2007 WATER QUALITY MONITORING REPORT

by Hilary Solomon
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2007 Water Quality Monitoring Report
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Introduction

The Poultney Mettowee Watershed Partnership (PMWP) in conjunction with the Poultney Mettowee Natural Resources Conservation District (PMNRCD) collected water quality samples at 18 sites between June and August, 2007. The samples were collected by both staff and volunteers and analyzed by the Vermont Department of Environmental Conservation's (DEC) LaRosa Environmental Lab (LaRosa) in Waterbury, VT, as part of their Volunteer Water Quality Monitoring Laboratory Services Partnership grant program.

Funding for this year's water quality monitoring program was provided through a Lake Champlain Basin Program Organization Support Grant and a Vermont DEC Watershed Grant. This funding was essential to our program's success.

This summer, with the help of our Green Mountain College interns Mara Smith and Irene Hollak, the Poultney Mettowee Watershed Partnership monitored five streams in the watershed. We sampled the Poultney River for the fifth year in a row; the Mettowee River, Flower Brook, and Beaver Brook were sampled for the third year, and the Castleton River was sampled for the second year.

Scientists at LaRosa analyzed the water samples for *E. coli*, turbidity and total phosphorus. *E. coli* tests measure the number of bacterial colonies in the water sample, while turbidity is a measure of water clarity (or conversely sediment levels) in the water and total phosphorus indicates the nutrient levels in the water.

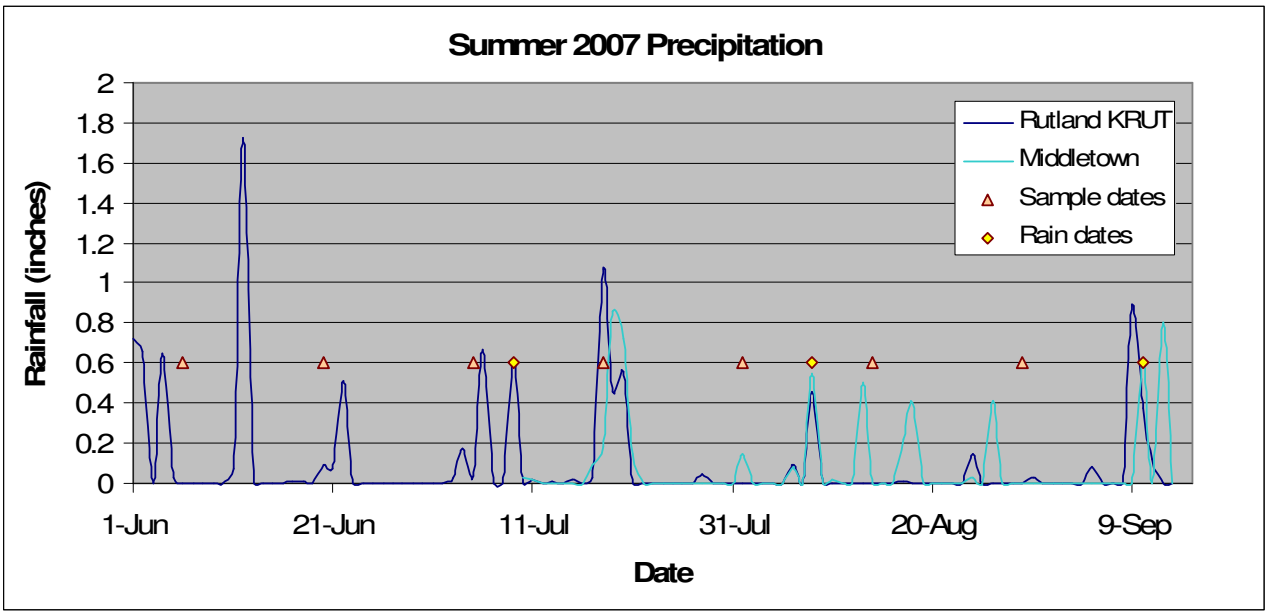
The PMWP collected samples every other Wednesday beginning June 6 and ending on August 29th. These samples were collected on scheduled days, based on the lab availability, and as a result were not always collected at times that provided the most information. Because the 2006 sample dates were often during the receding flows resulting from heavy rains, we decided to add three flexible sample dates based on rainfall levels (in hope of catching the rising waters after a storm, or we guessed most concentrated pollution). These storm dates occurred on July 9, August 8 and September 9th.

The results of the samples collected during storm dates were slightly different than expected. The *E. coli* concentrations were higher during rainfall events; however total phosphorus and turbidity did not differ markedly. Unfortunately, since the Poultney, Mettowee, and Castleton Rivers all appear to be more turbid (and sediment carries phosphorus) after rainfall events, we can only conclude that our study was not comprehensive enough to capture those concentrated flows. In addition, some of our normal samples were during or after rain events and may have had slightly elevated turbidity and total phosphorus levels, making a comparison between rain dates and normal monitoring dates less significant.

Precipitation

This year there were a number of rainfall events that affected our sampling program. As seen in the graph below, our sample dates occurred before, during, and after rainfall events. These conditions varied from last year, when most of the sample dates were several days after rainfall events. The variety of conditions seen this year allows us to look at the impact of rainfall (and overland contributions) on our sample results. Though we saw a variety of rainfall conditions, it is difficult to tell from the rainfall data, when in the 24-hour period the rains came as compared to our sample times, which are between 7 and 9 am.

Graph 1: Precipitation measured at the Rutland Airport (KRUT) (as reported on Weather Underground) and by a private gage in Middletown Springs.

