Summary Report: 2016 Sampling Results
South Chittenden River Watch

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TABLE OF CONTENTS

1.0 Introduction

This report provides a summary of the 2016 sampling results for the South Chittenden River Watch (SCRW). Sampling was carried out by a network of volunteers, operating under an EPA-approved Quality Assurance Project Plan. Analytical services were provided by the LaRosa Analytical Laboratory in Burlington, VT, through an analytical services partnership grant. A quality assurance review of data was performed by Dr. Bill Hoadley. This summary report has been prepared by Kristen Underwood of South Mountain Research & Consulting.

2.0 Background

The SCRW has been monitoring water quality (including sediment, phosphorus, nitrates, and *E.coli*) in four watersheds in southern Chittenden County (Figure 1) for several years, with the earliest monitoring efforts beginning in 2004 on the LaPlatte River.

- LaPlatte River (53 mi^2)
- McCabe's Brook (tributary of LaPlatte River, 6.2 mi^2)
- Thorp Brook (4.6 mi^2)
- Kimball Brook (2.9 mi^2)

In Figure 1, highlighted segments of the LaPlatte River main stem and Mud Hollow Brook are listed as impaired for contact recreation uses due to impacts from agricultural runoff and streambank erosion (VTDEC, 2016a). Additionally, the LaPlatte River main stem downstream of Hinesburg, Patrick Brook from Lower Pond to its confluence with the LaPlatte, and the lower 1.1 miles of Kimball Brook are each listed as stressed waters with impacts to aquatic health, aesthetics and secondary contact recreation uses resulting from development, channelization and agricultural land uses (VTDEC, 2016b).

Since baseline data now exist for these four watersheds during low to moderate flow conditions, the goal during this 2016 season was to sample water quality during high flow events, as a means of estimating relative contributions of sediment and nutrients to Lake Champlain in the context of the Lake Champlain Total Maximum Daily Load (TMDL) for phosphorus. Additional stations were established on the Thorp and Kimball Brooks to bracket potential hot spots of sediment and nutrients. Six focus study sites were monitored in McCabe's Brook, and three sentinel stations were monitored in LaPlatte River (Table 1, Figure 1). A separate initiative was also carried out this season in the LaPlatte River watershed under low flow conditions to monitor potential impacts from the Hinesburg WWTF. These results are to be reported under separate cover.

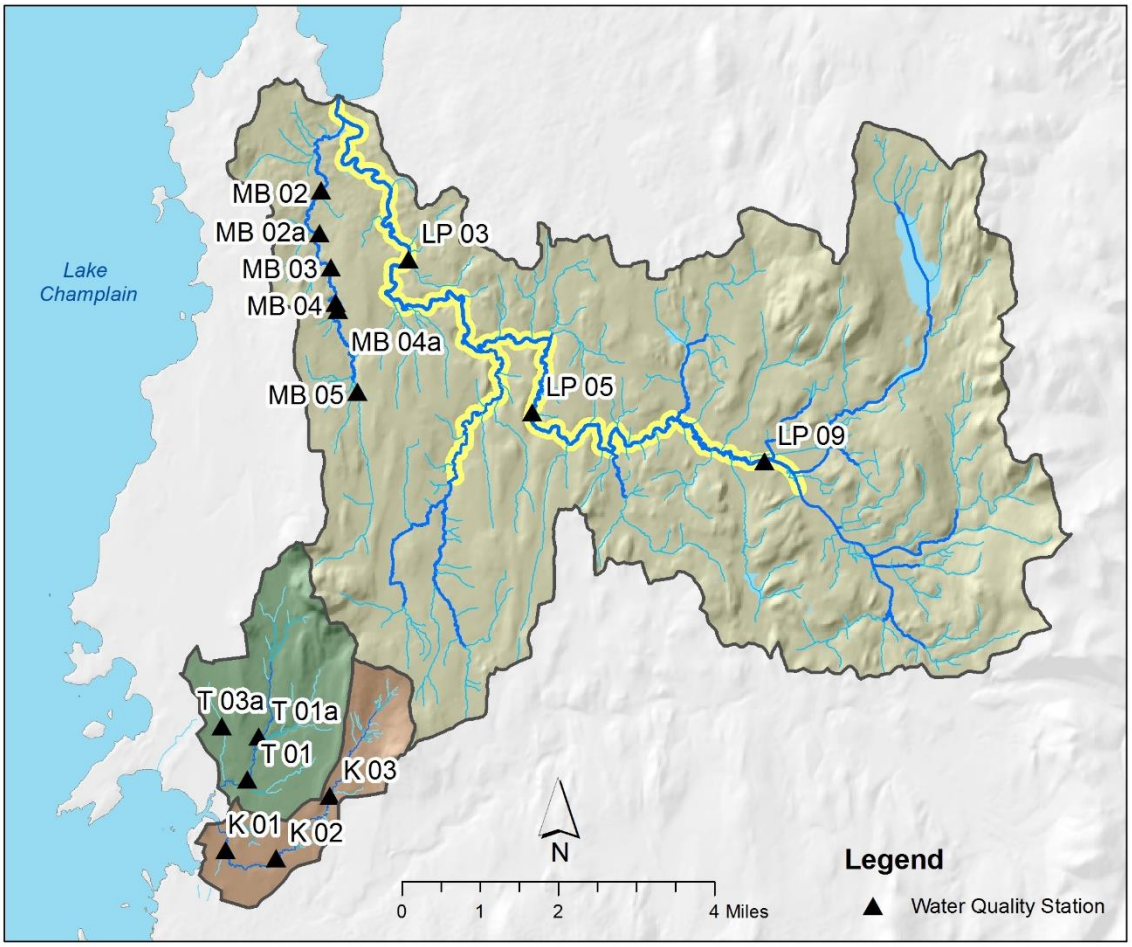

Figure 1. Location of SCRW monitoring stations for 2016

Table 1. 2016 Schedule of Sites / Parameters targeting High Flows

Stream and Location	Scheduled Analyses							
	E. coli	Cl	TSS	Turb.	TP	DP	TN	NOx
LaPlatte River – LP09, LP05, LP03			(X)*	X	X	X	X	X
McCabe's Brook – MB05, MB04a, MB04, MB03, MB02a, MB02	X	X	X		X	X	X	X
Thorp Brook – T01, T 01a, T 03a			X		X	X	X	X
Kimball Brook – K 03, K 02, K 01			X		X	X	X	X

**TSS analyses suspended on LaPlatte stations after 11/8/2016*

3.0 Precipitation and Streamflow Data

Overall, calendar year 2016 was a **below-normal precipitation year**, as recorded at regional weather stations in South Burlington (Airport) and Rutland. Snowfall in the winter of 2015–2016 was far below normal at these same stations (NOAA, 2017). The region was in a **moderate drought condition** for much of the year (US Drought Monitor, 2017). Summer and fall sampling months saw lower than normal precipitation.

Streamflow data were compiled from the LaPlatte River USGS streamflow gauging station (#04282750) at Shelburne Falls, VT, which has been operational since 1991. Figure A-1 in Appendix A presents a graph of the instantaneous discharge record (provisional data) from calendar year 2016 for the LaPlatte River station. Flows were somewhat elevated above normal in February, but then trended below normal for the remainder of the year – given the warm temperatures and lower-than-average precipitation. Based on the average annual mean daily flow computed on 24 years of approved record for this gage, flows in SCRW watersheds for water year 2016 were **below normal.**

Peak flow for water year 2016 was associated with warming temperatures, rain and snowmelt in late February when recorded flows (1,460 cfs) on February 25 exceeded the 2-year storm magnitude (981 cfs; Olson, 2014). Flows reached their lowest point for the year in August. Except for isolated storm events, flows in this river were below the Low Median Monthly flow for most of July through October (Table A-1).

