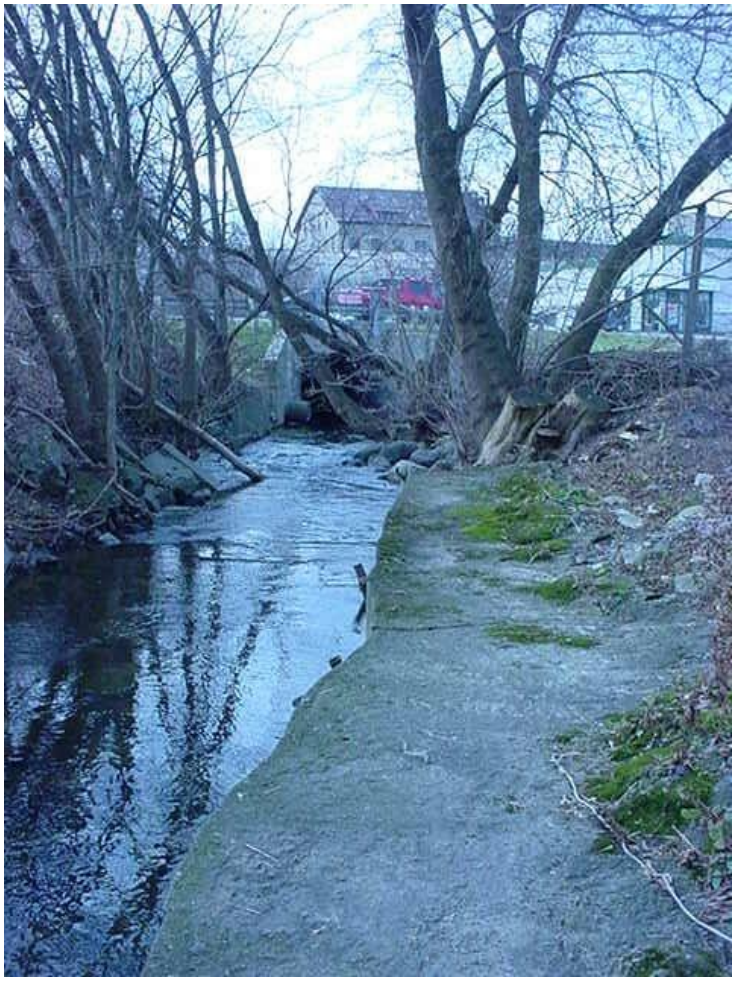
UPPER OTTER CREEK WATERSHED COUNCIL
SUMMER 2006 WATER QUALITY MONITORING PROGRAM



Moon Brook Photo by: Ethan Swift

Submitted by
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Submitted to
VT Department of Environmental Conservation
103 S. Main 10N Waterbury VT 05671-0408

2006 Upper Otter Creek Water Quality Monitoring Results

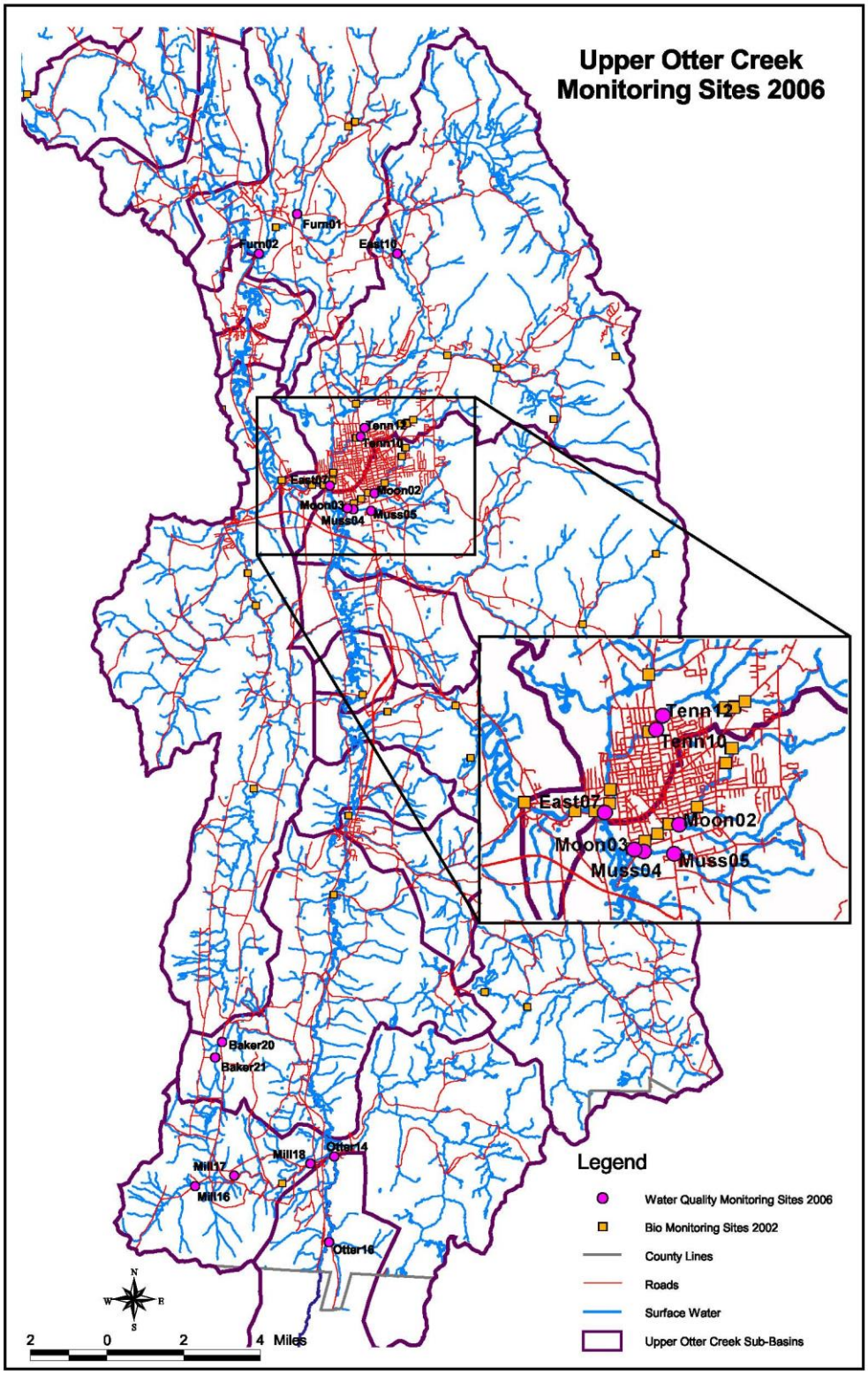
Sample Locations

All sampling sites monitored for this project were located in Rutland County on the mainstem of the Otter Creek or on significant tributaries to the Otter Creek. Many of these waters are those that have been identified in the *2004EPA 303(d) List* as waters either consistently not meeting Vermont Water Quality Standards (2000) or waters in need of further assessment. The following table lists all of the sites monitored in 2006 and their location in the watershed.

Table 1: Sample names and locations for Upper Otter Creek Watershed Council Summer 2006 water quality monitoring project.