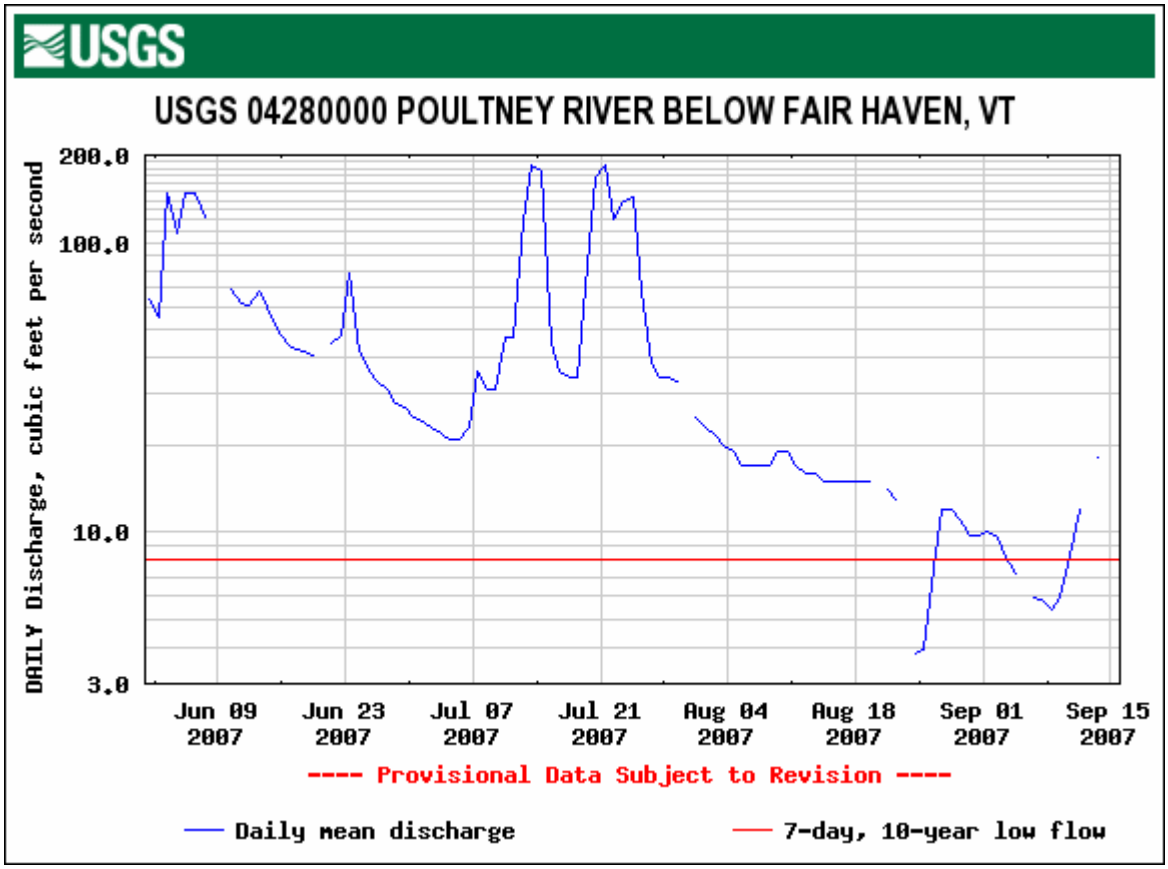


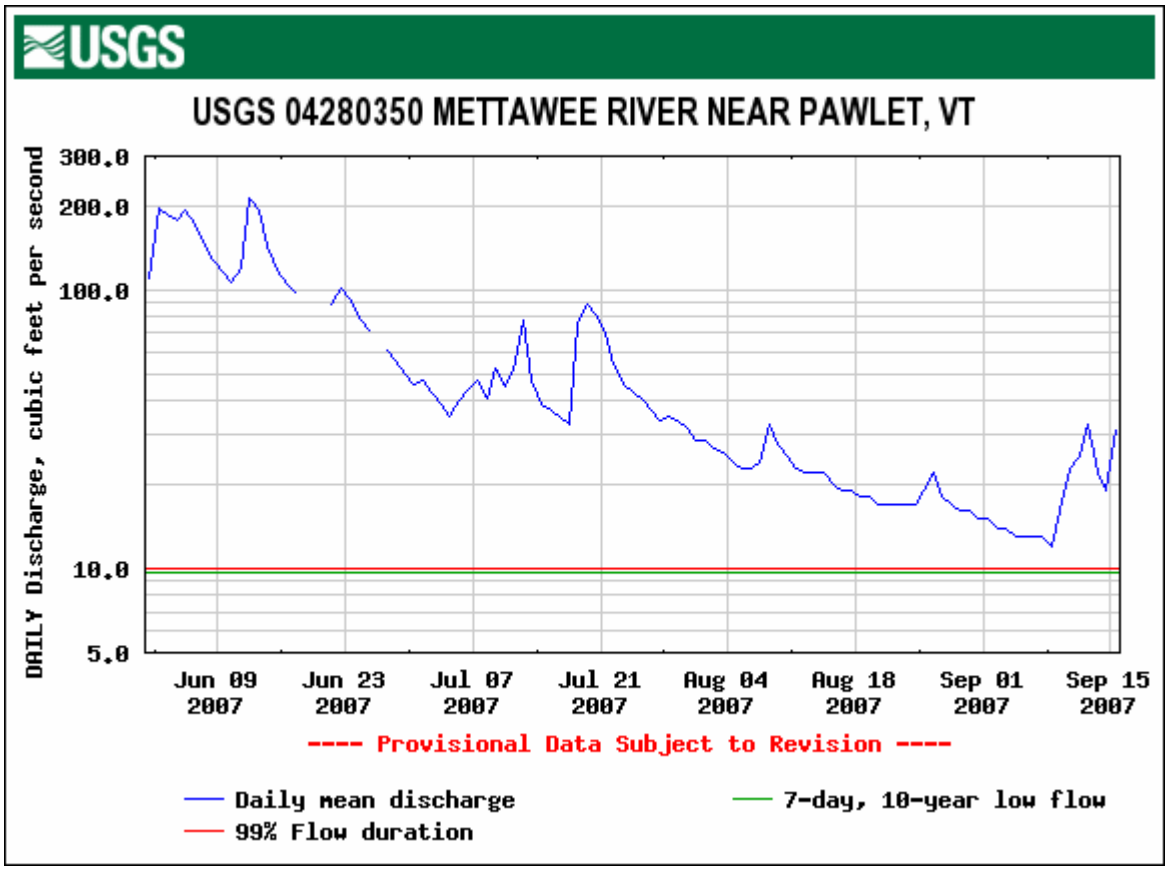
Flow Data

The following graphs contain US Geologic Survey (USGS) Flow Data for two gage stations in our watershed. The first graph shows flow data for the Poultney River recorded at the USGS station downstream of Fair Haven, VT. The second graph consists of flow data recorded at the USGS station on the Mettowee River at Bette's Bridge in Pawlet, VT.

Graph 2: Poultney River flow data (June 1 to September 15, 2007).

Graph 3: Mettowee River flow data (June 1 to September 15, 2007).


USGS
USGS 04280000 POULTNEY RIVER BELOW FAIR HAVEN, VT
DAILY Discharge, cubic feet per second
200.0
100.0
10.0
3.0
Jun 09 2007
Jun 23 2007
Jul 07 2007
Jul 21 2007
Aug 04 2007
Aug 18 2007
Sep 01 2007
Sep 15 2007
---- Provisional Data Subject to Revision ----
Daily mean discharge
7-day, 10-year low flow


USGS
USGS 04280350 METTAWEE RIVER NEAR PAWLET, VT
DAILY Discharge, cubic feet per second
300.0
200.0
100.0
10.0
5.0
Jun 09 2007
Jun 23 2007
Jul 07 2007
Jul 21 2007
Aug 04 2007
Aug 18 2007
Sep 01 2007
Sep 15 2007
---- Provisional Data Subject to Revision ----
Daily mean discharge
7-day, 10-year low flow
99% Flow duration

E. coli

Table 1: E. coli data for the 2007 sampling season.

Site	6-Jun	20-Jun	5-Jul	9-Jul	18-Jul	1-Aug	8-Aug	14-Aug	29-Aug	10-Sep
PR01	96	114	33	99	78	47	326	64	48	816
PR02	272	285	365		816	517		921	344	
PR03	179	261	613		345	241		231	142	
PR05	172	238	308		160	114		210	32	
PR06	185	501	291		147	365		93	152	
PR07	186	866	435		248	153		387	76	
PR08	1050	613	649	770	261	326	1050	1200	201	1410
Mett01.5	140	276	111	613	192	185	816	114	37	236
Mett02	162	517	156		125	248		118	238	
Mett02.5	308	649	345		488	326		276	199	
Mett03	326	1550	517	1990	517	411	2420	291	285	921
Flower01	206	1120	687		727	1050		517	687	
Beaver01	185	727	980		248	162		291	88	
CA01	214	488	326		866	613		186	193	
CA02	921	461	236		291	238		135	127	
CA03	260	727			435	291			50	
CA05	261	548	365	517			866			308
CA06	461	548	387	649	152	124	579	866	411	461

= above Vermont *E. coli* standard
= above Vermont and US EPA *E. coli* standards

Guidelines or standards for *E. coli* levels in streams fall under jurisdiction of State and Federal regulations. Vermont's Water Quality Standard for single samples collected from the rivers and streams similar to those found in our watershed is 77 colonies of *E. coli* per 100 ml of water. This number is one of the most protective of human health in the country (more information about the Vermont state standard can be found on our website (www.poutneymettowee.org) or the Vermont DEC website (http://www.anr.state.vt.us/dec/waterq/htm/wq_monitoring.htm). Please refer to the *Citizen's Guide to Bacteria Monitoring in Vermont Waters).* The US EPA standard for like waterbodies is set at 235 *E. coli* colonies per 100 ml of water. Vermont is governed by the more stringent 77 colonies per 100 ml of water; however, the US EPA standard can be used as a secondary benchmark against which to compare our results.

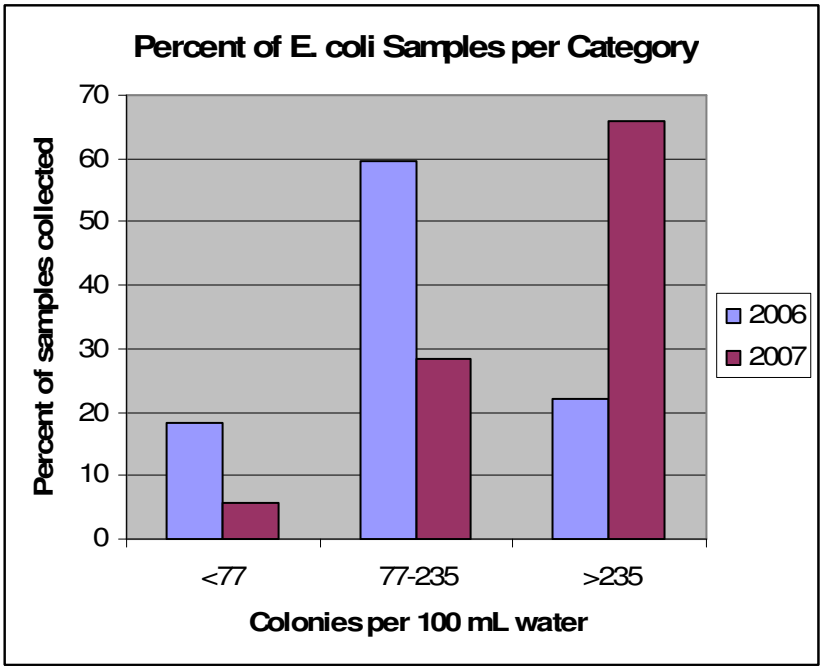
Sample dates were broken into two categories for the sake of the *E. coli* results. The first set of dates were the regularly scheduled bi-weekly sample dates. The second set of dates specifically targeted rain events. For *E. coli* results the two groups of samples showed significantly different results with higher levels of *E. coli* in the water during the rain dates.