A flow duration curve is also presented in Appendix A for the LaPlatte River gage based on daily mean flows recorded over 25 years from water years 1991 through 2015 (Figure A-2). According to the VTDEC *Guidance on Streamflow Observations at time of Water Quality Sampling of Rivers and Streams,* high flow levels are defined as those flow conditions which are equaled or exceeded only 25% of the time. Low flow levels are those equaled or exceeded more than 75% of the time, while those flows occurring between 25 and 75% of the time are classified as medium.

4.0 Methods

Water quality samples were collected by SCRW volunteers in accordance with quality assurance procedures outlined in the EPA-approved Quality Assurance Project Plan prepared by VTDEC.
A Quality Assurance Summary report for the 2016 sampling data has been provided under separate cover. Samples were delivered to the LaRosa Analytical Laboratory housed in the Hills Building in the University of Vermont campus in Burlington, Vermont.

SCRW volunteers collected grab samples in these four watersheds at 15 sites during one summer event, and two fall events. Drought conditions made it difficult to fulfill the original sampling goal to capture high flow events; therefore, a decision was made in late fall, to at least capture a couple of events regardless of flow condition.

In the end, two freshets of modest size were sampled on August 18 and November 22; both events were classified as moderate flows and captured water quality conditions as discharge was receding. An intervening event on November 8, occurred during low-flow conditions which exhibited base-flow characteristics (i.e., relatively stable flow stage, not significantly rising or falling in response to a rainfall or snowmelt event).

5.0 Sample Results

Appendix B contains quality-assured sample results for the 2016 season for the four SCRW watersheds. In general, water quality results for 2016 were consistent with historic results and trends summarized in previous summary reports for each watershed. Expanded information has been gathered for newly-established stations in the Thorp and Kimball watersheds to add to the evaluation of spatial trends in constituent concentrations.

5.1 Phosphorus

Figure 2 depicts the distribution of Total Phosphorus (TP) concentrations recorded during the three 2016 sampling events. The incremental subwatersheds draining to each water quality station are color coded based on the mean TP recorded during three sampling events occurring during low to moderate flows in August and November. Highest TP concentrations were detected in the western extents of each watershed, coincident with increasing density of glaciolacustrine soils and agricultural and developed land uses (Attachment D , Figures D-1, D-2, D-3). Patterns detected in Thorp and Kimball watersheds suggest an increasing concentration with distance downstream, although stations are few in number. In the McCabe's Brook tributary of the LaPlatte River, higher concentrations of TP were detected between stations MB05 and MB04.

The instream phosphorus criterion of 27 µg/L for warm-water medium gradient (WWMG) wadeable stream ecotypes in Class B waters is applicable at low median monthly (LMM) flow conditions during June through October (VWMD, 2016). Only the November 8 sampling event was classified as a low flow, where daily mean flow measured at Shelburne Falls on the LaPlatte River (6.2 cfs) was nearly at the LMM (5 cfs) (Table A-1). TP concentrations on this date exceeded 27 µg/L at all fifteen sampling stations in SCRW watersheds.

Dissolved phosphorus (DP) was analyzed during each event at all 15 stations, and ranged from 14 to 100% of the TP concentration, with a mean of 67%. The range and mean of these percentages did not vary significantly when results were stratified by flow condition (i.e., low flows vs moderate flows). Generally speaking, highest DP as a percentage of TP was reported for McCabe's Brook and Kimball Brook. Elevated DP as a percentage of TP tended to be coincident with low or nondetectable Total Suspended Solids.

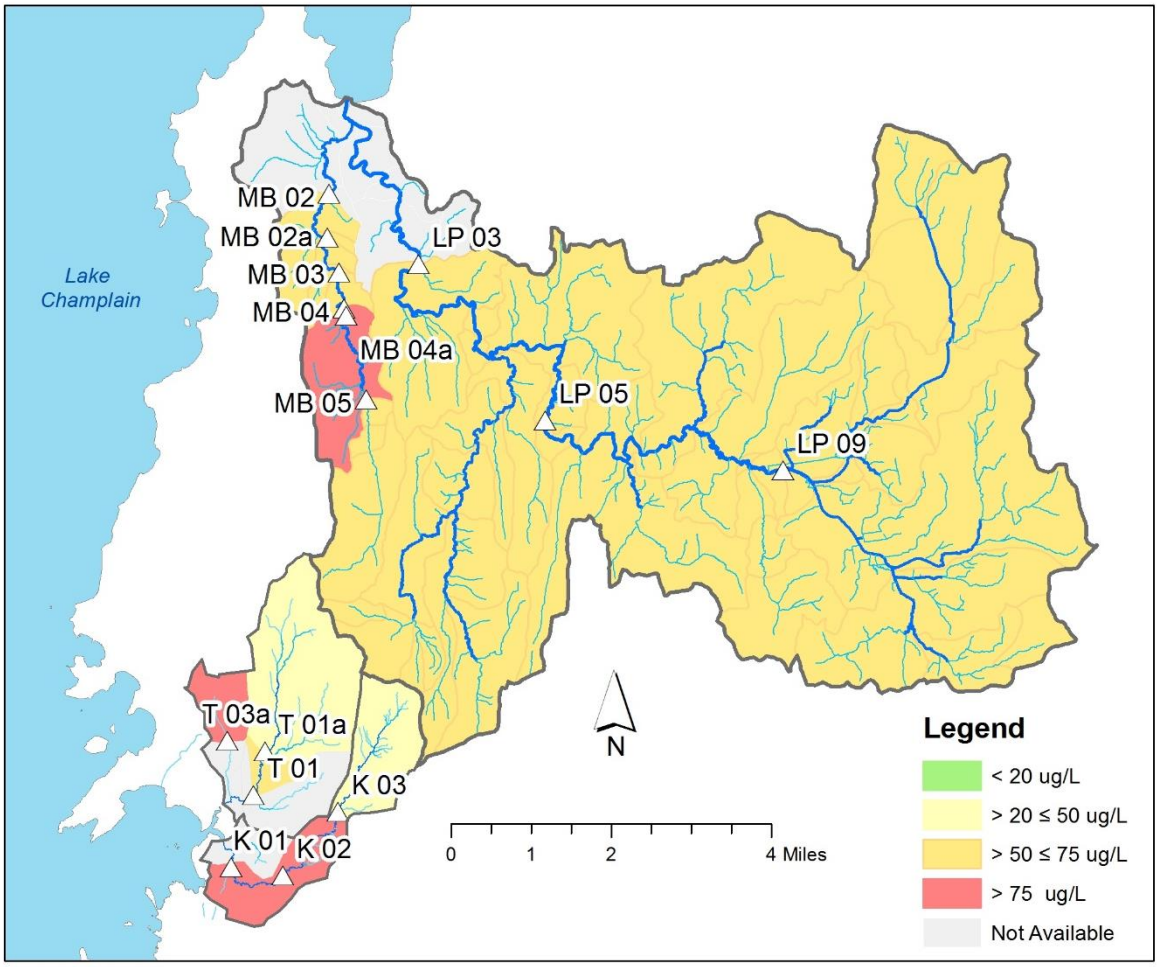

Figure 2. Distribution of Mean Total Phosphorus in Watersheds Monitored by the SCRW. Incremental subwatersheds draining to each water quality station are color coded based on mean TP recorded during three sampling events occurring during low to moderate flows in August and November, 2016.