Site	Description
moon02	Off of Avenue B at recreation area (Whites Pool) – Rutland
moon03	Below Forest St. Bridge – Rutland
muss04	Upstream from Park St. Bridge – Rutland
muss05	Before entering the Rutland County Fairgrounds – Rutland
east07	Off of Meadow St. at recreation area – Rutland
east10	Off Sangamon Road, downstream of bypass confluence - Chittenden
tenn10	Lincoln Avenue Park - Rutland
tenn12	RT 7 North - behind Sewards Restaurant – Rutland
otter14	Mount Tabor Road crossing - Danby
otter16	South End Road, below Emerald Lake - Dorset
mill16	Danby Mountain Road - bracketing a farm - Danby
mill17	High Bridge, just south of Keeler Road - Danby
mill18	Danby Slide, Downtown - Danby
baker20	East Road Bridge - Danby
baker21	Hossington Crossroad in - Danby
furn01	Off Oxbow Road, upstream of Pittsford village
furn02	Upstream of Cooley Bridge, downstream of Pittsford village

The following map shows the locations of all of the sampling sites in this study:



Map source: Steve Schild (Rutland RPC) and Ethan Swift (VT DEC)

Methodology

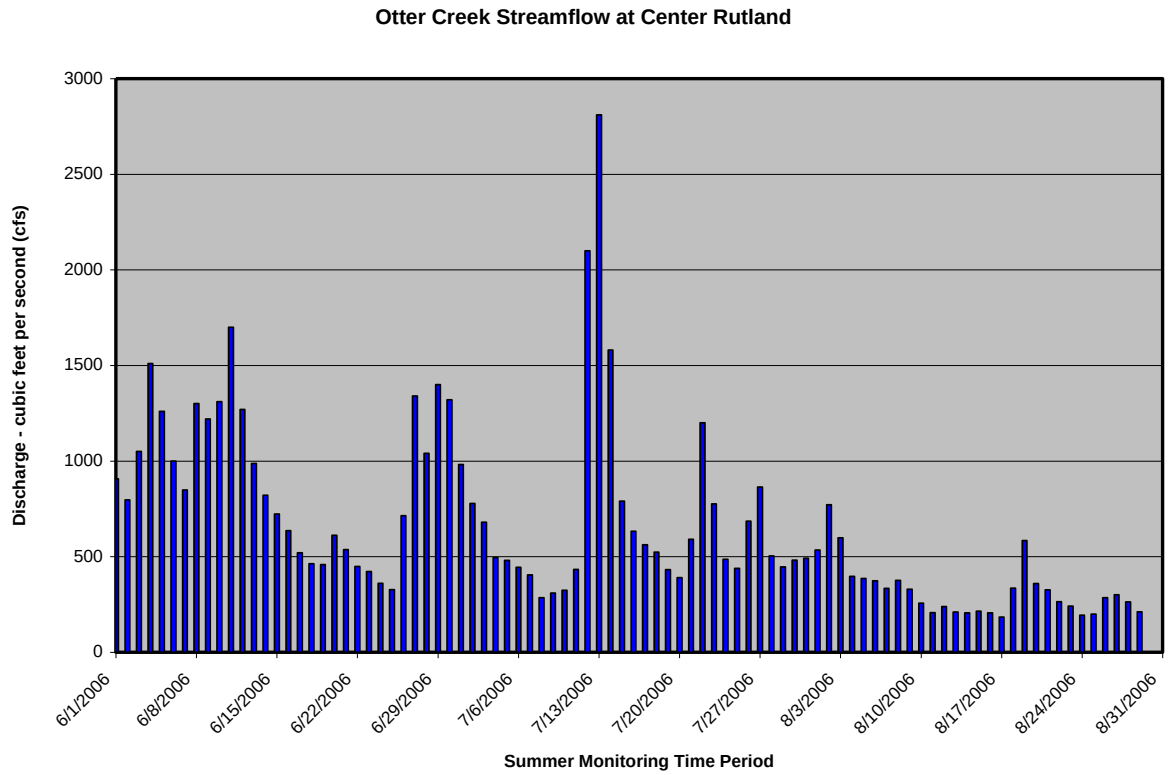
UOCWC followed all training, sample collection and sample transport protocols outlined in their June 2006 QAPP. The training schedule can be found in Appendix A.

Samples were collected at the above seventeen locations at seven dates (every other Tuesday morning between June 1 and August 30, 2006 throughout the summer). 100% of the proposed samples were collected and analyzed. Samples were reviewed for quality assurance (QA) and quality control (QC) and all sample results (field blanks, field duplicates and an extra phosphorus sample per batch for the matrix spike) were compiled and are listed in Appendix B.

Results

Streamflow Data

Chart 1: Streamflow data measured at the USGS gage station below Rutland Falls, Center Rutland.