This year the majority of samples were above both the Vermont and the US EPA Water Quality Standard for coliform concentrations. Of the 138 samples collected this season, only EIGHT samples (6%) were below Vermont's *E. coli* Water Quality Standard. Thirty-nine samples (28%) were above the Vermont standard and 91 samples (66%) were above both the Vermont standard and the US EPA standard.

All of the sites monitored regularly exceeded both the Vermont and the US EPA Water Quality Standards for *E. coli* concentration.

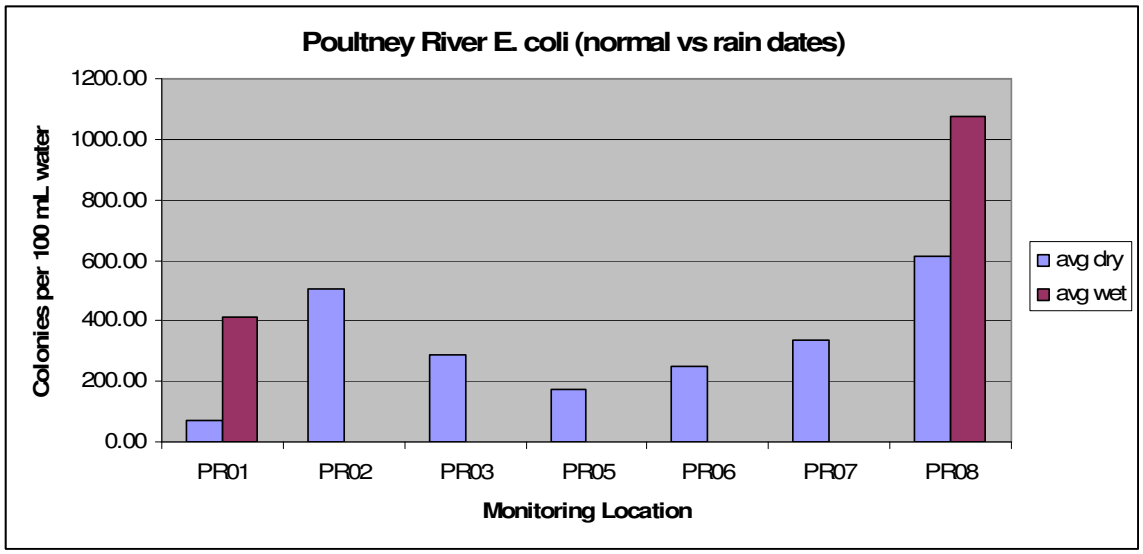
Geometric mean *E. coli* concentrations are used as longer-term indicators of systemic contamination. Vermont considers waters impaired for swimming use where geometric mean *E. coli* concentrations exceed 77 E. coli colonies per100ml for two or more years, based on five or more samples per year. Vermont considers the flow regime under which the samples were collected in determining impairment (Kamman, 2006). In 2006, the geometric mean (for all compiled data) was exceeded at all but three sites (PR02, PR06, Mett1.5). In 2007, the geometric mean for all sites exceeded 77 E. coli colonies per 100 ml of water. Adding the data for 2007 to all of the other data collected and taking the geometric mean finds that only PR01 and Mett01 (only one year of data for this site) do not exceed the Vermont Standard.

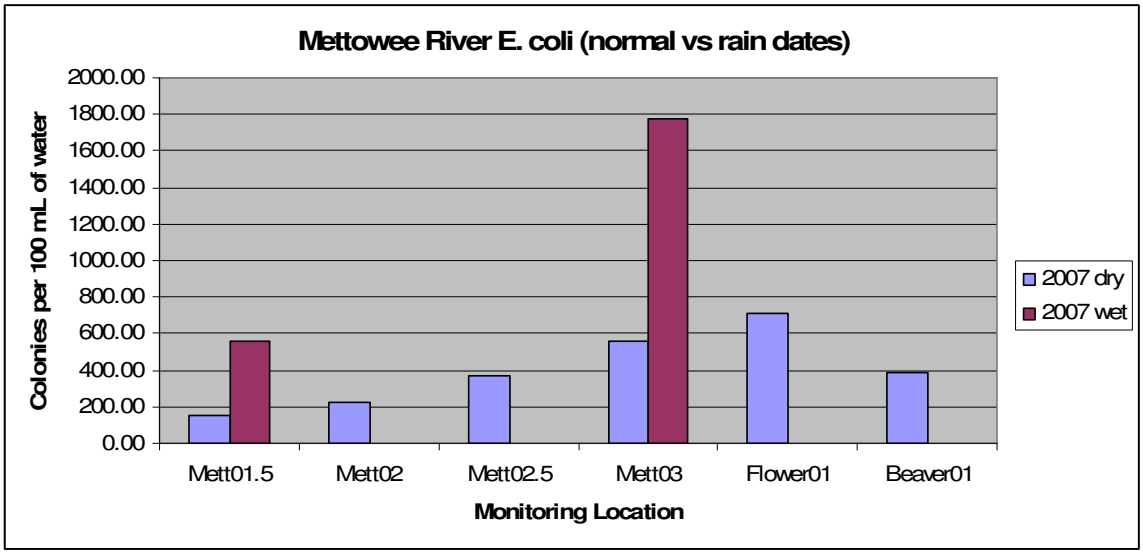
Graph 4: Comparison of the percent of samples meeting both standards, exceeding the Vermont standard, or exceeding both standards between 2006 and 2007.

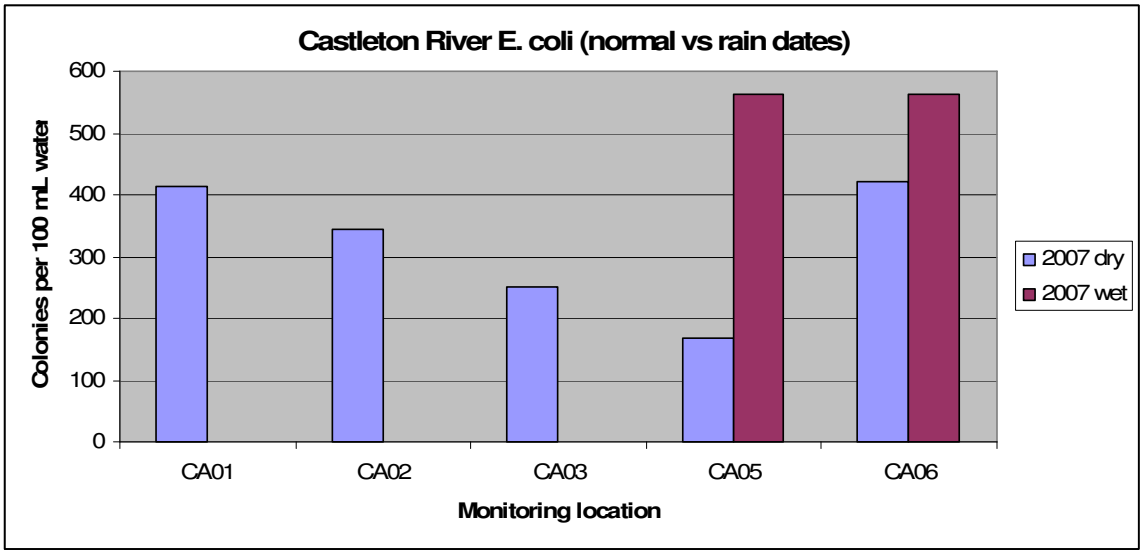


The above graph illustrates the increased levels of *E. coli* measured this year as compared to last year. Though many sites were above the Vermont standard last year, this year far more sites were above both the Vermont and US EPA standards. The heightened *E. coli* levels seen in the waters this year are likely correlated to the increased number of sample dates that corresponded to rainfall events.

Graphs 5-8: E. coli results for the Poultney, Mettowee and Castleton Rivers. Graphs depict scheduled sample dates (every other Wednesday) and additional storm sample dates.


