

**Missisquoi Bay Basin Project:
Identifying Critical Source Areas of Pollution**

***Short-term Tributary Monitoring Program
Interim Report
November 15, 2010***

Project Status

The first full season of short-term tributary water quality monitoring conducted by the Lake Champlain Basin Program (LCBP) began on March 22, 2010. LCBP staff has sampled five tributaries in the Missisquoi Bay Basin – Hungerford Brook, Black Creek, Tyler Branch, Trout River, and Mud Creek – in accordance with the approved Quality Assurance Project Plan (QAPP) for this project (see appended map for locations). LCBP staff will continue sampling until early winter of 2010, when the tributaries freeze. To date in 2010, 12 high-flow (storm event) and 4 low-flow (base flow) samples were collected at each site and analyzed for: water temperature, pH, conductivity, alkalinity, total and dissolved phosphorus, total nitrogen, total suspended solids, chloride, and earth metals (sodium, magnesium, potassium, calcium, and total calculated hardness). Additionally, 38 samples were collected from an automated sampler (ISCO) installed at Hungerford Brook and analyzed for total phosphorus and suspended solids. LCBP staff also collected one base-flow sample at each site on December 18, 2009. See Appendix A for a list of sampling dates and collection types.

As part of the sampling protocol, 8 field quality control (QC) samples were collected and analyzed for all parameters. According to the QAPP, “Field QC samples [should] represent approximately 10% of the water and biological collections made.” A total of 85 high- and low- flow samples have been collected, so QC samples are well within that range.

LCBP staff also collaborated with staff of the Québec Ministère du Développement durable, de l'Environnement et des Parcs (QCMDDEP) in order to compare laboratory testing results. Partners met in Highwater, Québec on September 8, 2010 to split samples that each group had collected from sampling sites in the Missisquoi Bay Basin; these samples were submitted to the Vermont and Québec laboratories for analyses of total suspended solids and total phosphorus. Samples were representative of low-flow conditions and results from these analyses will be evaluated in terms of relative percent difference to identify discrepancies between the two laboratories. Sample splits from a high-flow event will be collected in spring 2011 to identify laboratory discrepancies at higher flows.

Monitoring Data

All collected samples were submitted to the State of Vermont Department of Environmental Conservation LaRosa Environmental Laboratory (Lab) within their specified hold times, as required by the Lab and the approved QAPP for this project. Samples are analyzed by the Lab for alkalinity, total and dissolved phosphorus, total nitrogen, total suspended solids, chloride, and earth metals. LCBP staff measures the temperature, pH, and conductivity of each sample before submittal to the Lab.

To date, the Lab has finalized results for all samples collected prior to September 1, 2010 (Appendix B); all other results will be submitted to the LCBP upon completion and approval by the Laboratory Director. Four of the ISCO samples were analyzed for total suspended solids out of their accepted hold times, so these data will be flagged in any future analyses as suspect. Few data are currently available for a rigorous statistical

analysis; a complete data analysis will be provided with the final report for this project, per the contractual requirements.

Challenges Encountered

The QAPP states that “Water quality samples will be taken following precipitation events with a target of 20 high-flow total phosphorus samples per year. In addition, 4 low-flow total phosphorus samples will be taken each year.” The high-flow target has been challenging to meet due to the lack of large storm events this year, as well as their timing. LCBP staff is working to collect additional storm events before the tributaries freeze when precipitation events occur, but it is unlikely that the target of 20 sampling dates will be met. The low-flow target has been met for 2010.

The QAPP also recommends a target for automated sample collection: “The United States Geological Survey (USGS) will install an automated sampler (ISCO) on Hungerford Brook... A total of 40 samples per year will be collected between the months of March and November.” To date, 38 samples have been collected for analysis, so it is likely that this target will be met before the end of November. The ISCO was initially programmed on April 15, 2010 to begin collecting samples after the stage level reached 2.0 ft; on July 2, 2010 this program was changed to a 1.0 sample threshold level to allow samples collection during smaller storm events over the drier summer months (Figure 1).

