1.07	Brilyea West	Addison	West Branch Dead Creek	In Service	Medium	Medium	VDFW WMA
1.09	Norton	Addison	West Branch Dead Creek-TR	In Service	Low	Low	VDFW WMA
1.13	Martin	Addison	West Branch Dead Creek-TR	In Service	Low	Low	VDFW WMA

State ID	Dam Name	Town	Stream	Dam Status	TNC Rank	Dam Hazard Class	Comments
1.14	Harte	Addison	West Branch Dead Creek-TR	In Service	Low	Low	VDFW WMA
1.15	Norton Shallow Dike	Addison	West Branch Dead Creek-TR	In Service	Low	Low	VDFW WMA
1.16	McCuens Slang	Addison	Whitney Creek	In Service			
31.03	Coffin	Bristol	Winona Lake-TR	In Service	Very Low	Very Low	
238.01	Youngs Brook	West Rutland	Youngs Brook	Breached (Partial)	High	High	May not be a barrier