Poultney River E. coli (normal vs rain dates)
Colonies per 100 mL water
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
PR01
PR02
PR03
PR05
PR06
PR07
PR08
Monitoring Location
avg dry
avg wet


Mettowee River E. coli (normal vs rain dates)
Colonies per 100 mL of water
2000.00
1800.00
1600.00
1400.00
1200.00
1000.00
800.00
600.00
400.00
200.00
0.00
Mett01.5
Mett02
Mett02.5
Mett03
Flower01
Beaver01
Monitoring Location
2007 dry
2007 wet


Castleton River E. coli (normal vs rain dates)
Colonies per 100 mL water
600
500
400
300
200
100
0
CA01
CA02
CA03
CA05
CA06
Monitoring location
2007 dry
2007 wet

Total Phosphorus

Table 2: Total Phosphorus results for the 2007 sampling season.

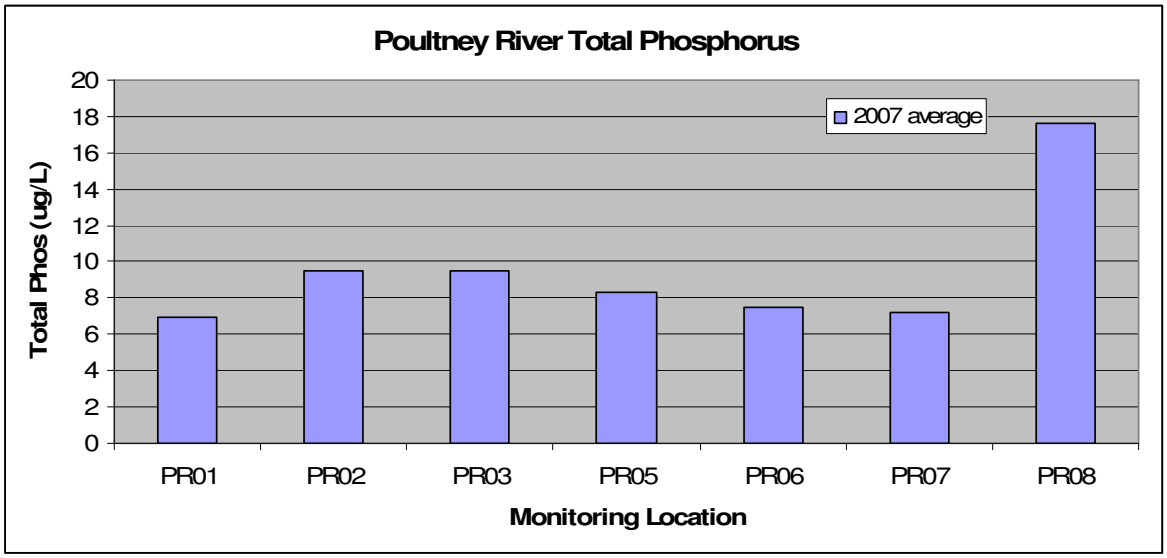
Site	6-Jun	20-Jun	5-Jul	9-Jul	18-Jul	1-Aug	8-Aug	14-Aug	29-Aug	10-Sep
PR01	7.62	7.22	8.56	9.72	6.84	5.56	8.54	5.61	<5	<5
PR02	7.97	10.9	10.2		11.8	9.01		9.54	7.2	
PR03	7.86	12.2	8.49		11.6	8.42		9.31	8.34	
PR05	10.5	12.3	5.71		10.1	6.24		7.34	6.23	
PR06	6.3	7.43	6.41		10.5	5.8		6.91	9.31	
PR07	6.09	7.12	6.32		7.68	11.7		6.32	<5	
PR08	24.8	22	18.4	16.6	7.7	11.9	15.7	20	15.9	23.3
Mett01.5	11.1	10.2	6.68	13.1	7.08	5.13	12.2	<5	<5	<5
Mett02	13.6	13.5	7.4		7.21	5.71		5.32	<5	
Mett02.5	15.6	14.6	9.29		9.28	6.42		6.77	5.06	
Mett03	14.9	17.7	8.59	12.2	7.94	6.8	14.6	6.8	5.65	7.49
Flower01	10.8	13.4	8.07		11.3	9.38		10.1	6.92	
Beaver01	14	25	17.1		19.1	31.6		13.8	9.97	
CA01	22.8	28.8	20.8		26	20.8		20.9	16.1	
CA02	36.3	45.4	35.9		41.8	60.6		43.9	24.8	
CA03	19.9	49.2	<5		16	10.7		<5	20.9	
CA05	35.8	53	21.6	23.9	15.3	16	20.1	23.3	16.7	30.2
CA06	26.5	28.5	21.1	27.6	21.6	19.7	21.1	28.1	22.1	23.8

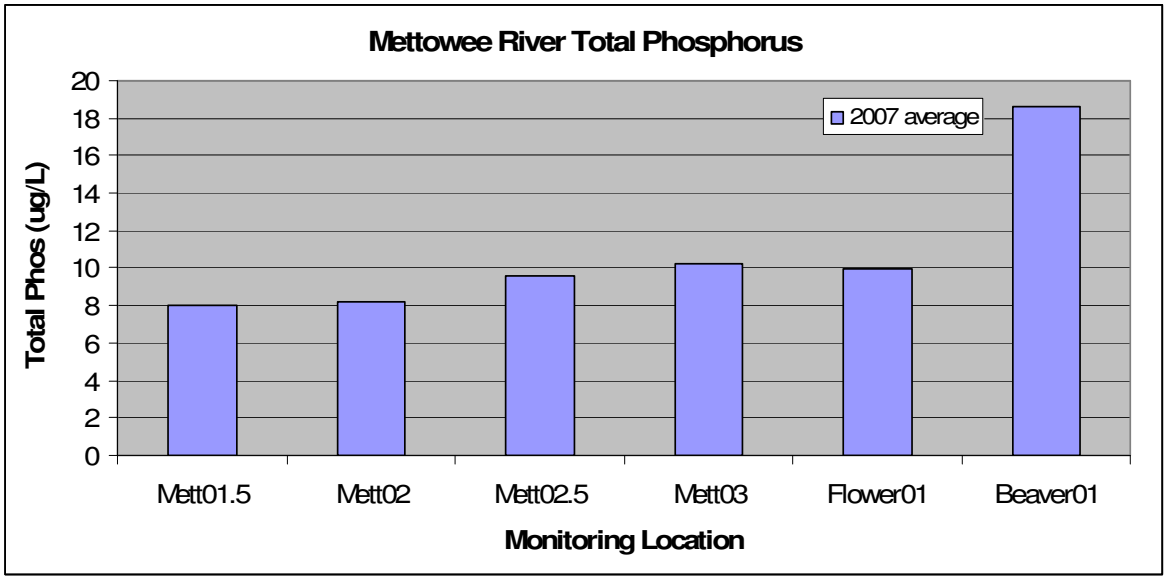
According to Vermont DEC's Neil Kamman, "There is no specific criterion for TP in streams, except for streams ≥2,500 ft (nominally Class A{1}), where the criterion is 10ppb at low monthly median flow. Otherwise, the standard is that: "...loadings shall be limited so that they will not contribute to the acceleration of eutrophication or stimulation of the growth of aquatic biota in a manner that prevents the full support of uses."" (Personal communication, December 2006; Vermont WQS, http://www.nrb.state.vt.us/wrp/publications/wqs.pdf)

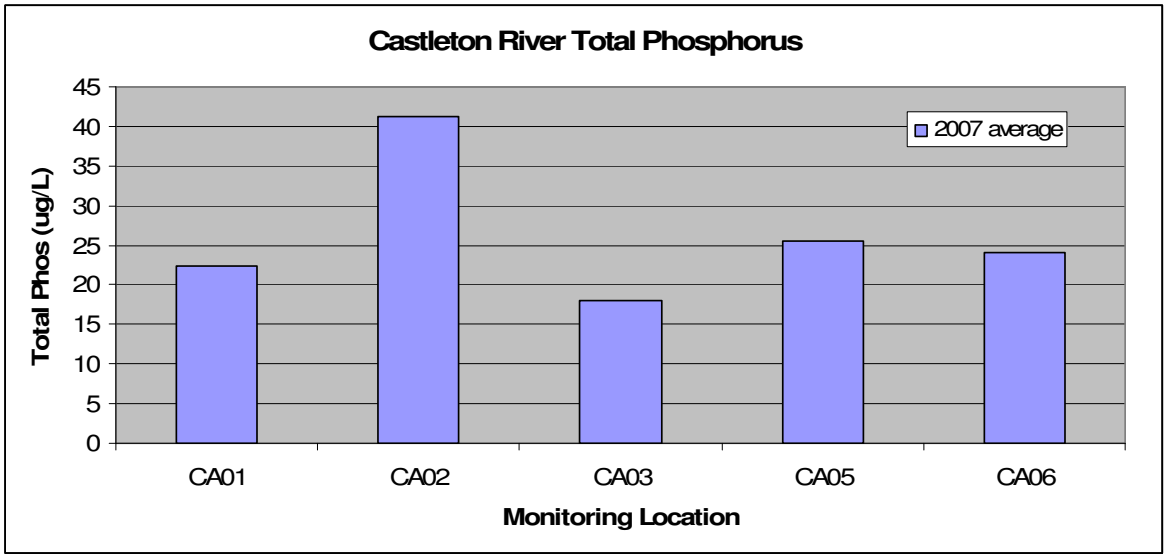
The Vermont Water Quality Standards set 54 ppb as a goal for the South Lake B section of Lake Champlain (LCBP, http://www.lcbp.org/Atlas/HTML/is_pintro.htm). The PMWP has in the past used both 25 ppb and 10 ppb as goals for the rivers in our watershed. For the Poultney River and the Mettowee River which have cobble and gravel as bottom substrates, we generally see Total Phosphorus measurements near the 10 ppb goal. For the Castleton and Hubbardton Rivers, which have clay and silt as bottom substrates (phosphorus bonds with clay and sediment), we expect higher Total Phosphorus levels.