Water quality in the SCRW watersheds varies in space, depending on the geologic setting and soil types present in the catchment areas draining to each station, as well as variation in land use and land cover characteristics. A separate study recently completed by the Addison County River Watch Collaborative found a strong, and statistically-significant, positive correlation between mean water quality concentrations (for Total Phosphorus, *E. coli* and Turbidity) and both the percentage of fine-grained glacial lake soils and the percentage of agricultural land use in the catchments draining to water quality stations (ACRWC & SMRC, 2016). Except for the headwater portions of LaPlatte River east of the Hinesburg village, SCRW watersheds tend to have a high percentage of low-infiltration, fine-grained silt and clay soils derived from glacial lake sediments (Attachment D, Figures D-1, D-2). These areas are also characterized by higher densities of agricultural and developed land uses (Figure D-3).

5.2 Nitrogen

Total Nitrogen (TN) was analyzed during each event at all 15 stations, and ranged from 0.2 to 2.6 mg/L, with a mean of 0.7 mg/L. Given elevated nitrogen concentrations detected historically, all stations were also tested for nitrate and nitrite forms of nitrogen (N03-N02). Nitrate-nitrite concentrations ranged from <0.05 to 1.2 mg/L, with a mean of 0.3 mg/L. TN and N03-N02 concentrations on these low-flow and moderate-flow sample dates were well below the water quality standard for Class B waters of 5.0 mg/L as nitrate-N (which applies at flows exceeding LMM; VTWMD, 2016).

N03-N02 forms of nitrogen were detected primarily in the Kimball Brook stations on moderate flow dates (Aug 18, Nov 22), and at the LaPlatte stations during the low-flow event (Nov 8), but were reported at, or only slightly above, the detection limit in McCabe's Brook during all three sample events.

5.3 Sediment

Sediment was monitored in each of the SCRW watersheds by analyzing for Total Suspended Solids (TSS). While, Vermont Water Quality Standards are established for Turbidity, TSS has been monitored historically in SCRW watersheds to examine patterns in the relative phosphorus burden of sediments with fluctuating discharge, and to enable coarse estimates of sediment loading to receiving waters. Historically, Turbidity has been monitored alongside TSS to establish a relationship between Turbidity and TSS. In 2016, however, Turbidity analyses were limited to LaPlatte River stations (Table 1).

TSS was analyzed during each event at all 15 stations (except for the Nov 22 event at LaPlatte stations), and ranged from <1 to 59 mg/L, with a mean of 10.7 mg/L. TSS was generally somewhat higher in concentration during the moderate flow events (August 18, Nov 22) than during the low-flow event (Nov 8). Highest TSS concentrations were detected in Thorp Brook (T03a) and Kimball Brook (K02) during the August 18 storm event.

Turbidity samples were collected at LaPlatte River stations on all three sample dates. The Vermont Water Quality Standard for Turbidity in warm-water Class B streams (25 NTUs) is applicable as an annual average under dry weather base-flow conditions (VWMD, 2016). Only one sample date during 2016 met these conditions. On November 8, Turbidity did not exceed that standard at any of the three LaPlatte River stations.

5.4 E. coli

As part of a more focused evaluation, six stations in McCabe's Brook were monitored for *E. coli*. Counts ranged from 4 to 866 MPN/100 mL. The mean of *E.coli* counts during the two moderate flow events (291 MPN/100 mL) was greater than the mean at low flow (166 MPN/100 mL), suggesting the importance of runoff-related sources of pathogens.

Vermont Water Quality Criteria (VTDEC, 2016) state that *E. coli* is not to exceed a geometric mean of 126 MPN/100mL obtained over a representative period of 60 days, and no more than 10% of samples should be above 235 MPN/100 mL (VWMD, 2016). During moderate flow conditions on August 18, as

discharge was receding from a summer storm event, *E.coli* counts at all six McCabe's stations exceeded the health-based standard of 235 MPN/ 100 mL (Figure 3). This health-based standard was also exceeded during low, base-flow conditions on November 8 at stations MB04 and MB02a.

The geomean of *E. coli* counts detected at McCabe's stations, exceeded the geomean standard of 126 MPN/100 mL at stations MB02, MB02a, and MB04 (Figure 4). Historic data from the LaPlatte River has informed the *Vermont Statewide TMDL for Bacteria-impaired Waters* (VTDEC, 2011) that addresses impaired segments of the main stem and Mud Hollow Brook (Figure 1). Based on 2016 data, segments of the McCabe's Brook are similarly impacted by pathogens.

6.0 Project Implementation

In 2017, with partial funding from a LaRosa Laboratory support grant, SCRW will continue high-flow monitoring to track longer-term water quality trends in these direct-drainage systems to prioritize outreach and remedial actions at the subwatershed scale. The same stations will be monitored in LaPlatte River and Kimball Brook. Monitoring in the McCabe's Brook will be scaled back to sentinel sites (MB 02, 02a, 4, 5). In the Thorp Brook, SCRW will establish three new monitoring stations on Thorp Brook and tributaries just upstream of station, T01a, to further refine spatial trends and bracket three watershed improvement practices recently, or about to be, implemented by stakeholders (Table 2; Figure 5). These projects have been identified as part of the "Ahead of the Storm" project and will address water quality stressors including pathogens, sediments and nutrients, as well as concentrated stormwater runoff.

Water quality results for South Chittenden River Watch watersheds are used by watershed towns, VT DEC, Vermont Agency of Agriculture, the Natural Resources Conservation Service and District offices, UVM Extension, USDA Farm Service Agency, US Fish & Wildlife Service, and Vermont Fish & Wildlife Department. Results are used to understand baseline water quality conditions, determine effectiveness of BMPs, and identify hot spot phosphorus loading and critical source area locations in need of remediation recommendations and investments. Towns and citizens rely on SCRW monitoring data results to understand stream water quality conditions under current regulations, inform education outreach efforts, town plan and regulations updates, regional plan updates, monitor effectiveness of storm water practices and sewer treatment systems and to inform optimal conservation practices designs for water quality improvement projects.

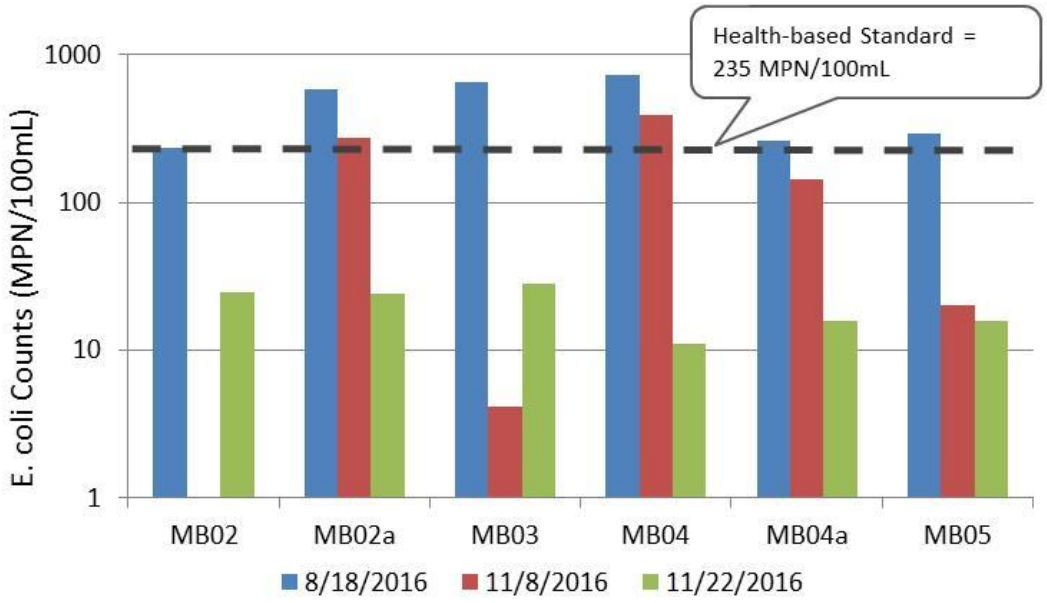

Figure 3. *E.coli* detected at McCabe's Brook stations in 2016.