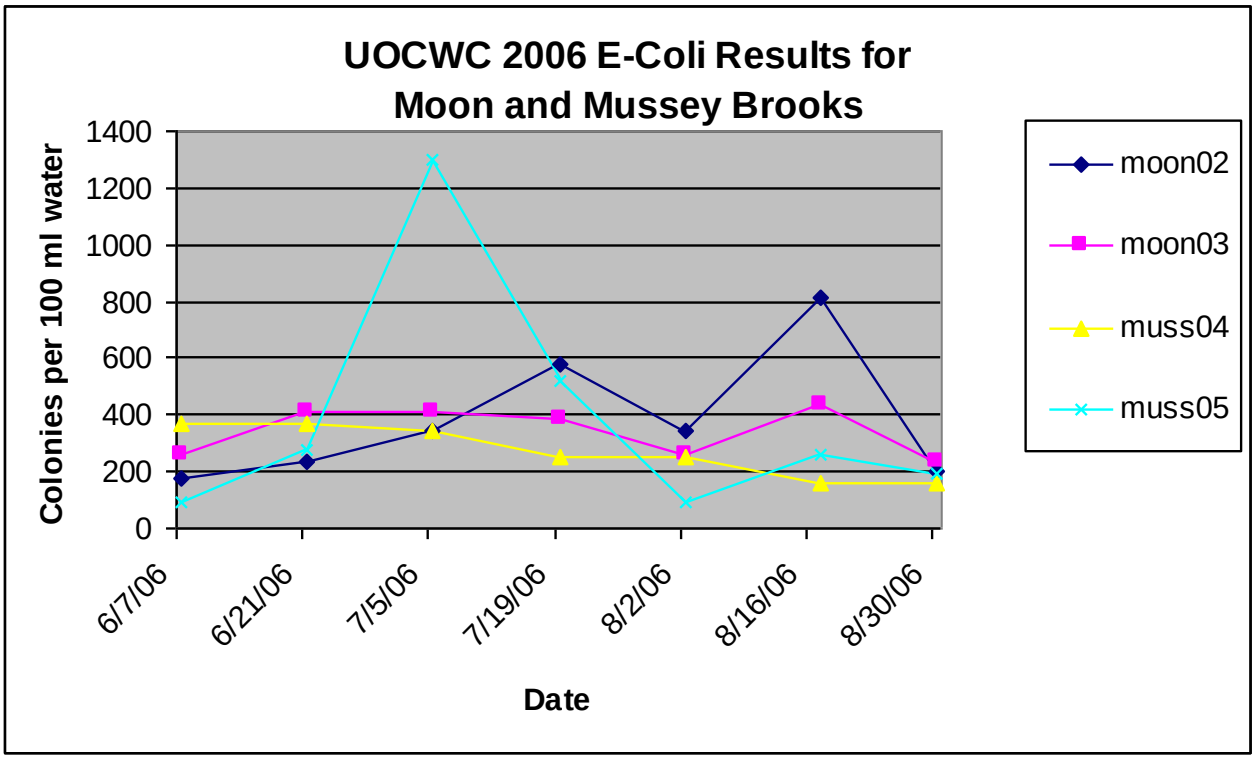


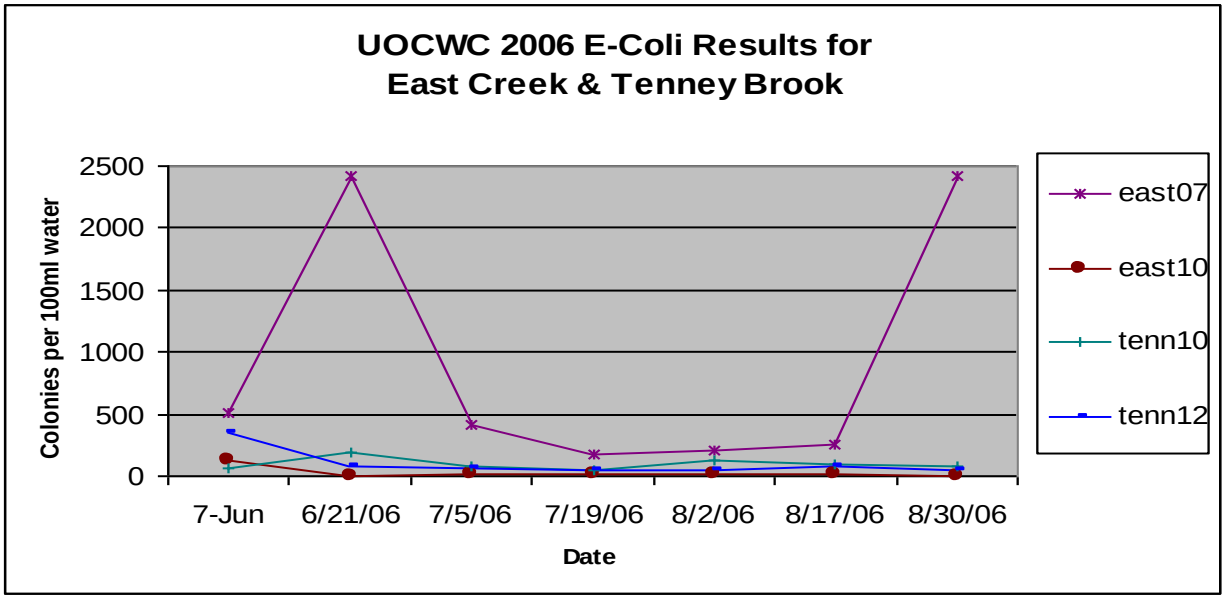
The above chart shows streamflow for the Otter Creek at Center Rutland between the dates of June 1 and August 31, 2006. The highest flow for this period occurred during the first half of the summer. The samples collected during the second sample date should reflect these high streamflow conditions

E. Coli (Escherichia coli)

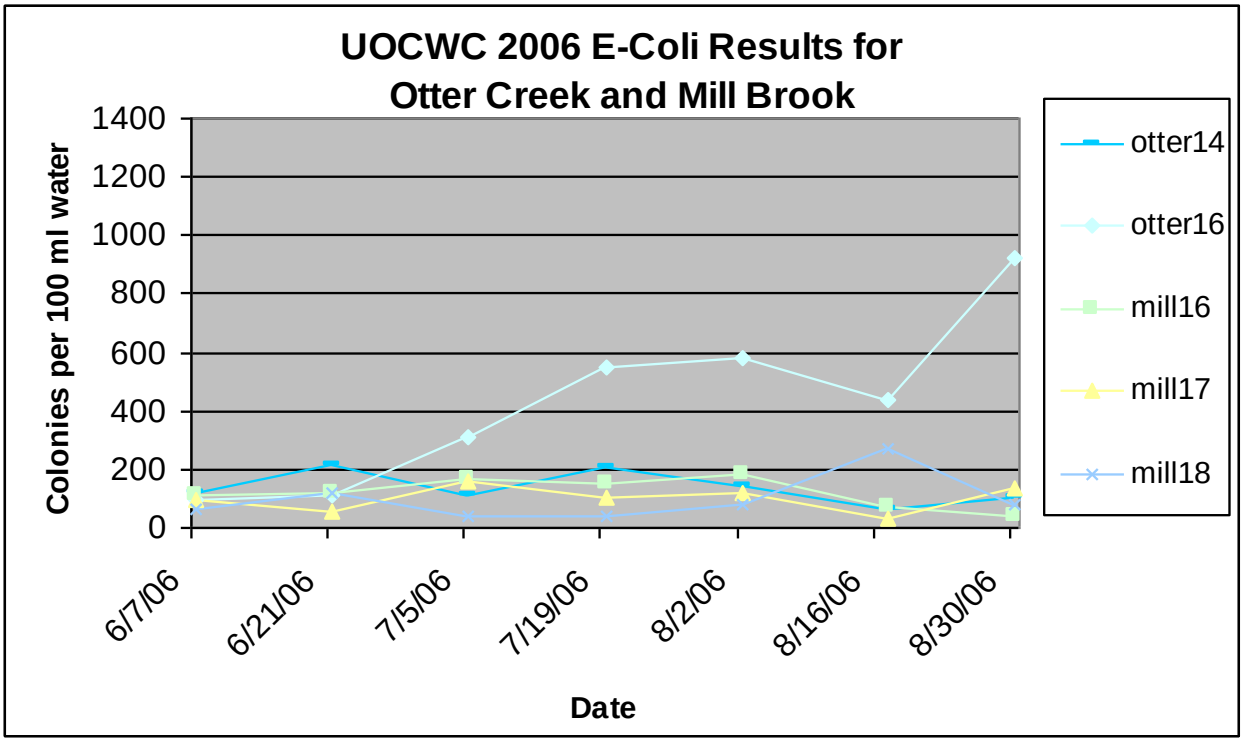
E. coli counts measure one type of fecal coliform bacteria found in the digestive tracts of human and other warm-blooded animals. High *E. coli* levels indicate that fecal waste is being carried over land or through groundwater into streams. People exposed to fecal wastes of sick individuals can develop serious diseases or other health consequences. US EPA sets its recommended limits for *E. coli* levels in waters where swimming may occur at 235 colonies per 100mL of water, while the Vermont DEC sets their recommended limit for class B waters (current classification for most of the sites monitored) at 77 colonies per 100 ml of water.