The Total Phosphorus results for the normal sample dates compared to the rain dates were not significantly different. This is likely due to the fact that the rainfall during the rain events was not enough to cause an increase in TP. The TP levels may also be affected by other factors, such as spring runoff and rain frequency, such that some of the normal sample dates were slightly elevated. It is important to note that several of the normal sample dates were during or shortly after rain events. Additionally, none of the sampling events captured extremely turbid flows, which have been documented within the watershed.

Graphs 9-11: Total phosphorus data for the Poultney, Mettowee and Castleton Rivers (averaged for all dates collected this year).


Poultney River Total Phosphorus
Total Phos (ug/L)
20
18
16
14
12
10
8
6
4
2
0
2007 average
PR01
PR02
PR03
PR05
PR06
PR07
PR08
Monitoring Location


Mettowee River Total Phosphorus
Total Phos (ug/L)
20
18
16
14
12
10
8
6
4
2
0
2007 average
Mett01.5
Mett02
Mett02.5
Mett03
Flower01
Beaver01
Monitoring Location


Castleton River Total Phosphorus
Total Phos (ug/L)
45
40
35
30
25
20
15
10
5
0
2007 average
CA01
CA02
CA03
CA05
CA06
Monitoring Location

Turbidity

Table 3: Turbidity results for the 2007 sampling season.

Site	6-Jun	20-Jun	5-Jul	9-Jul	18-Jul	1-Aug	8-Aug	14-Aug	29-Aug	10-Sep
PR01	0.52	0.36	0.52	0.38	<0.2	<0.2	0.32	0.21	<0.2	0.66
PR02	0.76	1	0.72		0.75	0.74		0.71	<0.2	
PR03	2.1	0.64	0.29		0.99	0.25		0.72	0.38	
PR05	0.4	1.04	0.37		0.45	0.33		0.57	0.33	
PR06	0.67	0.63	0.65		0.57	0.77		0.44	0.29	
PR07	0.72	0.65	0.61		0.34	0.36		0.4	0.23	
PR08	3.44	3.02	3.77	3.97	0.41	1.45	1.9	3.65	1.71	
Mett01.5	2.51	1.54	0.49	2.73	0.7	0.35	1.52	0.32	0.24	0.37
Mett02	2.06	1.61	0.46		0.3	0.69		0.27	0.3	
Mett02.5	1.96	2.42	0.38		0.84	0.5		0.57	0.65	
Mett03	1.46	3.27	0.65	1.82	0.54	0.97	0.81	0.64	0.63	0.61
Flower01	1	1.99	0.9		0.96	0.94		1.24	0.65	
Beaver01	0.96	2.22	1.13		1.49	2.5		1.15	0.65	
CA01	2.14	2.67	2.26		2.18	1.9		2	1.27	
CA02	5.72	5.37	5.56		5.07	4.06		3.59	2.09	
CA03	3.34	3.04			1.28	1.53				
CA05	2.03	2.95	2.52	1.9			1.38			1.55
CA06	2.54	3.27	2.49	3.79	3.13	2.17	2	2.41	1.68	2.46

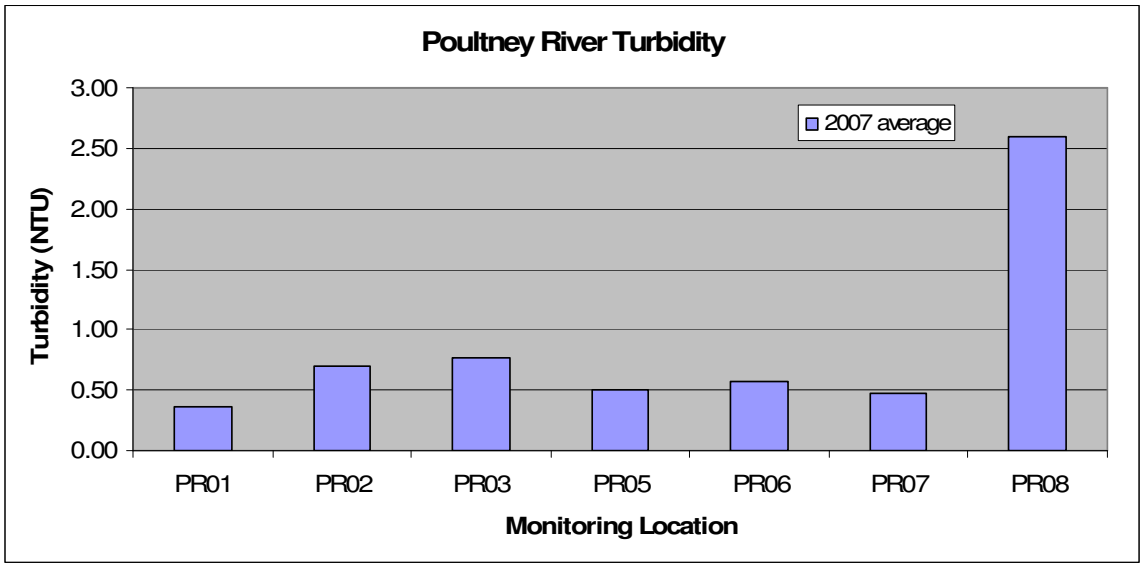
Again, according to Vermont DEC's Water Quality Standards, turbidity results "for class A(1) and A(2) waters, are not to exceed 10 NTU. For Class B waters designated warmwater reaches, they are not to exceed 25 NTU. For Class B waters in designated coldwater reaches, turbidity is not to exceed 10 NTU.(Kamman, personal communication, December 2006; Vermont WQS, http://www.nrb.state.vt.us/wrp/publications/wqs.pdf)"

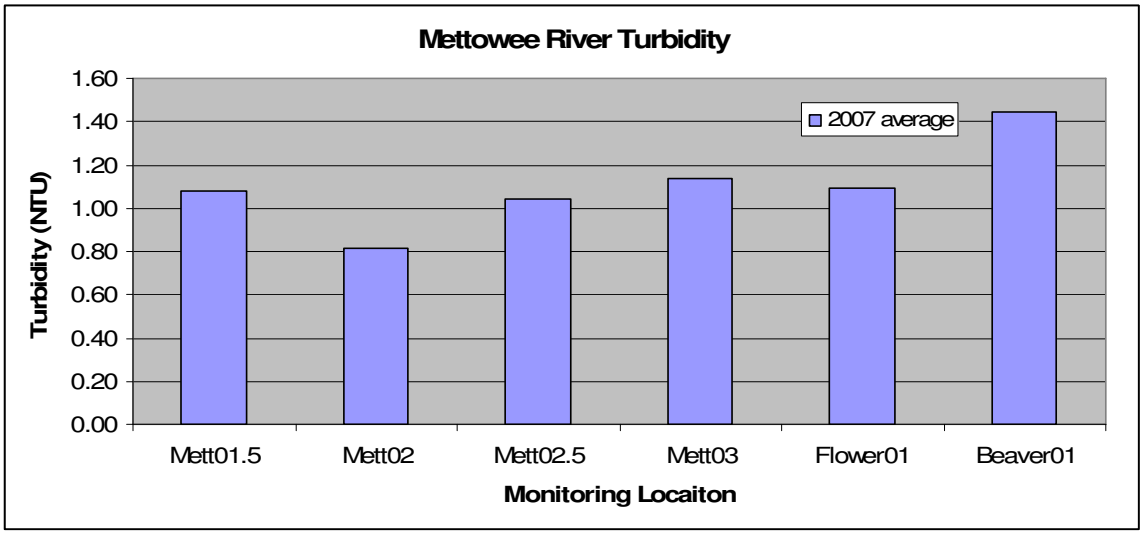
Based on the warmwater/coldwater fish habitat designations found in Vermont's Water Quality Standards (WQS), the only warmwater segments in the Poultney Mettowee watershed include the Poultney River below Carvers Falls and "all waters west of 22A". The Castleton crosses 22A in Fair Haven, but no samples were collected in the section designated warmwater.