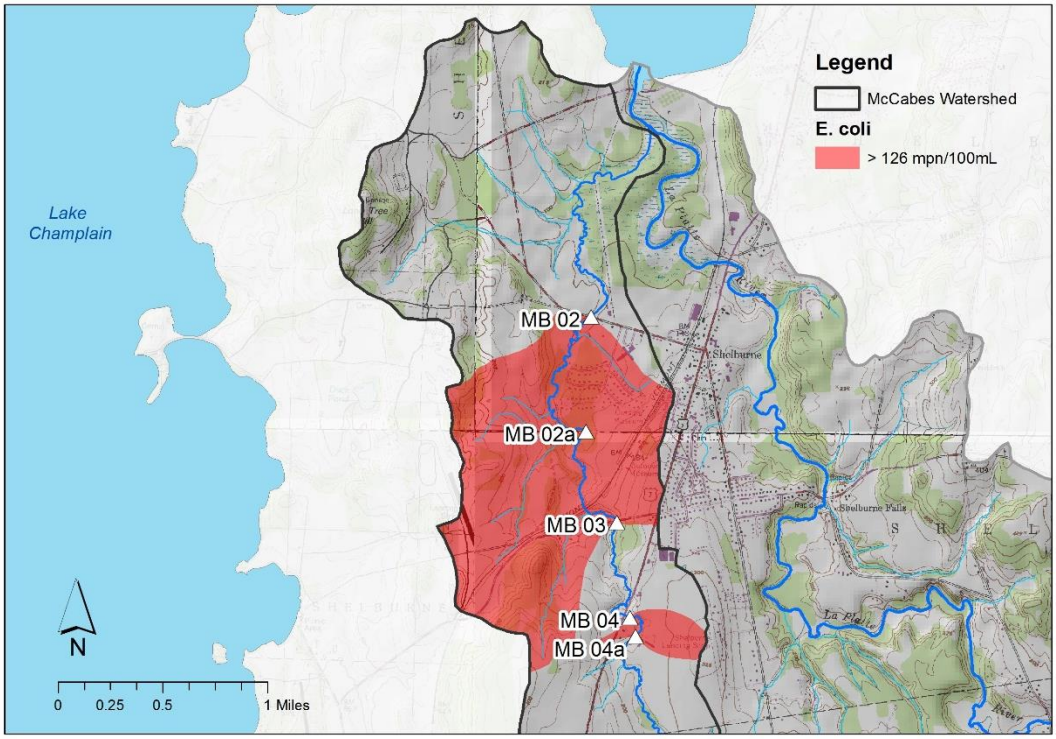

Figure 4. Subwatersheds draining to McCabe's Brook water quality stations, highlighted in red where the geomean of 2016 detections exceeds the VWQS of 126 MPN/100mL.

Table 2. Description of improvement projects to be implemented in Thorp Brook watershed.

Site	Description	Partners
A	Mack Farm Field gullies – stabilization	Landowner, USDA Farm Service Agency, VT Agency of Agriculture
B	East Thompson Point Road – road ditch improvements including stone-lined swale, grass swale, buffer improvements, check dams, and bioretention	Town of Charlotte, Better Back Roads, Milone & MacBroom
C	Big Oak Lane – gully stabilization and enhanced stormwater retention	Big Oak Lane association, ERP, Milone & MacBroom

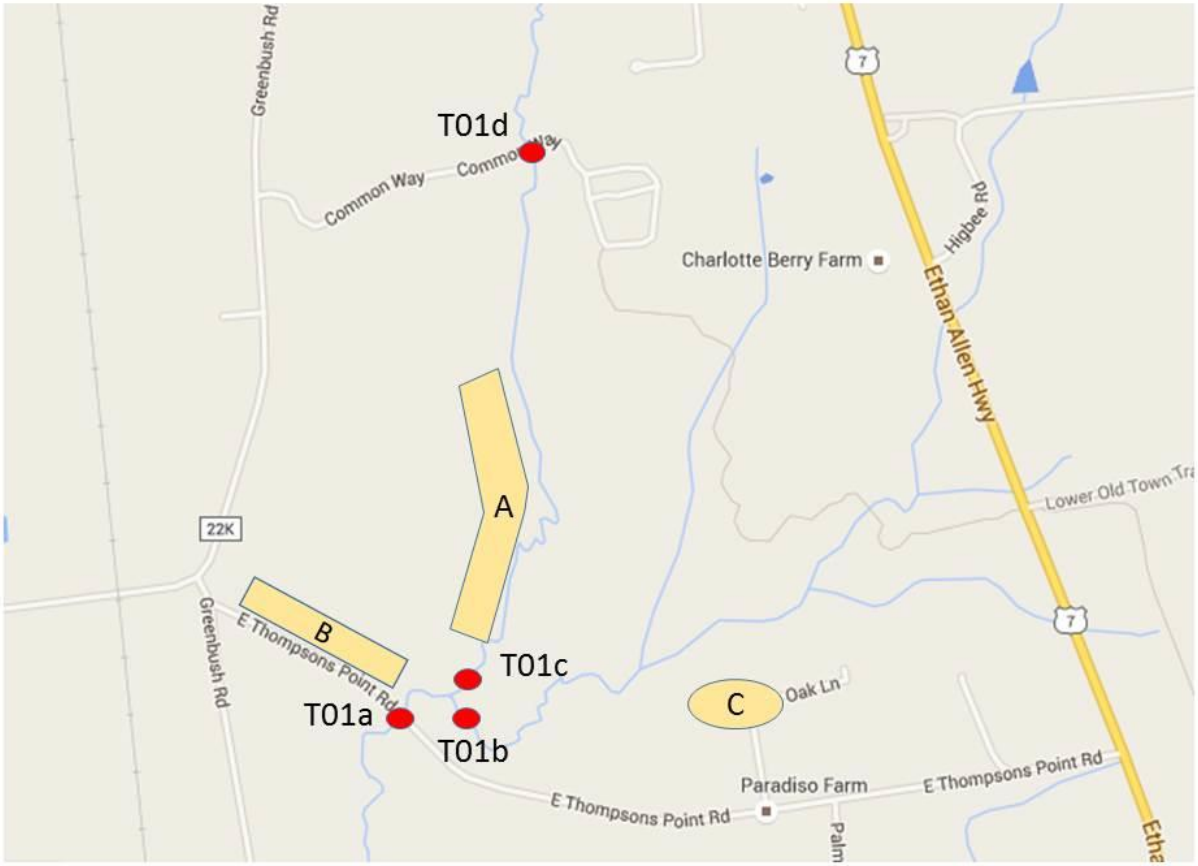

Figure 5. Location of 2017 bracket monitoring sites and treatment practices on Thorp Brook.

7.0 References

Addison County River Watch Collaborative and South Mountain Research & Consulting, 2016, *Workshops and Analysis to Enhance Flood Resiliency of Headwater Forests*, Final Grant Summary Report, Grant Award #: WG224-16.

Olson, S.A., 2014, Estimation of flood discharges at selected annual exceedance probabilities for unregulated, rural streams in Vermont, *with a section on* Vermont regional skew regression, by Veilleux, A.G.: U.S. Geological Survey Scientific Investigations Report 2014–5078, 27 p. plus appendixes, *http://dx.doi.org/10.3133/sir20145078*.