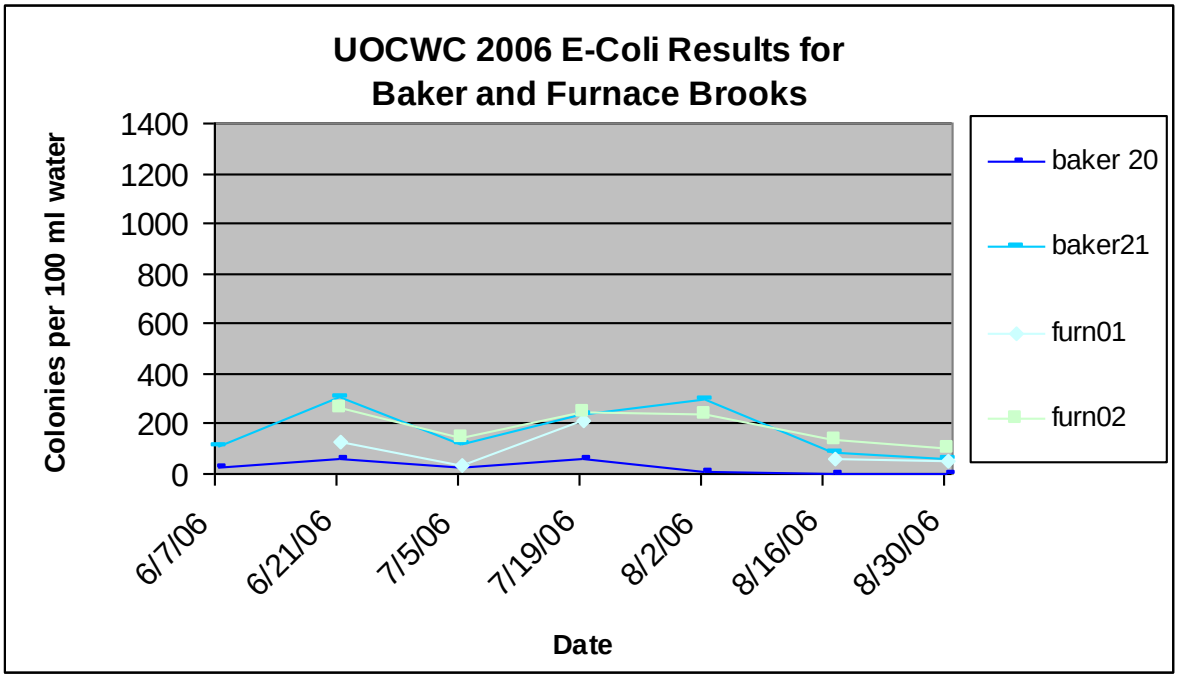
Charts 2-5: E. Coli results for Upper Otter Creek





Sample results for east07 on 6/21 were 2419.60
and sample results for east07 on 8/30 were 2419.60





Many of the creeks measured exceeded State and Federal *E. coli* standards at some point during the summer. *E. coli* results for lower Moon Brook (Moon02 and Moon03), Mussey Brook (Muss04 and Muss05) and East Creek near the Combined Sewer Overflow (CSO) (East07) were chronically high during the 2006 sampling season. Moon02 remained high during the latter part of the summer when rainfall and streamflow were low. High *E. coli* levels during this low-flow period may indicate *E. coli* contributions from illicit discharges or other urban inputs.

An Upper Otter Creek (headwater) site (Otter 14) showed elevated *E. coli* levels in the latter half of the summer as well, perhaps indicating the contribution of overland runoff to *E. Coli* levels in the Otter Creek. This area is also a significant wetland complex, and some of the high E. coli levels may be attributable to wildlife in close proximity to these waters.

Turbidity and Suspended Solids

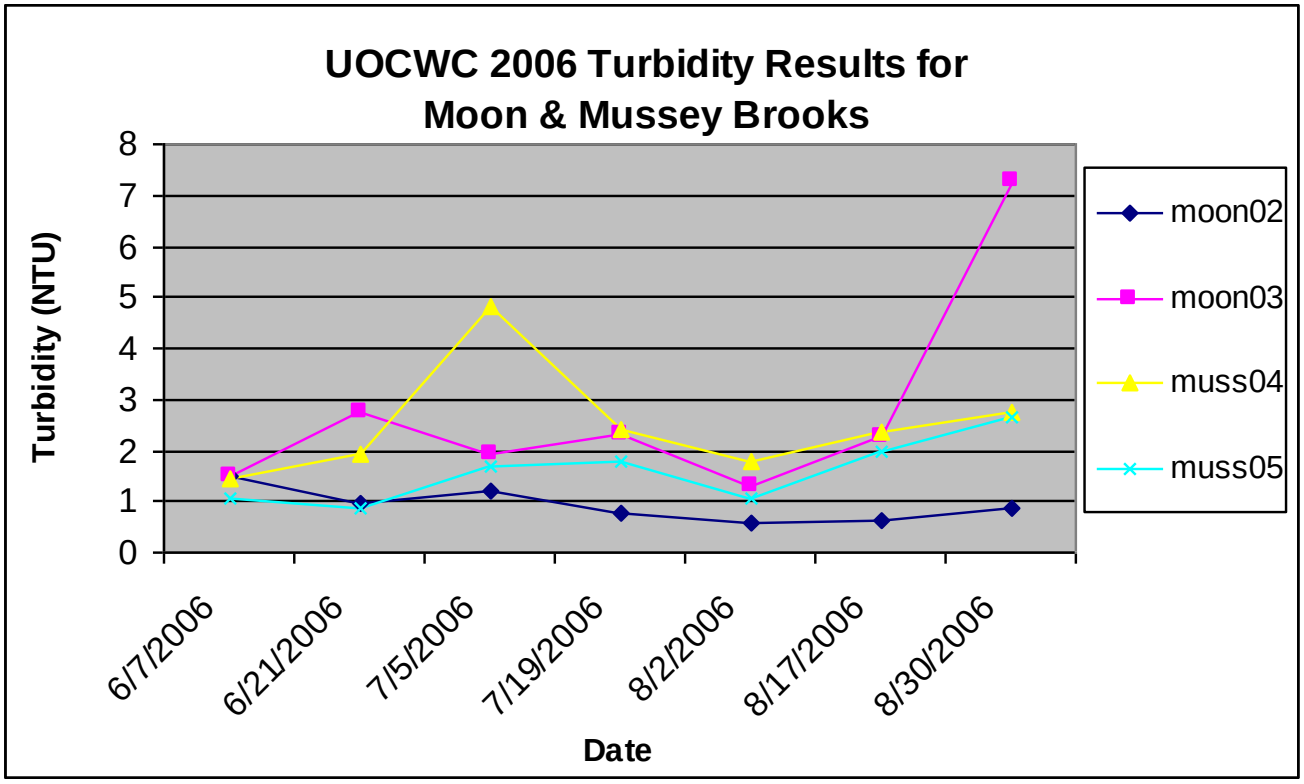
The amount of turbidity and/or total suspended solids (TSS) found in water serves to determine its relative clarity. Suspended solids in the water create turbid (murky) conditions and reduce the transmission of light. Suspended solids are varied, ranging from clay, silt and plankton, to industrial wastes and sewage.