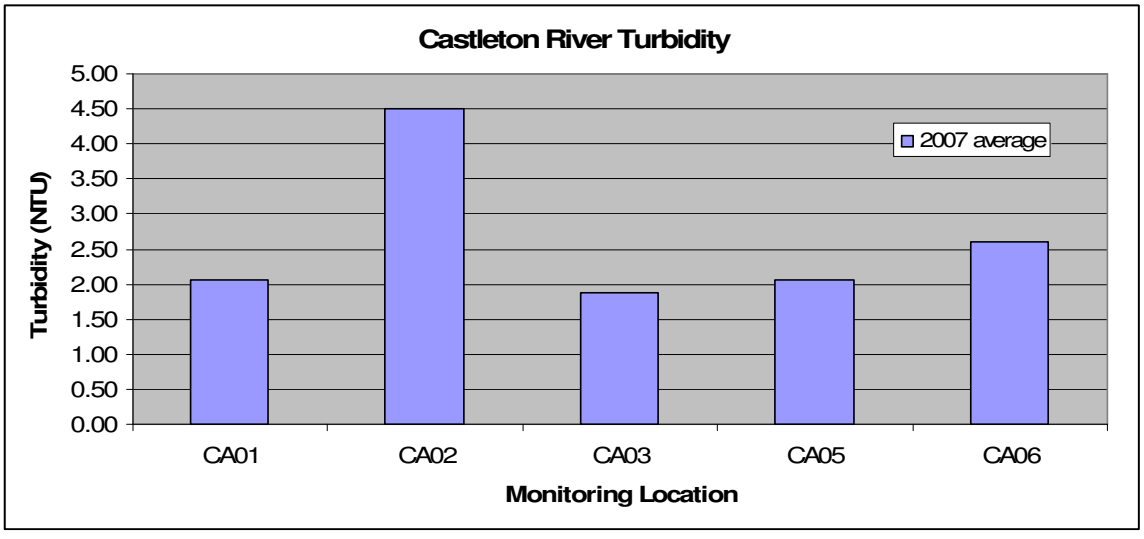
Similar to phosphorus results, the Poultney and Mettowee Rivers had extremely low turbidity levels. The highest turbidity measurement on the Poultney River was 3.97 on July 9th at PR08 (Greene Road), while the highest turbidity measures in the Mettowee watershed was 3.27 NTU at Mett03 (upstream of Butternut Bend) on June 20th. The Castleton River turbidity concentrations ranged between 1.27 and 5.72 NTU (about twice as high as last year, which was extremely dry). All of the turbidity results were within the Vermont DEC standards.

The Turbidity results for the normal sample dates compared to the rain dates were not significantly different. Similar to total phosphorus, this is likely due to the fact that the rainfall during the rain events was not enough to cause a significant increase in turbidity. It is important to note that several of the normal sample dates were during or shortly after rain events. Additionally, none of the sampling events captured extremely turbid flows, which have been documented within the watershed.

Graphs 12-14: Turbidity results for the 2007 sampling season.







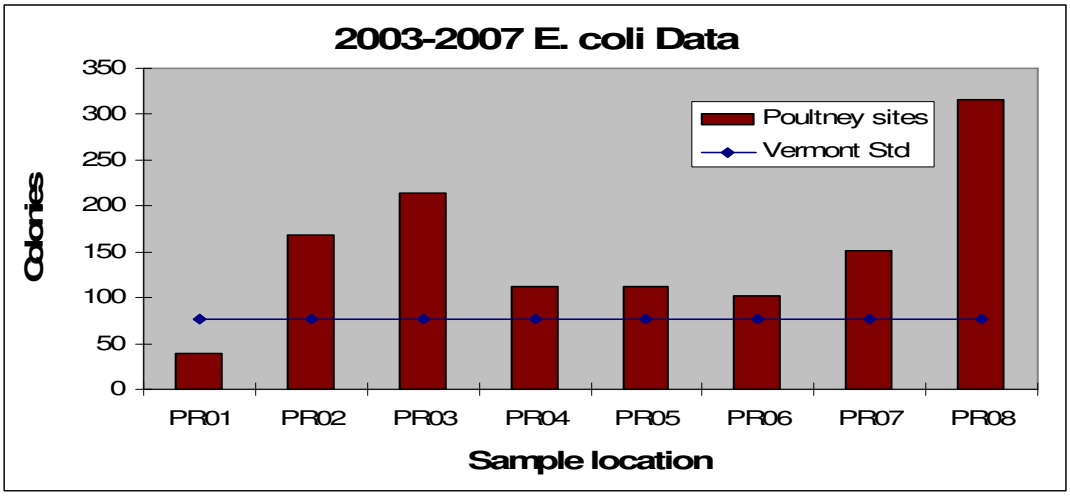
COMPILED DATA: AVERAGES FOR ALL DATA COLLECTED TO DATE

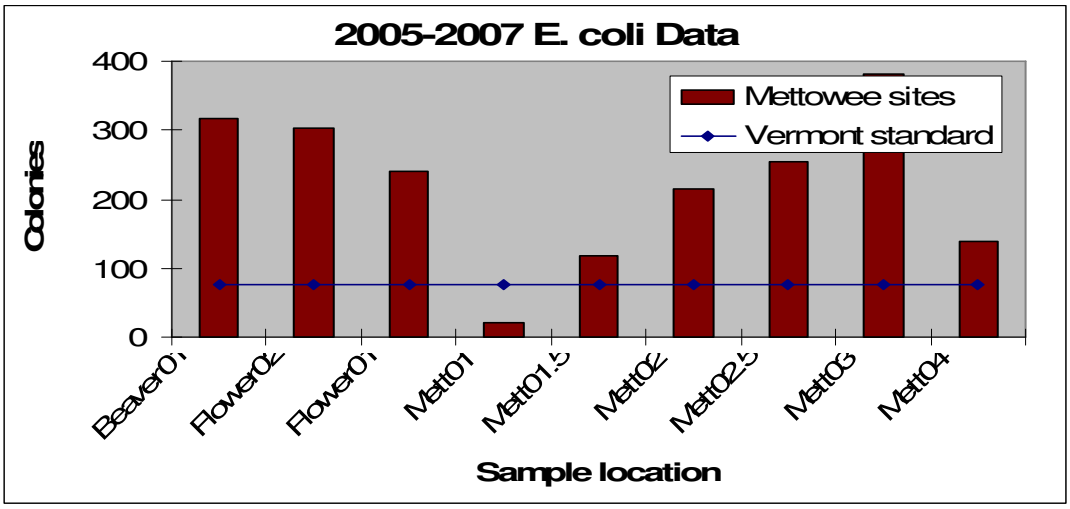
The following graphs include all of the data collected to date by the PMWP. The data has been averaged by site and ranges from one to five years worth of results. It is generally recognized that stream data becomes statistically significant when five or more years of data are available (Kamman, personal communication, 2004). These graphs, though only some sites contain five years worth of data, begin to show water quality differences between the sites. Each of the following graphs represents a stream continuum from upstream to downstream. Hopefully, this will help the reader to visualize the changes in water quality that are occurring spatially.