NOAA Online Weather Data: Daily Almanac accessed in February 2017 at: http://www.weather.gov/climate/xmacis.php?wfo=btv

US Drought Monitor, accessed 16 January 2017, http://droughtmonitor.unl.edu/Home/StateDroughtMonitor.aspx?VT

USGS, 2017, on-line surface water data, <http://waterdata.usgs.gov/vt/nwis>.

VTDEC, 2011, *Vermont Statewide Total Maximum Daily Load (TMDL) for Bacteria Impaired Waters*, prepared by FB Environmental Associates, Inc., Portland, ME. Including Appendix 9.

VTDEC Water Quality Division, 2009 (August 18), *Proposed Nutrient Criteria for Vermont's Lakes and Wadeable Streams*. http://www.anr.state.vt.us/dec/waterq/lakes/docs/lp_2009nutrientcriteria.pdf

VT DEC Water Quality Division, 2016a, *State of Vermont 2016 303(d) List of Waters*: *Part D – Impaired Surface Waters in Need of TMDL*.

VT DEC Water Quality Division, 2016b, *State of Vermont Stressed Waters List*.

Vermont Watershed Management Division, 2016. *Vermont Water Quality Standards*. Effective 15 January 2017. Montpelier, VT. http://www.watershedmanagement.vt.gov/rulemaking/docs/wrprules/wsmd_wqs2014.pdf

Appendix A

Flow Data

Table A-1. 2016 Daily Mean Flows recorded in LaPlatte River at Shelburne Falls on sample dates, with reference to estimated peak flows and low median monthly flows.

	River	LaPlatte River	
	USGS Gage #	#04282795	
	Drainage Area (sq mi)	44.6	
Sample Dates	8/18/2016	31	M-FF
(Daily Mean Flows, cfs)	11/8/2016	6.2	L-BF
	11/22/2016	11.2	M-FF
Peak Flows	Q2	981	
(Olson, 2014; App 3)	Q5	1,560	
(Weighted)	Q10	2,000	
	Q25	2,650	
	Q50	3,200	
	Q100	3,780	
	Q500	5,400	
Low Median Monthly Flow		5.0 (Aug)	
7Q10 Flow		0.78	
(Blaine Hastings, VWMD, Jan 2014; based on gaging records from 1990 - 2012)			

Abbreviations: Flow condition follows VTDEC Guidance:
Flow Level: Fd - Flood (>bankfull flow), H - High (>p.75), M - Moderate (>p.25 ≤ p.75), L - Low (≤ p.25), where p = percentile
Flow Category: BF - Base Flow, FF - Freshet Flow, HF - Hydro Flow

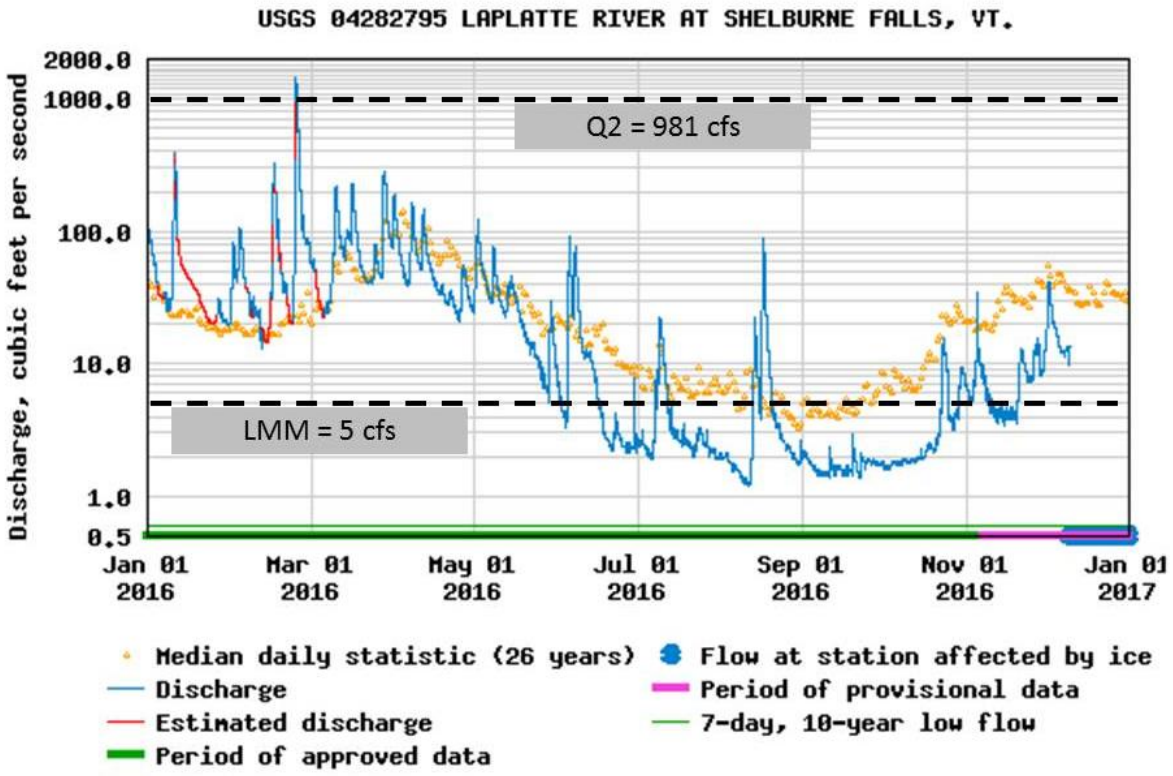

Figure A-1. Instantaneous Discharge Recorded at Shelburne Falls on the LaPlatte River in 2016.

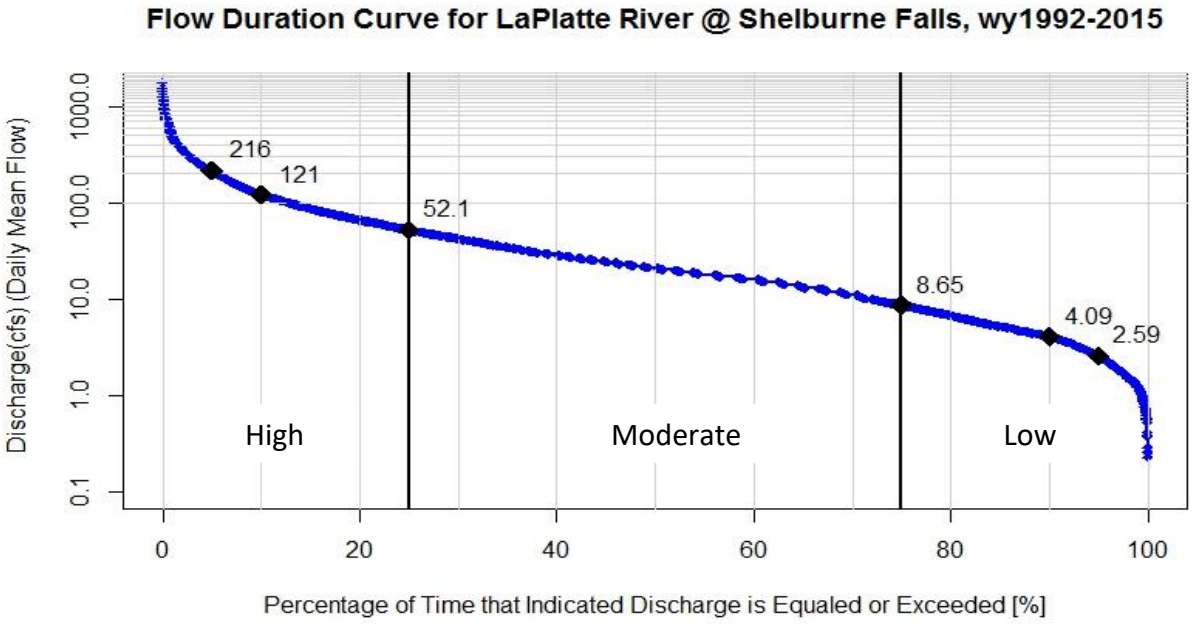

Figure A-2. Flow Duration Curvey for LaPlatte River at Shelburne Falls, water years 1992-2015.