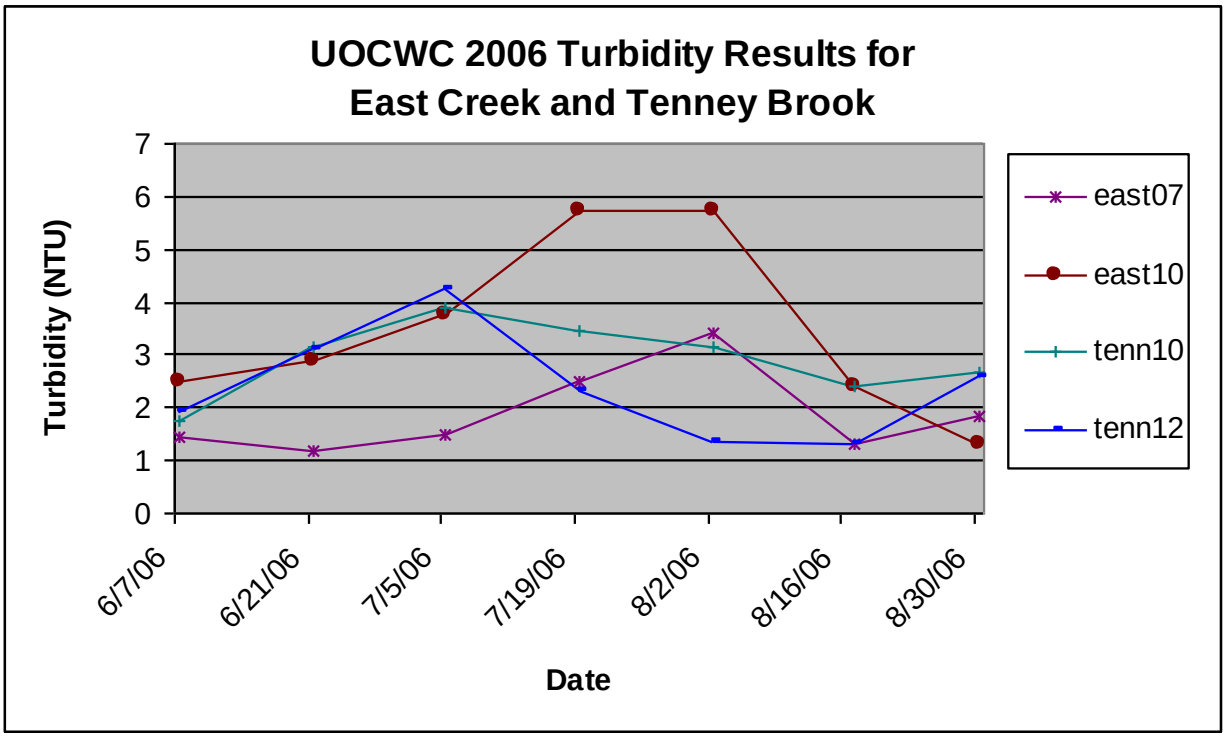
Water containing high levels of sediment, loses its ability to support a diversity of aquatic organisms, becoming warmer as suspended particles absorb heat from the sunlight and cause depleted dissolved oxygen concentrations. Photosynthesis decreases because less light penetrates the water, resulting in even further drops in oxygen levels. The combination of

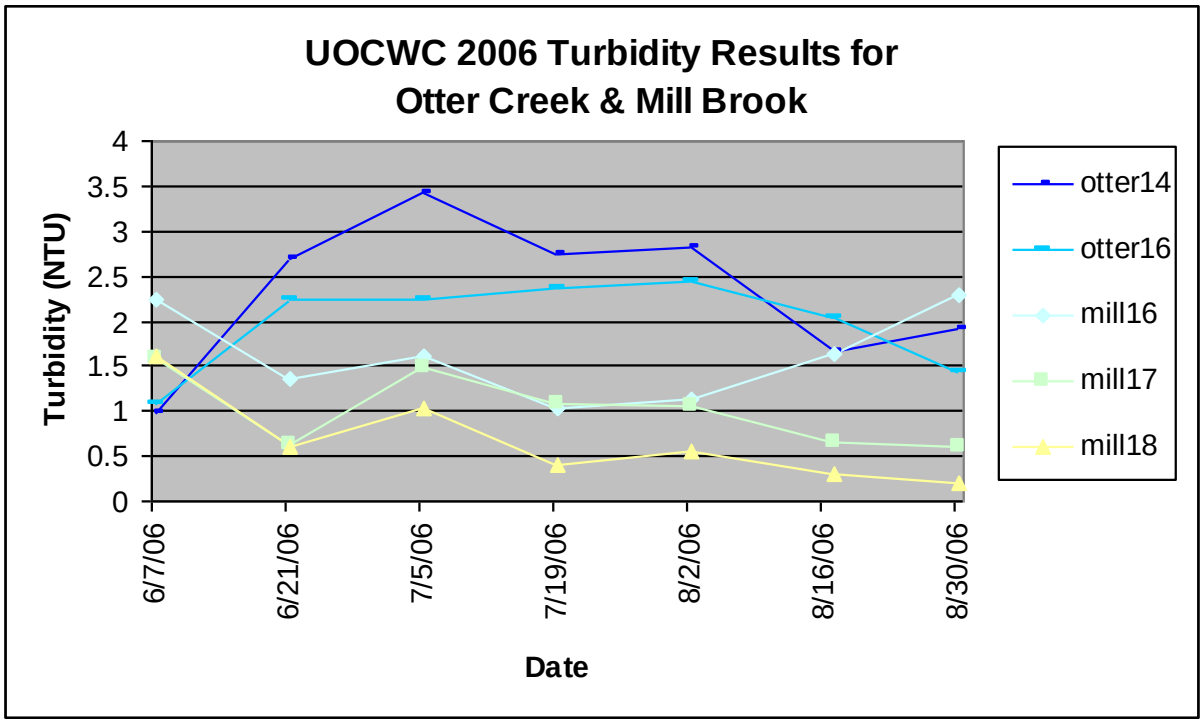
warmer water, less light and oxygen depletion may make it impossible for some forms of aquatic life to survive.