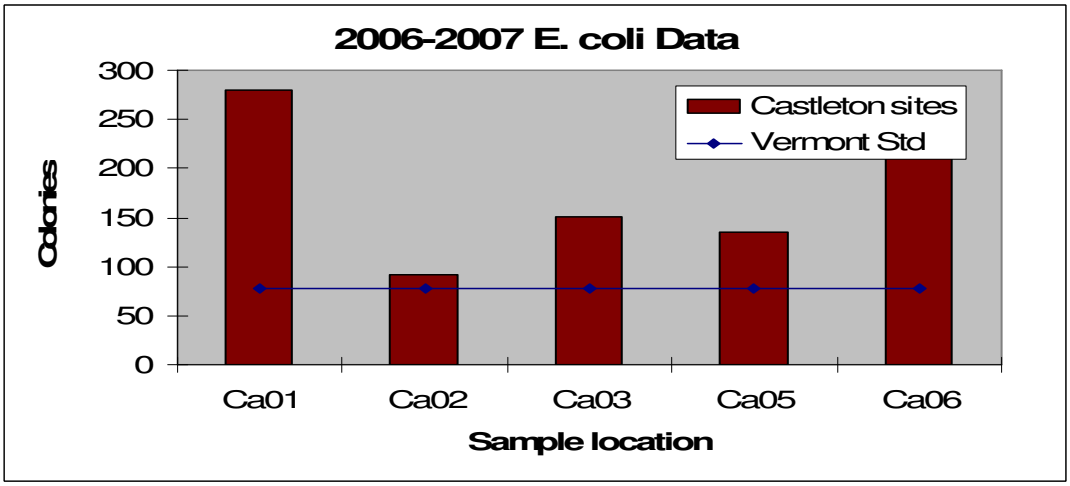
E. coli

The *E. coli* graphs show that many of the sites in the watershed are consistently over the State and Federal water quality standards. The lowest *E. coli* concentrations are found in the headwaters of the Poultney and Mettowee Rivers. The upstream site on the Castleton River (CA01) and the site on Beaver Brook are downstream of several wetlands and livestock pastures. *E. coli* bacteria at this site may result from either livestock in the stream or naturally-occurring animals, such as beaver, in the stream. Sites Flower01 and Mett02.5 may receive groundwater inputs from septic systems in Pawlet.

Graphs 15-17: Compiled Geometric mean E. coli data for the Poultney, Mettowee, and Castleton Rivers.





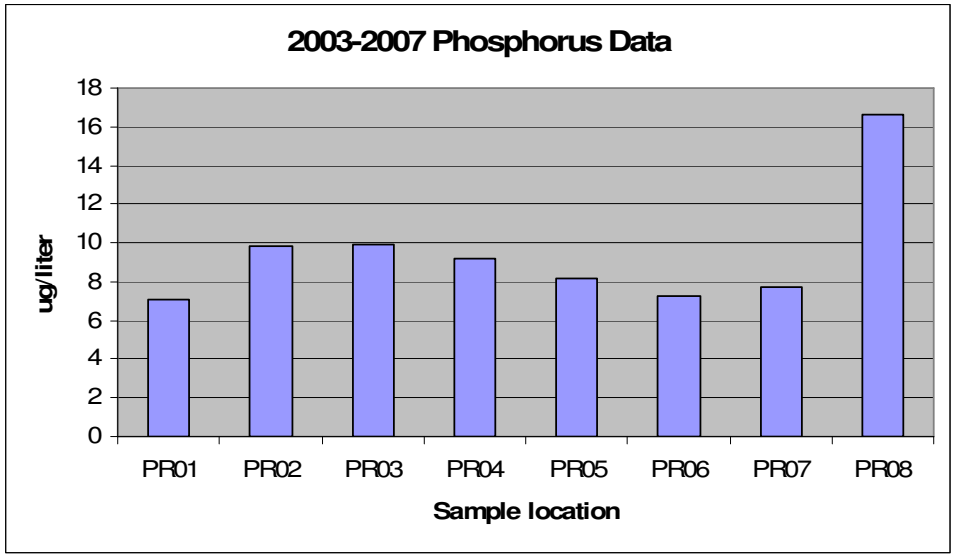


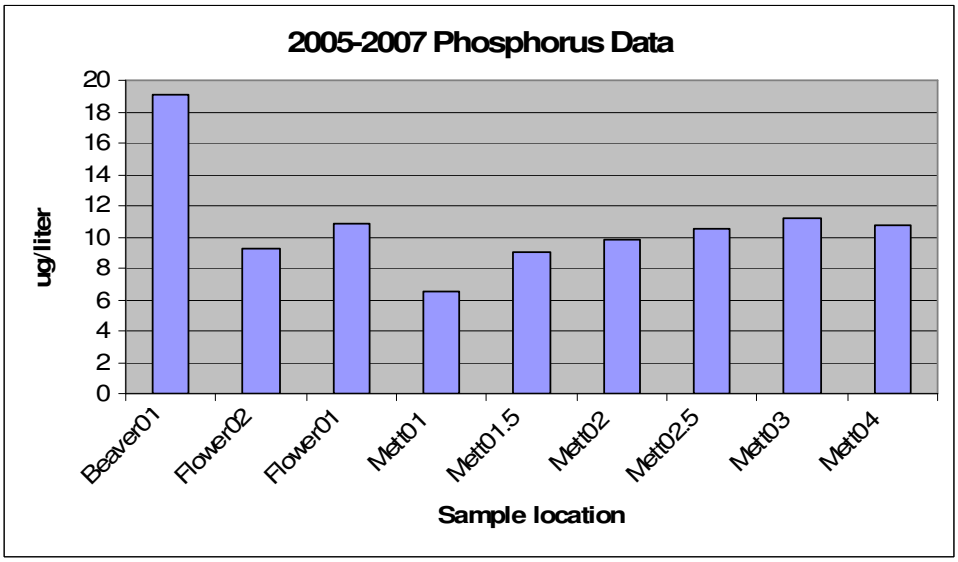
Phosphorus

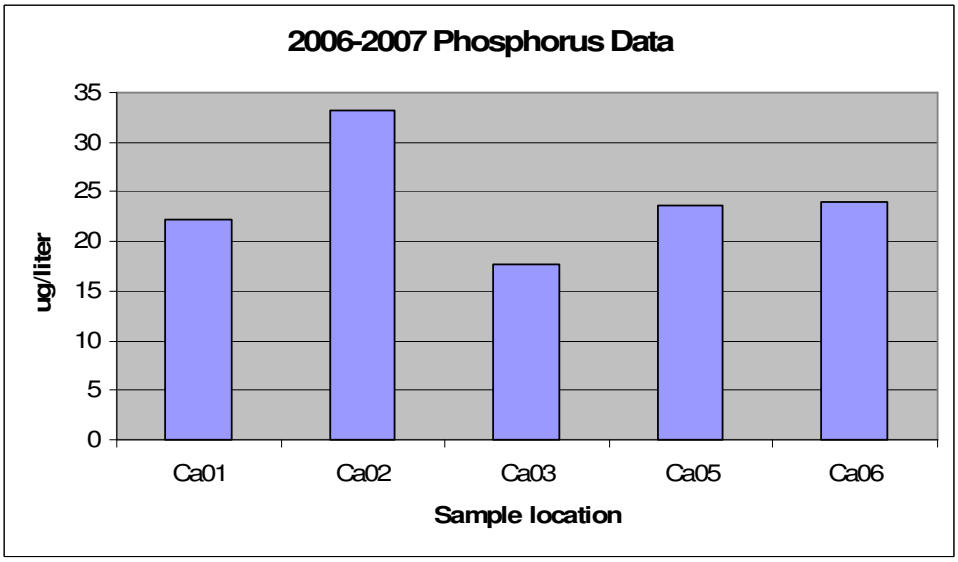
The phosphorus measurements were variable along the length of the streams monitored. Again, the headwater Poultney and Mettowee sites (PR01 and Mett01) showed the lowest levels of phosphorus over the duration of the study period for each (five seasons for the Poultney and two for the Mettowee). This is to be expected, since as mentioned above, phosphorus binds to soil, and there is likely to be less sediment at the headwaters of a stream than downstream where more erosion and river movement occurs. Of the Poultney and Mettowee sites, the downstream Poultney site, PR08 (Green Rd) and Beaver Brook, had the highest phosphorus measurements over the duration of the study (around 17 and 19 ppb respectively).

This year the PMWP sampled the Castleton River for the second time. This stream show relatively high phosphorus results (as compared to the Poultney and Mettowee Rivers). The Castleton River sites averaged between 17 and 34 ug/liter of total phosphorus.

Graphs 18-21: Averaged Total Phosphorus data for the Poultney, Mettowee, and Castleton River sites.