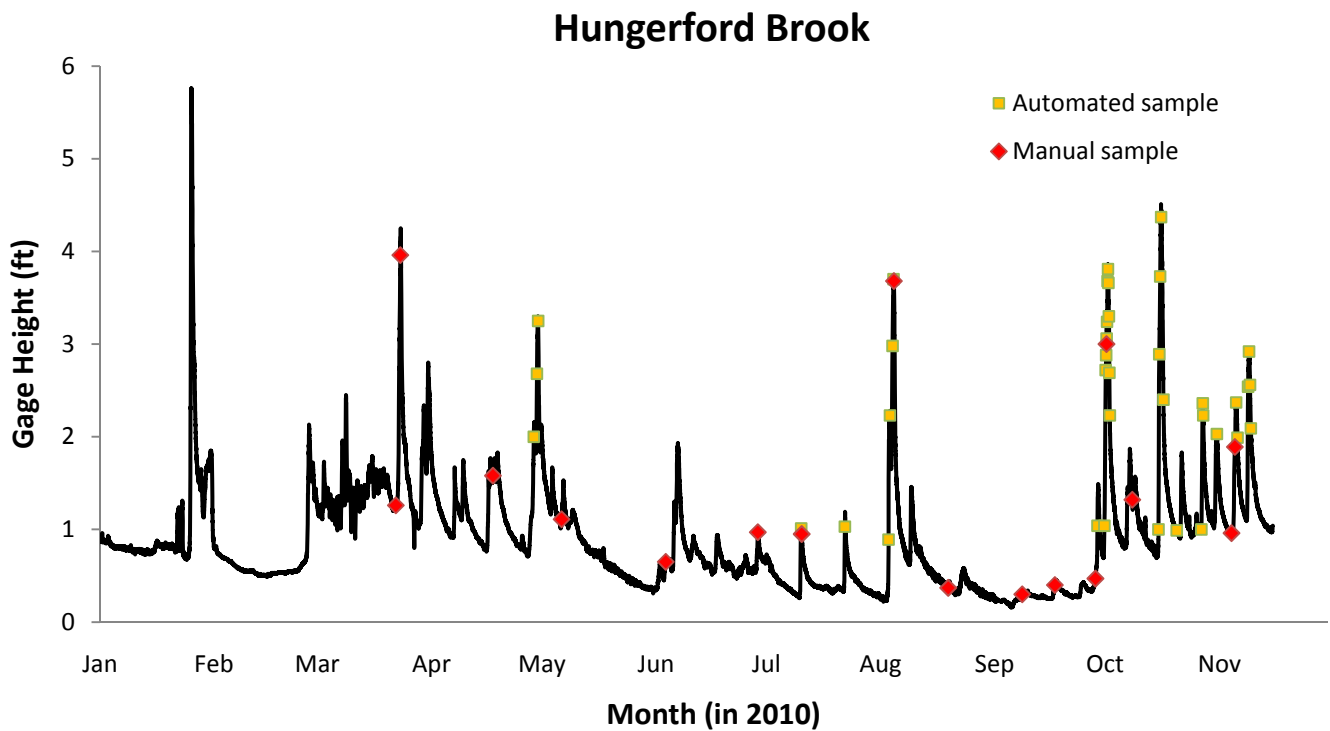


Figure 1. Hungerford Brook hydrograph for 2010 (through November 15, 2010) with manual and automated sample collection dates.

Appendix A

Summary of the Short-term Tributary Monitoring Program collection events as of November 15, 2010. "Date collected" refers to the date the sample was collected from the tributary (for ISCO samples this refers to the date LCBP staff removed the sample(s) from the ISCO). Low-flow events represent seasonal base flow and high-flow events represent seasonal storms. The ISCO is the automated sampler installed at Hungerford Brook; it often collects multiple samples during a single storm event.