Appendix B

Water Quality Data Tables by Watershed

Abbreviations:

TN = Total Nitrogen
TP = Total Phosphorus
DP = Dissolved Phosphorus
TSS = Total Suspended Sediments

MPN/100 mL = organisms per 100 milliliters
mg/L = milligrams per liter
ug/ L = micrograms per liter
NTU = Nephelometric Turbidity Units

-- = No Data
NS = Not Sampled
NA = Not Analyzed (e.g., insufficient sample volume; vial broken in transit)
NM = Not Measured

JB = estimated value; constituent was present in an associated field blank

JD = estimated value; Relative Percent Difference (RPD) of primary and field duplicate sample values exceeded the QAPP RPD goal for that constituent

Note: QA/QC issues further detailed in separate QA Summary Report

LaPlatte River

Site	Date	Chloride (mg/L)	E. Coli. (mpn/100mL)	TN (mg/L)	NO2-NO3 (mg/L)	TP (µg/L)	DP (µg/L)	TSS (mg/L)	Turbidity (NTU)
LP03	8/18/2016	19.7		0.82	0.08	133	62.2	40.4	37
LP05	8/18/2016			0.91	0.08	118	58.6	34.7	32.4
LP09	8/18/2016	25		0.62	< 0.05	65.3	40.3	9.4	8.05
LP03	11/8/2016	38.2		0.39	< 0.05	31.9	24.4	1.8	3.49
LP05	11/8/2016	53		0.99	0.42	35.7	25.7	2.6	5.13
LP09	11/8/2016			2.59	0.89	76.2	38.1	7.2	8.35
LP03	11/22/2016			0.29	< 0.05	17.4	17.8		3.77
LP05	11/22/2016			0.33	< 0.05	23.3	12.1		4.74
LP09	11/22/2016			0.4	0.09	47.2	17.6		3.26

VT Water Quality Standards, 2016 (effective January 15, 2017):

- **Turbidity** (warm water Class B) = **25 NTUs** as an annual average under dry weather base-flow conditions.
- **E. coli** (Class B): Not to exceed a geometric mean of 126 organisms /100ml obtained over a representative period of 60 days, and no more than 10% of samples above **235 organisms/100 ml**. In waters receiving combined sewer overflows, the representative period shall be 30 days.
- **Phosphorus** (Class B, Warm-water Medium Gradient): Not to exceed **27 ug/L** at low median monthly flow during June through October in a section of the stream representative of well-mixed flow.

McCabe's Brook (LaPlatte River Tributary)

Site	Date	Chloride (mg/L)	E. Coli. (mpn/100mL)	TN (mg/L)	NO2-NO3 (mg/L)	TP (µg/L)	DP (µg/L)	TSS (mg/L)	Turbidity (NTU)
MB02	8/18/2016	32.8	866	0.82	0.08	110	59.4	24.8	
MB02a	8/18/2016	29.6	579	0.85	< 0.05	93.2	70.8	6.3	
MB03	8/18/2016	28.2	649	0.97	< 0.05	105	81	6.9	
MB04	8/18/2016	21.5	727	1.05	< 0.05	136	94.4	7.6	
MB04a	8/18/2016	20.1	261	1.08	< 0.05	121	96.7	6.6	
MB05	8/18/2016	18.5	291	1.09	< 0.05	106	88	4.5	
MB02	11/8/2016			0.22	< 0.05	52.2	27.5	10	
MB02a	11/8/2016	77	272	0.28	0.06	45.7	24.8	1.1	
MB03	11/8/2016	124	4		0.09	29.5	28.9	< 1	
MB04	11/8/2016	36	387	0.86	< 0.05	174	120	7.3	
MB04a	11/8/2016	98.2	144	0.43	< 0.05	68.9	40.4	4.3	
MB05	11/8/2016	27.4	20	0.62	< 0.05	61.1	49	2.2	
MB02	11/22/2016	83.5	25	0.31		48.7	43.4	14.8	
MB02a	11/22/2016	108	24	0.21	< 0.05	22.9	19.5	< 1	
MB03	11/22/2016	103	28	0.28	< 0.05	27.7	25.2	< 1	
MB04	11/22/2016	66.5	11	0.43	< 0.05	52.4	42	3	
MB04a	11/22/2016	34.5	16	0.45	< 0.05	61.7	49.7	2.6	
MB05	11/22/2016	23.8	16	0.46	< 0.05	38.5	29.8	1.4	

VT Water Quality Standards, 2016 (effective January 15, 2017):

- **Turbidity** (warm water Class B) = **25 NTUs** as an annual average under dry weather base-flow conditions.
- **E. coli** (Class B): Not to exceed a geometric mean of 126 organisms /100ml obtained over a representative period of 60 days, and no more than 10% of samples above **235 organisms/100 ml**. In waters receiving combined sewer overflows, the representative period shall be 30 days.
- **Phosphorus** (Class B, Warm-water Medium Gradient): Not to exceed **27 ug/L** at low median monthly flow during June through October in a section of the stream representative of well-mixed flow.

Thorp Brook (direct drainage to Lake Champlain)

Site	Date	Chloride (mg/L)	E. Coli. (mpn/100mL)	TN (mg/L)	NO2-NO3 (mg/L)	TP (µg/L)	DP (µg/L)	TSS (mg/L)	Turbidity (NTU)
T01	8/18/2016	18.8		1	0.13	91.4	48.7	5	
T01a	8/18/2016			0.6	0.13	72.1	37.7	12	
T03	8/18/2016			0.84	0.27	119	40.4	44.4	
T01	11/8/2016	26.6		0.23	< 0.05	37.3	27.4	2.1	5.14
T01a	11/8/2016			0.21	< 0.05	29.5	18.9	3.8	
T03a	11/8/2016			0.31	< 0.05	214	34.3	6.2	
T01	11/22/2016			0.39	0.09	50.2	34.5	6.1	
T01a	11/22/2016			0.46	0.15	46.8	27.6	5.1	
T03a	11/22/2016			0.47	0.23	180	42.9	4.2	

VT Water Quality Standards, 2016 (effective January 15, 2017):

- **Turbidity** (warm water Class B) = **25 NTUs** as an annual average under dry weather base-flow conditions.
- **E. coli** (Class B): Not to exceed a geometric mean of 126 organisms /100ml obtained over a representative period of 60 days, and no more than 10% of samples above **235 organisms/100 ml**. In waters receiving combined sewer overflows, the representative period shall be 30 days.
- **Phosphorus** (Class B, Warm-water Medium Gradient): Not to exceed **27 ug/L** at low median monthly flow during June through October in a section of the stream representative of well-mixed flow.