2003-2007 Phosphorus Data
ug/liter
0
2
4
6
8
10
12
14
16
18
PR01
PR02
PR03
PR04
PR05
PR06
PR07
PR08
Sample location

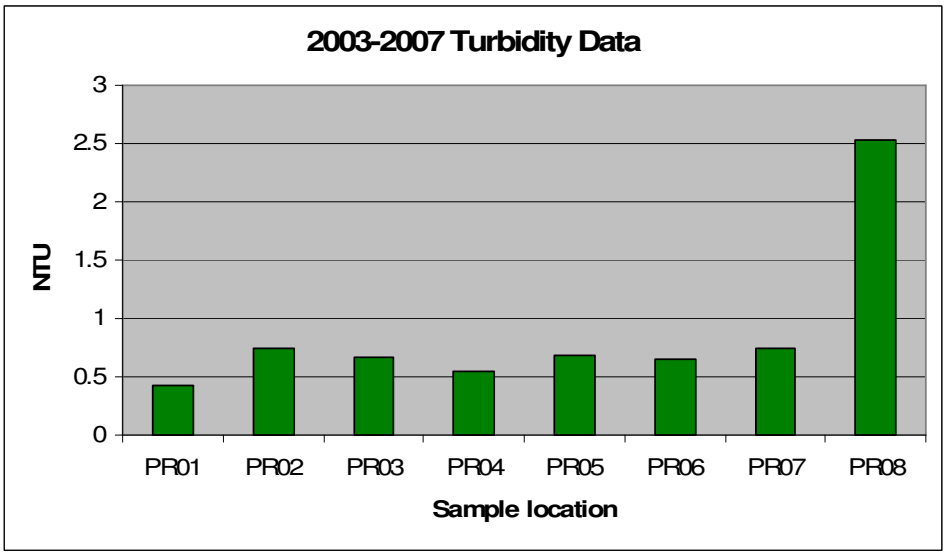

2005-2007 Phosphorus Data
ug/liter
0
2
4
6
8
10
12
14
16
18
20
Beaver01
Flower02
Flower01
Mett01
Mett01.5
Mett02
Mett02.5
Mett03
Mett04
Sample location

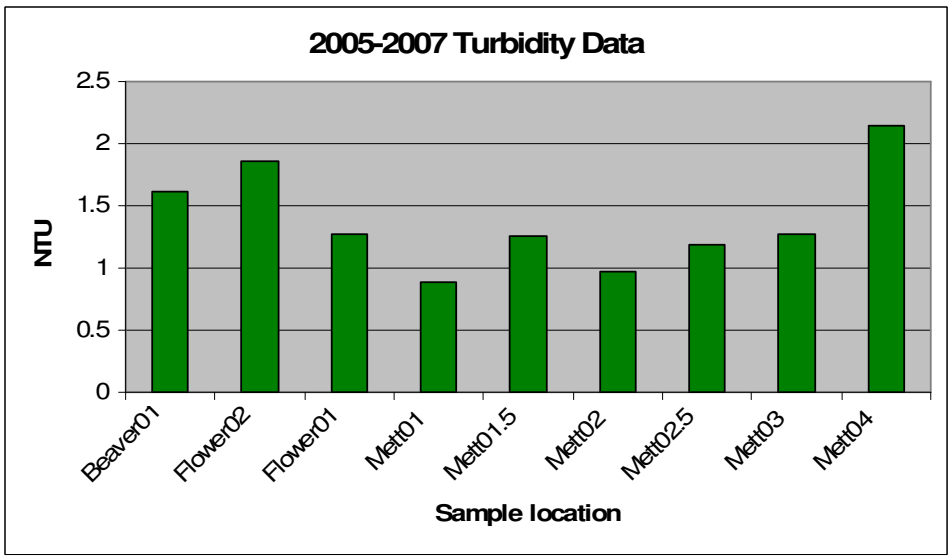

2006-2007 Phosphorus Data
ug/liter
0
5
10
15
20
25
30
35
Ca01
Ca02
Ca03
Ca05
Ca06
Sample location

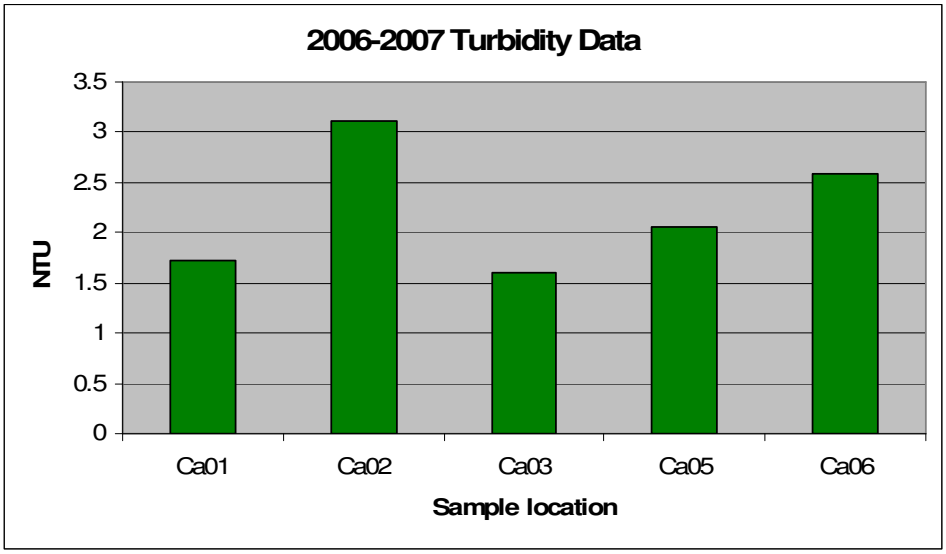
Turbidity Data

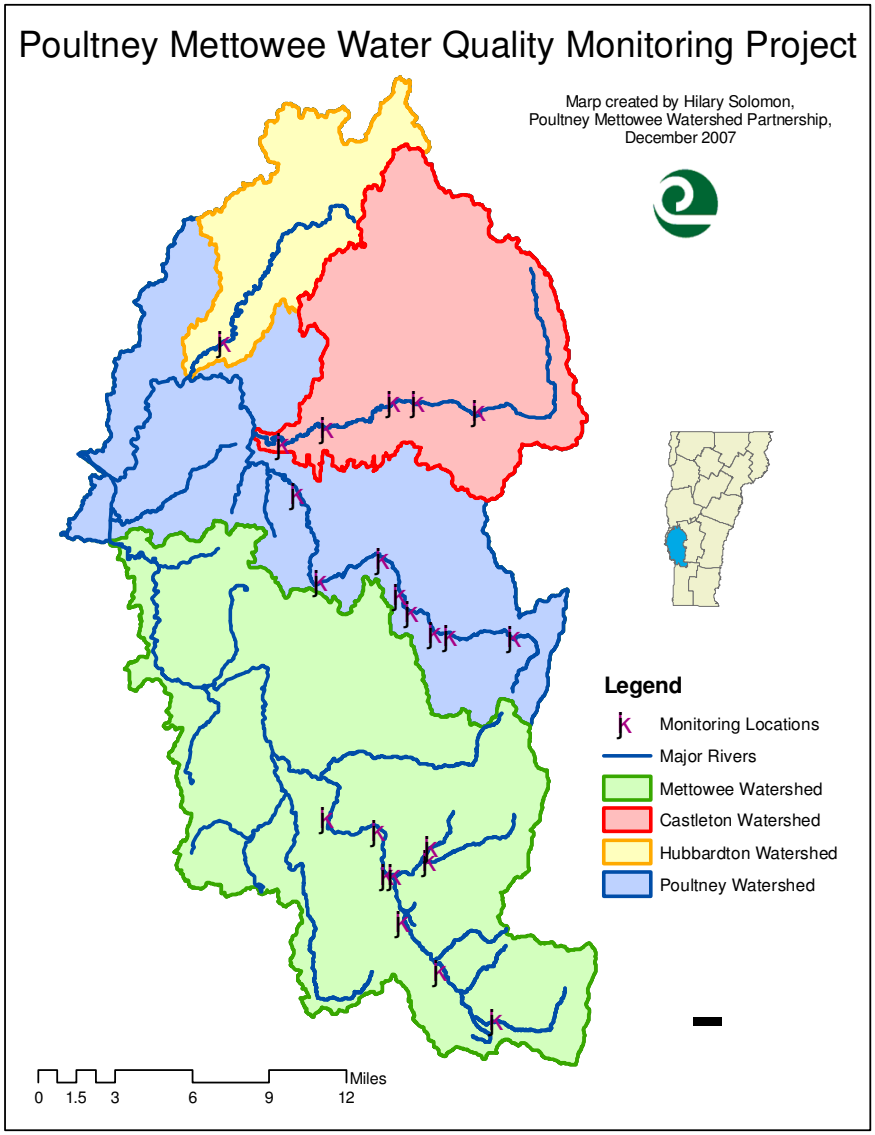
All of the averaged turbidity results are within coldwater standards for the Poultney, Mettowee and Castleton Rivers. Turbidity is highest at the downstream Poultney River site (PR08), Mettowee site 4, and the Castleton site 2.

Graphs 22-25: Averaged Turbidity data for the Poultney, Mettowee, and Castleton River sites.






2006-2007 Turbidity Data
NTU
3.5
3
2.5
2
1.5
1
0.5
0
Ca01
Ca02
Ca03
Ca05
Ca06
Sample location



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