Date Collected	Low-flow	High-flow	ISCO (# samples)
12/18/2009	1		
3/22/2010	1		
3/23/2010		1	
4/17/2010		1	
4/29/2010			2
5/6/2010		1	1
6/3/2010		1	
6/28/2010		1	
7/10/2010		1	1
7/28/2010			1
8/4/2010		1	4
8/19/2010	1		
9/8/2010	1		
9/17/2010		1	
9/28/2010		1	
10/1/2010		1	4
10/6/2010			8
10/8/2010		1	
10/20/2010			6
11/2/2010			5
11/4/2010	1		
11/5/2010		1	
11/10/2010			6
TOTAL	5	12	38

Appendix B.

Summary of water chemistry results for high-flow (Table 1), low-flow (Table 2), and automated ISCO samples (Table 3) collected through September 1, 2010.

Table 1. Mean and standard deviation of high-flow water chemistry results (n=7, through September 1, 2010).

Tributary, Analyte	Mean	SD
Black Creek		
Alkalinity (mg CaCO ₃ /L)	44.39	14.29
Calcium (mg/L)	14.94	5.01
Chloride (mg/L)	5.05	1.81
Magnesium (mg/L)	2.34	0.59
Nitrogen, Total	0.94	0.48
Phosphorus, Filtered (ug P/L)	53.79	48.49
Phosphorus, Total (ug P/L)	217.01	214.69
Potassium (mg/L)	2.18	1.15
Sodium (mg/L)	3.76	1.12
Solids, Total Suspended (mg/L)	59.84	94.29
Total Calculated Hardness (mg/L)	46.96	14.94
Hungerford Brook		
Alkalinity (mg CaCO ₃ /L)	116.51	40.04
Calcium (mg/L)	40.59	13.90
Chloride (mg/L)	22.97	8.72
Magnesium (mg/L)	7.10	2.35
Nitrogen, Total	2.90	2.17
Phosphorus, Filtered (ug P/L)	101.59	85.88
Phosphorus, Total (ug P/L)	306.11	295.01
Potassium (mg/L)	5.13	2.77
Sodium (mg/L)	14.98	5.34
Solids, Total Suspended (mg/L)	49.62	59.92
Total Calculated Hardness (mg/L)	130.70	44.37
Mud Creek		
Alkalinity (mg CaCO ₃ /L)	34.33	15.41
Calcium (mg/L)	9.88	3.67
Chloride (mg/L)	7.27	3.34
Magnesium (mg/L)	3.88	1.55
Nitrogen, Total	1.62	1.13
Phosphorus, Filtered (ug P/L)	80.84	43.57
Phosphorus, Total (ug P/L)	198.40	107.46
Potassium (mg/L)	2.52	1.15
Sodium (mg/L)	4.87	1.94
Solids, Total Suspended (mg/L)	48.35	32.66
Total Calculated Hardness (mg/L)	40.63	15.55

Trout Brook

Alkalinity (mg CaCO ₃ /L)	8.83	3.45
Calcium (mg/L)	4.48	0.76
Chloride (mg/L)	2.24	0.33
Magnesium (mg/L)	0.69	0.12
Nitrogen, Total	0.41	0.12
Phosphorus, Filtered (ug P/L)	10.25	4.20
Phosphorus, Total (ug P/L)	118.67	108.34
Potassium (mg/L)	0.36	0.05
Sodium (mg/L)	1.40	0.53
Solids, Total Suspended (mg/L)	81.57	103.41
Total Calculated Hardness (mg/L)		

Tyler Branch

Alkalinity (mg CaCO ₃ /L)	22.60	9.17
Calcium (mg/L)	8.40	2.68
Chloride (mg/L)	2.67	0.95
Magnesium (mg/L)	1.29	0.39
Nitrogen, Total	0.79	0.22
Phosphorus, Filtered (ug P/L)	21.94	8.02
Phosphorus, Total (ug P/L)	139.69	112.96
Potassium (mg/L)	1.06	0.26
Sodium (mg/L)	1.98	0.83
Solids, Total Suspended (mg/L)	61.96	72.21
Total Calculated Hardness (mg/L)	26.30	8.27

Table 2. Mean and standard deviation of low-flow water chemistry results (n=4, through September 1, 2010).