Kimball Brook (direct drainage to Lake Champlain)

Site	Date	Chloride (mg/L)	E. Coli. (mpn/100mL)	TN (mg/L)	NO2-NO3 (mg/L)	TP (µg/L)	DP (µg/L)	TSS (mg/L)	Turbidity (NTU)
K01	8/18/2016			1.23	0.27	348	296	2.1	
K02	8/18/2016			1.32	0.85	141	48.2	58.8	
K03	8/18/2016			0.79	0.25	53	55	5.6	
K01	11/8/2016			1.71	0.24	216	31.2	25.1	
K02	11/8/2016			0.37	< 0.05	116	117	< 1	
K03	11/8/2016			0.46	< 0.05	48.1	36.5	< 1	
K01	11/22/2016			1.72	1.18	236	208	4.3	
K02	11/22/2016			1.16	0.9	44.8	34.9	1.3	
K03	11/22/2016			0.67	0.29	34.7	30	< 1	

VT Water Quality Standards, 2016 (effective January 15, 2017):

- **Turbidity** (warm water Class B) = **25 NTUs** as an annual average under dry weather base-flow conditions.
- **E. coli** (Class B): Not to exceed a geometric mean of 126 organisms /100ml obtained over a representative period of 60 days, and no more than 10% of samples above **235 organisms/100 ml**. In waters receiving combined sewer overflows, the representative period shall be 30 days.
- **Phosphorus** (Class B, Warm-water Medium Gradient): Not to exceed **27 ug/L** at low median monthly flow during June through October in a section of the stream representative of well-mixed flow.

Appendix C

Monitoring Station Locations and Rationale

LaPlatte River

Site ID	Flow Target	Site Location and Remarks	Site Lat	Site Long
LP 03 (LR04)	H	LaPlatte River at Falls Road. East (right bank), 30 meters south of Falls Rd bridge. Hinesburg. Upstream drainage 44.8 sm.	44.37022	-73.21577
LP 05	H	LaPlatte River at Carpenter Road Bridge. Left bank, 5 meters upstream from bridge. Charlotte. Upstream drainage 31.2 sm.	44.34176	-73.1838
LP07a	L	LaPlatte River below Hinesburg WWTF Outfall near DEC Biostation		
LP 08	L	LaPlatte River ~40 meters below Hinesburg WTF Outfall.	44.33319	-73.12618
LP 09	H/L	LaPlatte River. 15 meters upstream of Hinesburg WTF Outfall. Hinesburg. Upstream drainage 17.7 sm.	44.33395	-73.126

McCabe's Brook (LaPlatte River watershed)

Station No.	Flow Target	Coordinates	Town	Description	Remarks
MB 02	H	44.38305 -73.23853	Shelburne	McCabe's Brook, Harbor Rd. bridge. Left bank, 30 meters below bridge.	Surface drain channel enters from right bank about half way between the bridge and the sampling point. Upstream drainage 4.57 mi^2.
MB 02a	H	44.37502 -73.23881	Shelburne	McCabe's Brook off path starting from the end of School Street in Shelburne. Right bank.	Upstream from the School Street neighborhood. Stream flows from Bostwick Road to sampling location along fields and through woods. Small tributary enters upstream from west.
MB 03 (LR 03)	H	44.36892 -73.23586	Shelburne	McCabe's Brook, Bostwick Rd. Bridge. Left bank at downstream discharge from culvert.	Stream plunges upstream below Route 7. Forest, wetlands, in-stream pebble, sand, and silt deposition.
MB 04	H	44.36230 -73.23461	Shelburne	McCabe's Brook, Route 7 bridge. Right bank at upstream end of bridge.	Upstream bank erosion. Vermont Teddy Bear storm drainage pond overflow immediately upstream on east drainage.
MB 04a	H	44.36086 -73.23405	Shelburne	McCabe's Brook, Vermont Teddy Bear access road	Upstream Route 7 fill disposal on farm fields on east drainage. Upstream from disposal site, pasture and corn fields with manure spreading on west drainage. Upstream drainage 3.31 mi^2.
MB 05 (LR 05)	H	44.34582 -73.22868	Charlotte	McCabe's Brook, Lime Kiln Rd. bridge. Downstream discharge from culvert.	Horses upstream, west (left) bank. Nordic Farm upstream west drainage.

Thorp and Kimball Brooks

Station No.	Target Flow	Coordinates	Town	Description	Remarks
T 01	H	44.273073 -73.256597	Charlotte	Thorp Brook west of Greenbush Road. Right bank. Walk downstream about 50 feet. Sample mainstem below confluence of tributary	Upstream from Lake Champlain backwater. Drains residential, farms and agricultural land from the north. Upstream drainage 2.93 mi^2.
T 01a	H	44.28177 -73.25335	Charlotte	Thorp Brook north side of East Thompson's Point Road and downstream of trib.	Drains road, residential,farm and agricultural land from the north. Upstream drainage ____ mi^2.
T 03	H	44.2835 -73.26279	Charlotte	West Tributary to Thorp Brook south side of East Thompson's Point Road.	Drains residential and agricultural land. History of very high nitrogen levels at T 03.5 located east side of Lake Road at Converse Bay Road latitude.
K 01	H	44.2604 -73.2617	Charlotte	Kimball Brook 10 feet south of Town Line Road.	Drains agriculture and pollutants from Town Line Rd to Greenbush Road.
K 02	H	44.25934 -73.24867	Charlotte	Kimball Brook 25 feet east of Greenbush Road.	Upstream from Lake Champlain backwater. Drain farmland and housing lots from the east, and including wooded land west of Route 7 and Mount Philo. Upstream drainage 1.87 mi^2.
K 03	H	44.2706 -73.2352	Charlotte	Kimball Brook west of Route 7, about 20 feet upstream of the culvert under road into the Claflin Farm development.	Drains agricultural runoff and Route 7 and local roads runoff.