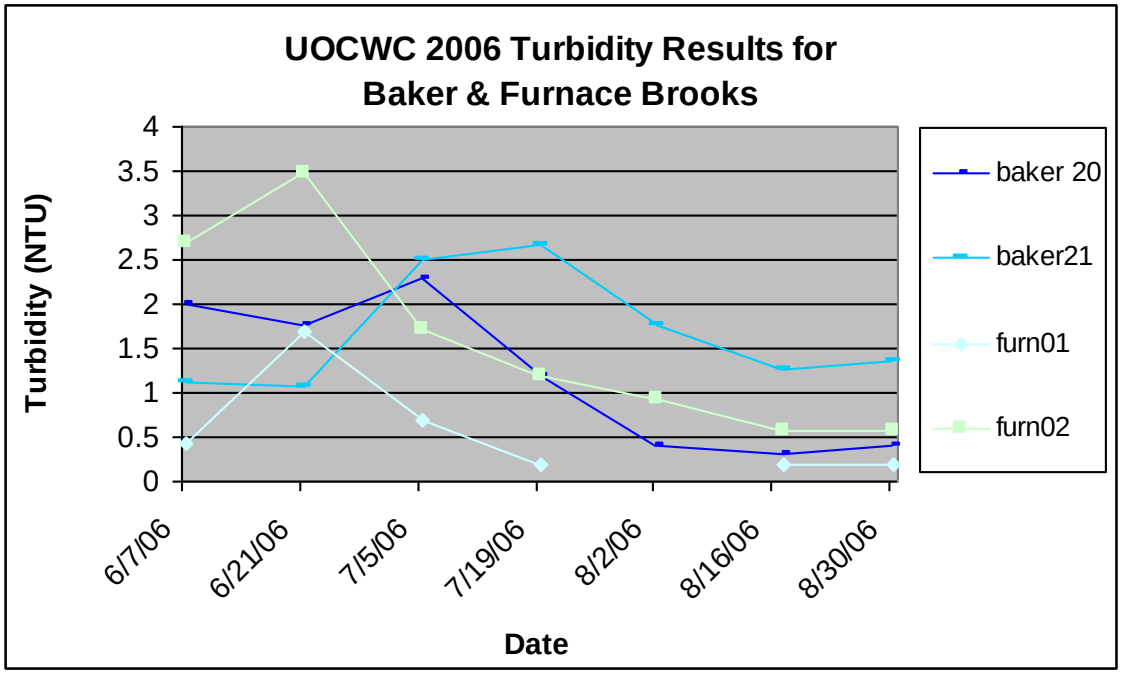
Suspended solids affect aquatic life in other ways as well. Suspended solids can clog fish gills, reduce growth rates, decrease resistance to disease and prevent egg and larval development. Particles of silt, clay and organic materials settle to the bottom, especially in areas of a river or stream that are slow moving. These settled particles could smother the eggs of fish and aquatic insects, as well as suffocate newly hatched insect larvae. Material that settles into the spaces between rocks makes these microhabitats unsuitable for mayfly and stonefly nymphs, caddisfly larvae and other aquatic insects living there (Above information from Richards, West River Report, 2004).

Charts 6-9: Turbidity Results for Upper Otter Creek




UOCWC 2006 Turbidity Results for
East Creek and Tenney Brook
Turbidity (NTU)
0
1
2
3
4
5
6
7
6/7/06
6/21/06
7/5/06
7/19/06
8/2/06
8/16/06
8/30/06
Date
east07
east10
tenn10
tenn12


UOCWC 2006 Turbidity Results for
Otter Creek & Mill Brook
Turbidity (NTU)
0
0.5
1
1.5
2
2.5
3
3.5
4
6/7/06
6/21/06
7/5/06
7/19/06
8/2/06
8/16/06
8/30/06
Date
otter14
otter16
mill16
mill17
mill18

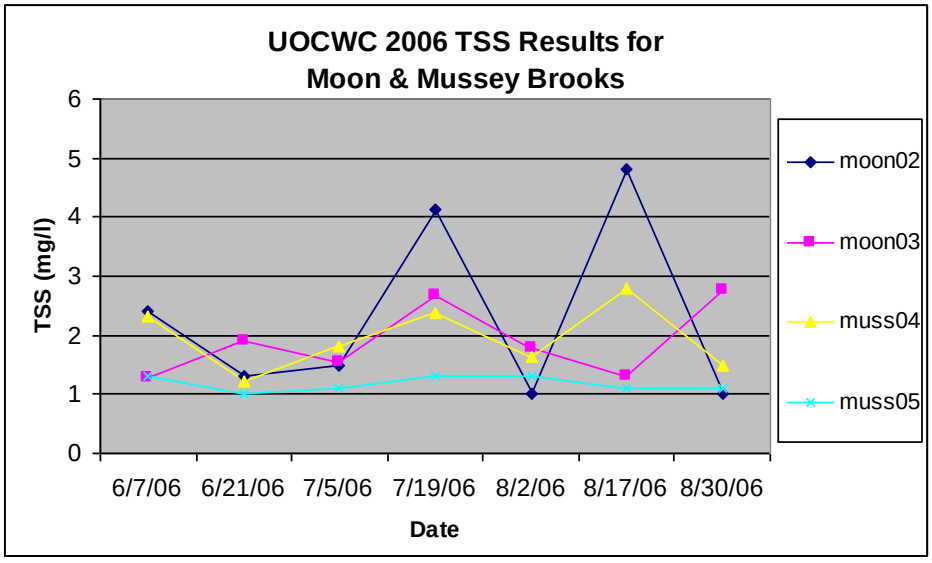


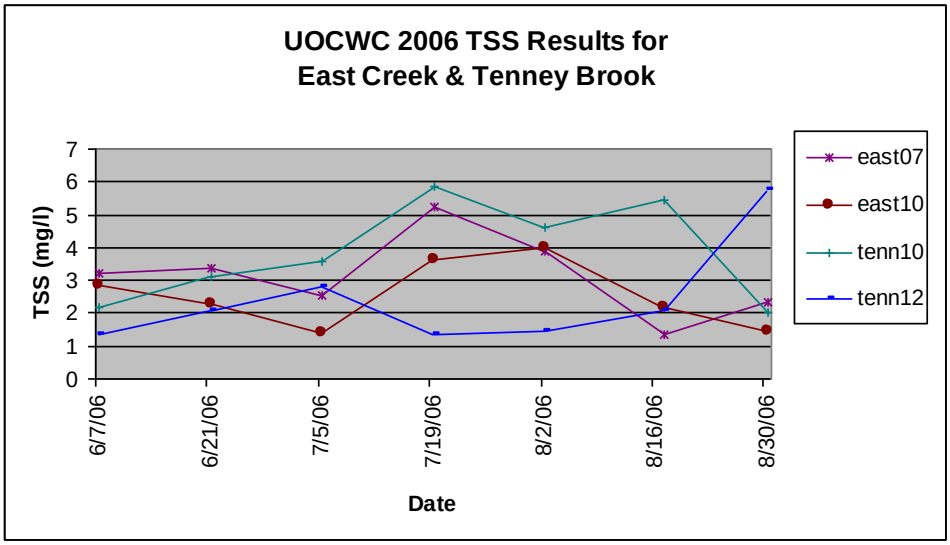
Turbidity is a measure of sediment levels in the water. High turbidity is often associated with sediments carried in stormwater runoff, though anthropogenic sources such as water from car washing, cleaning of sidewalks or buildings and leaking septic systems can cause increases in turbidity when runoff is low.