Tributary, Analyte	Mean	SD
Black Creek		
Alkalinity (mg CaCO ₃ /L)	50.13	20.61
Calcium (mg/L)	16.86	6.64
Chloride (mg/L)	5.56	1.40
Magnesium (mg/L)	2.60	0.91
Nitrogen, Total - Persulfate	0.47	0.13
Phosphorus, Filtered (ug P/L)	23.15	5.59
Phosphorus, Total (ug P/L)	40.65	7.79
Potassium (mg/L)	1.33	0.32
Sodium (mg/L)	4.21	1.26
Solids, Total Suspended (mg/L)	5.91	2.63
Total Calculated Hardness (mg/L)	52.78	20.33
Hungerford Brook		
Alkalinity (mg CaCO ₃ /L)	137.00	30.58
Calcium (mg/L)	46.65	10.90

Chloride (mg/L)	28.85	7.99
Magnesium (mg/L)	9.08	2.07
Nitrogen, Total - Persulfate	1.83	0.79
Phosphorus, Filtered (ug P/L)	35.58	7.39
Phosphorus, Total (ug P/L)	64.08	7.84
Potassium (mg/L)	4.04	1.42
Sodium (mg/L)	18.93	5.72
Solids, Total Suspended (mg/L)	9.85	6.90
Total Calculated Hardness (mg/L)	154.00	33.60

Mud Creek

Alkalinity (mg CaCO3/L)	53.68	26.06
Calcium (mg/L)	13.61	5.93
Chloride (mg/L)	10.79	5.48
Magnesium (mg/L)	5.77	2.72
Nitrogen, Total - Persulfate	0.47	0.15
Phosphorus, Filtered (ug P/L)	29.50	5.04
Phosphorus, Total (ug P/L)	36.33	1.35
Potassium (mg/L)	1.67	0.60
Sodium (mg/L)	7.30	3.62
Solids, Total Suspended (mg/L)	2.88	1.65
Total Calculated Hardness (mg/L)	57.78	26.02

Trout Brook

Alkalinity (mg CaCO3/L)	18.88	9.06
Calcium (mg/L)	7.56	2.33
Chloride (mg/L)	4.52	1.75
Magnesium (mg/L)	1.18	0.34
Nitrogen, Total - Persulfate	0.46	0.08
Phosphorus, Filtered (ug P/L)	6.27	0.80
Phosphorus, Total (ug P/L)	8.97	2.75
Potassium (mg/L)	0.58	0.24
Sodium (mg/L)	3.29	1.24
Solids, Total Suspended (mg/L)	1.78	1.13
Total Calculated Hardness (mg/L)	23.75	7.23

Tyler Branch

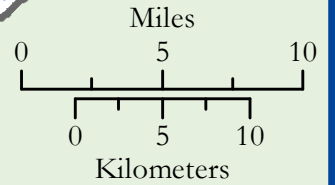
Alkalinity (mg CaCO3/L)	40.05	17.35
Calcium (mg/L)	14.68	5.55
Chloride (mg/L)	6.04	2.68
Magnesium (mg/L)	2.22	0.77
Nitrogen, Total - Persulfate	0.82	0.23
Phosphorus, Filtered (ug P/L)	8.91	1.41
Phosphorus, Total (ug P/L)	14.80	4.39
Potassium (mg/L)	1.20	0.41
Sodium (mg/L)	4.23	1.84
Solids, Total Suspended (mg/L)	2.60	2.54
Total Calculated Hardness (mg/L)	45.85	17.05

Table 3. Mean and standard deviation of total phosphorus and total suspended solids samples collected from the automated sampler (n=9, through September 1, 2010).

Analyte	Mean	SD
Phosphorus, Total (ug P/L)	461.33	223.00
Solids, Total Suspended (mg/L)	157.50	126.25

Missisquoi Bay Basin

Short-term Monitoring Program Sites



- Short-term Monitoring Program water quality sampling with USGS flow gage
- ✕ Short-term Monitoring Program USGS flow gage
- Short-term Monitoring Program USGS weather station
- Existing NOAA weather station
- Major waters
- - - Sub-basin bounds (HUC12)

Sources: Geobase, NOAA, USGS, VCGI