Appendix D

Physical Characteristics of SCRW Watersheds

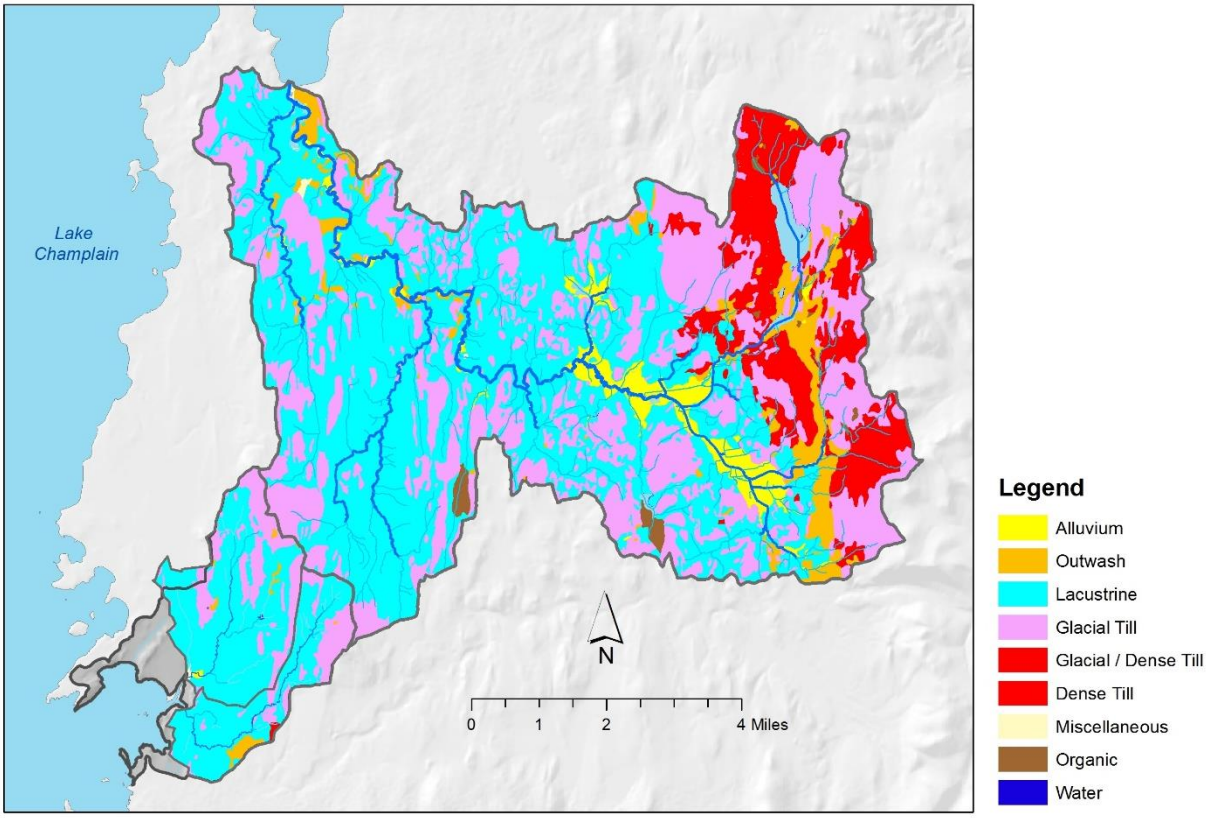

Figure D-1. Distribution of Soils, by Parent Material, in the SCRW watersheds.

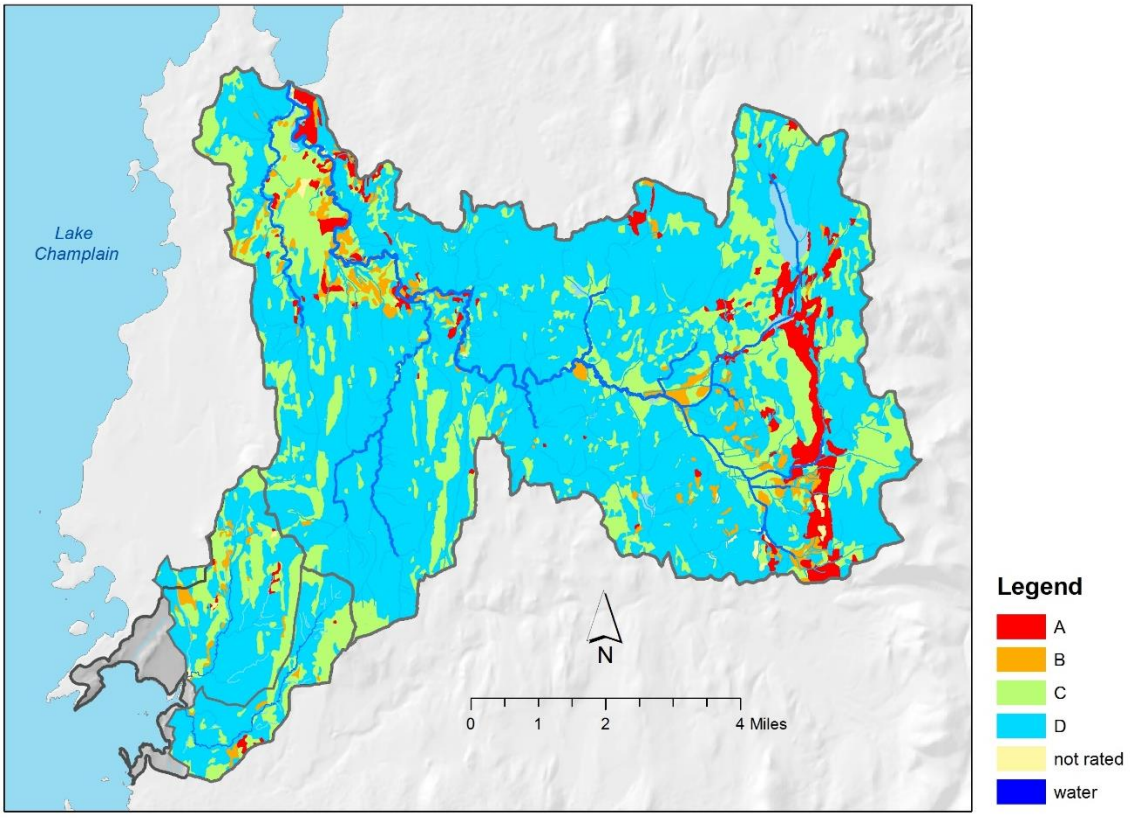

Figure D-2. Distribution of Soils, by Hydrologic Soil Group, in the SCRW watersheds.

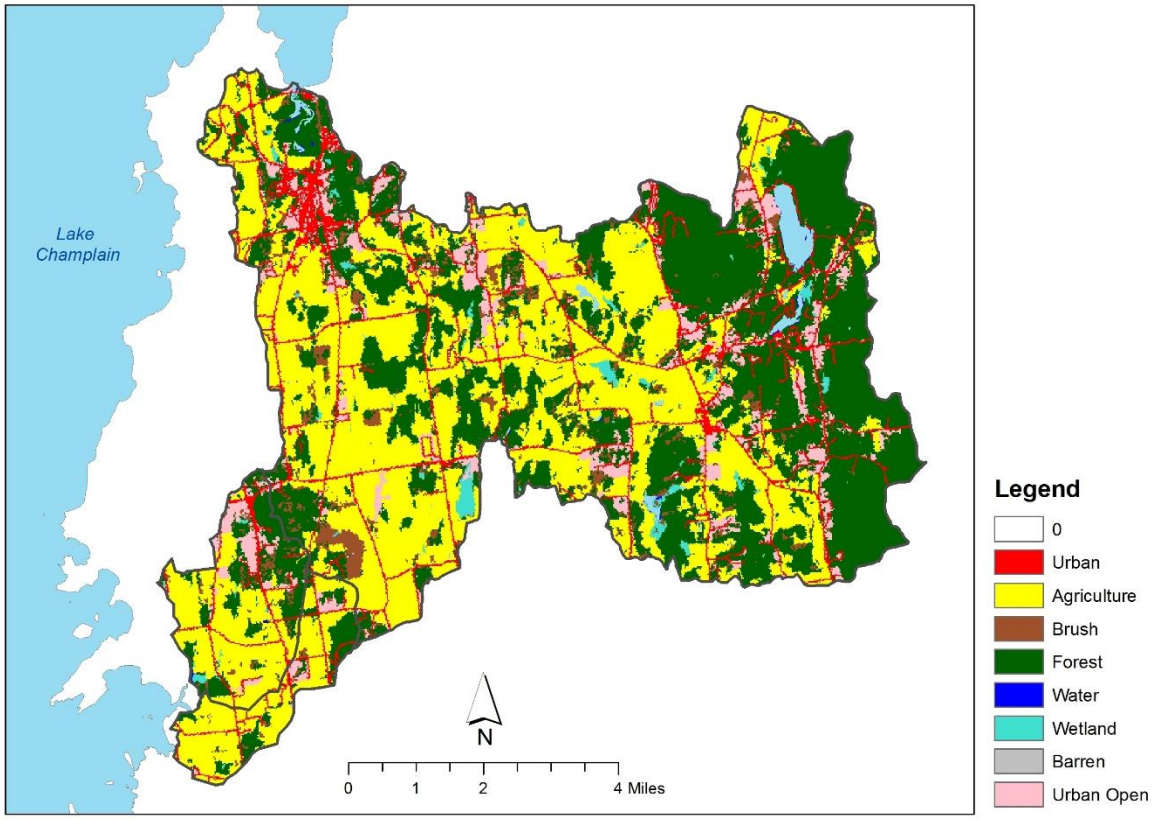

Figure D-3. Distribution of Land Cover / Land Use in the SCRW watersheds (source date: 2001).