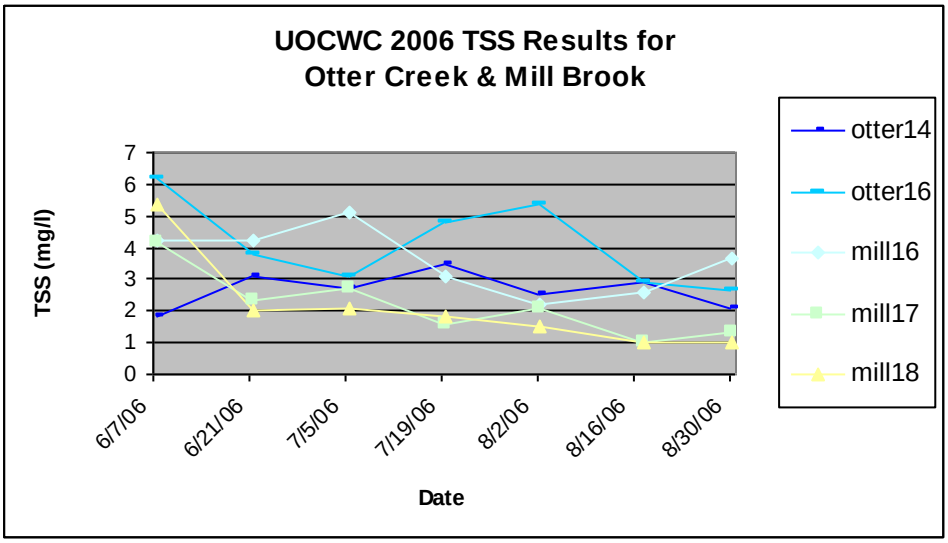
Overall the turbidity measured for the Otter Creek was relatively low, while the turbidity in urban tributaries was generally higher, but still within state standards for cold water habitat. Of particular note were high turbidity levels recorded at East10, much higher in the headwaters in the Town of Chittenden, where the effects of urban runoff is fairly negligible. Otter14 showed higher levels of turbidity throughout the summer. Most of the higher turbidity results were associated with runoff events. State standards for turbidity are 10 NTU for cold water fish habitat and 25 NTU for warm water fish habitat.

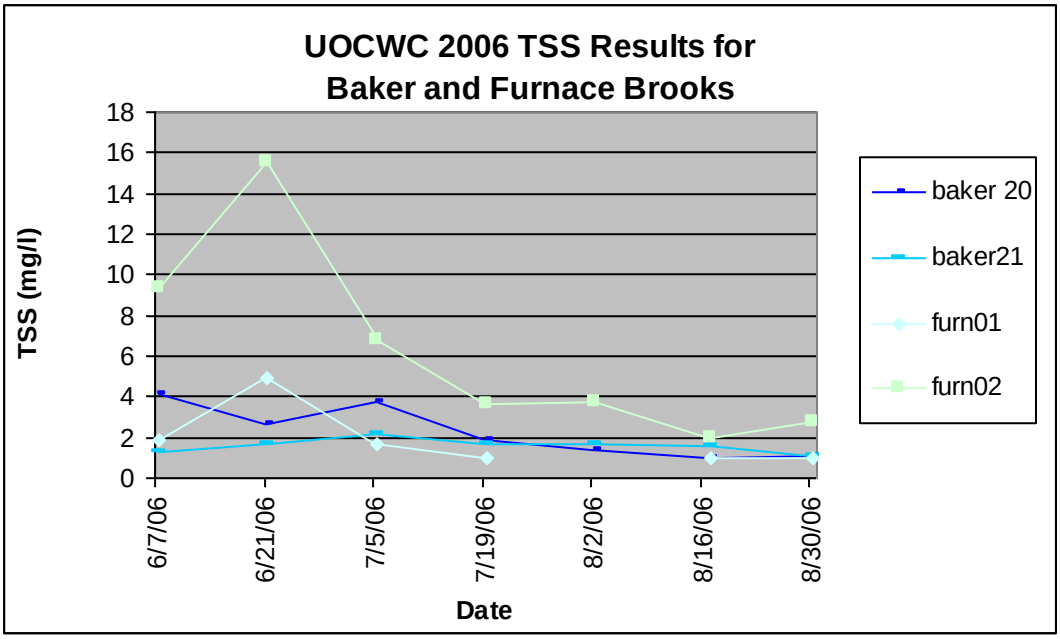
Total Suspended Solids

Charts: 10-13: Total Suspended Solids,(TSS) results for Upper Otter Creek


UOCWC 2006 TSS Results for
Moon & Mussey Brooks
TSS (mg/l)
0
1
2
3
4
5
6
6/7/06
6/21/06
7/5/06
7/19/06
8/2/06
8/17/06
8/30/06
Date
moon02
moon03
muss04
muss05


UOCWC 2006 TSS Results for
East Creek & Tenney Brook
TSS (mg/l)
0
1
2
3
4
5
6
7
6/7/06
6/21/06
7/5/06
7/19/06
8/2/06
8/16/06
8/30/06
Date
east07
east10
tenn10
tenn12


UOCWC 2006 TSS Results for
Otter Creek & Mill Brook
TSS (mg/l)
0
1
2
3
4
5
6
7
6/7/06
6/21/06
7/5/06
7/19/06
8/2/06
8/16/06
8/30/06
Date
otter14
otter16
mill16
mill17
mill18

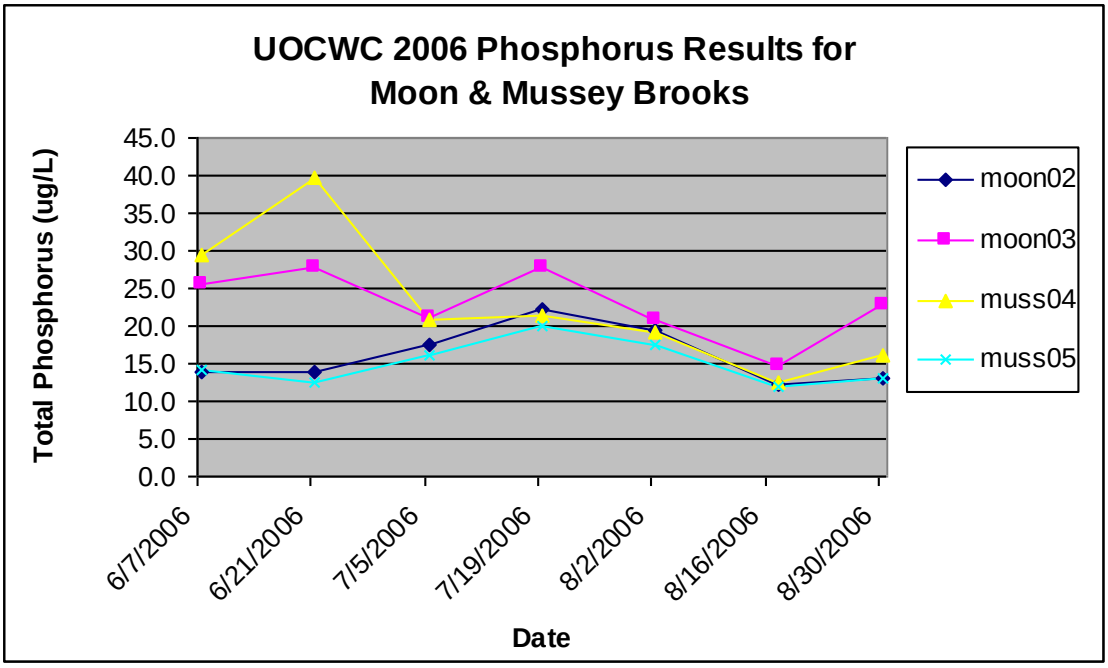


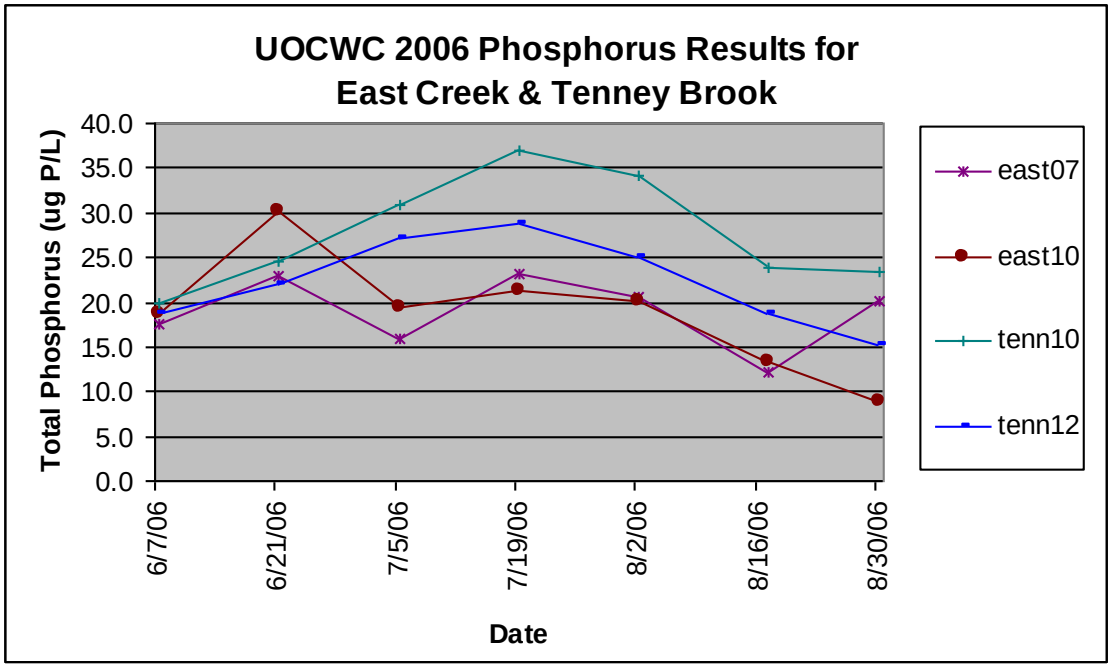
The total suspended solids (TSS) results for Otter Creek monitoring locations clearly demonstrated a link between high levels of sediment in the water and the occurrence of storm-related, overland runoff. The lowest Furnace Brook site (Furn02) showed the highest TSS levels of all sites monitored this season that appeared to correlate to precipitation events. Moon Brook (Moon02) and Tenney Brook showed the highest levels of TSS in the latter half of the summer, indicating that other factors may be responsible for TSS levels in the absence of precipitation events.

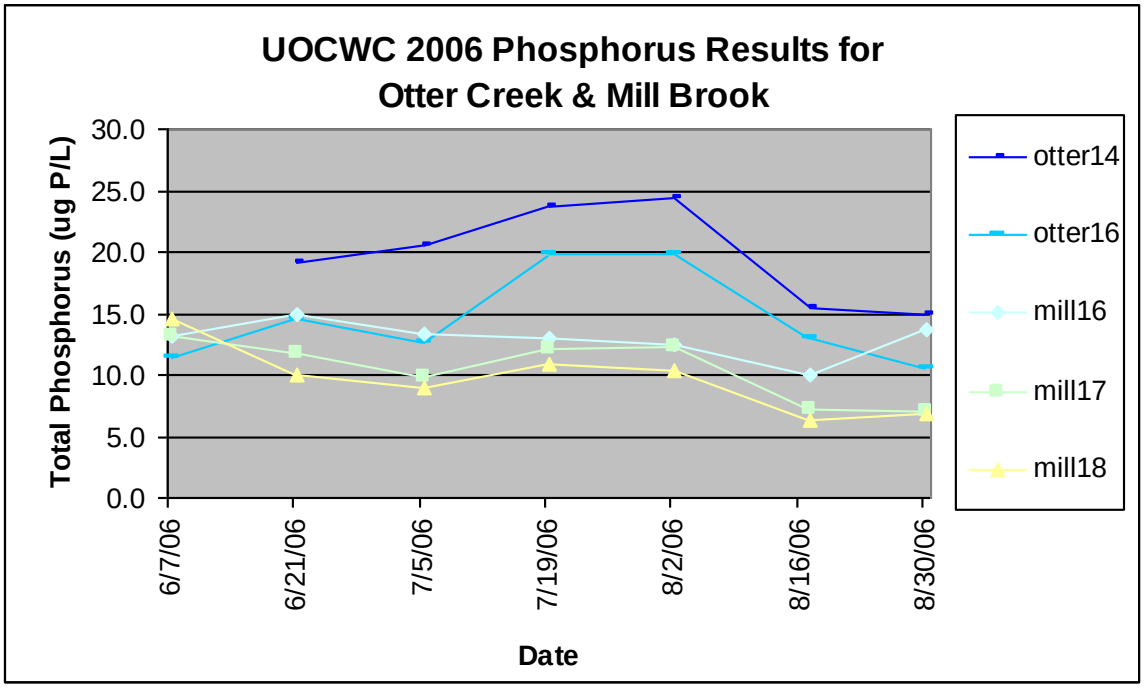
Total Phosphorus

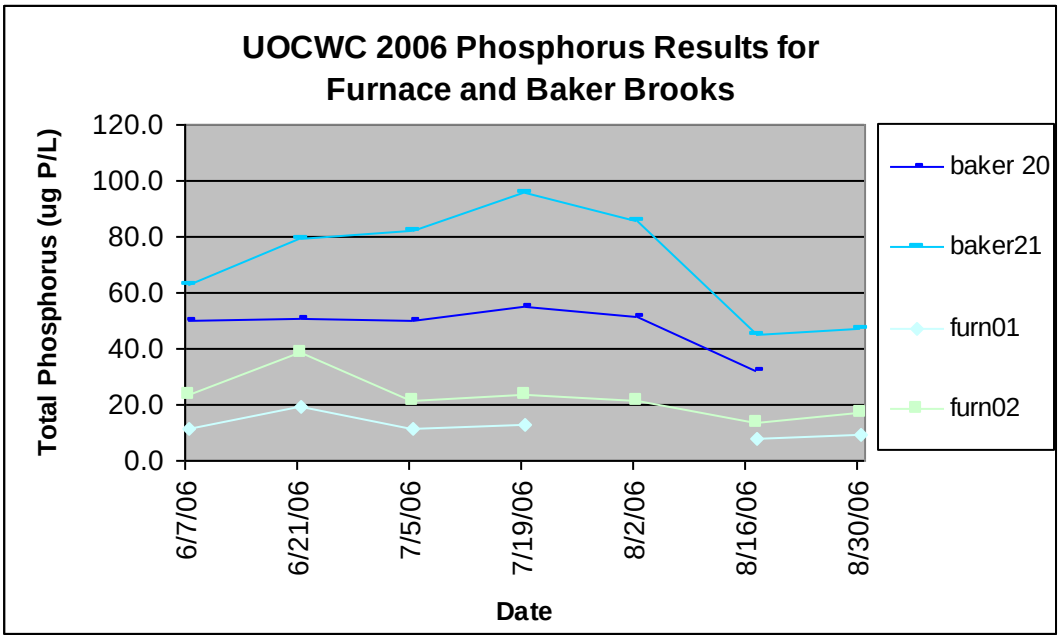
Nitrogen and phosphorus are nutrients that, when above their natural levels in the environment can change the local ecologic balance. Phosphorus is often the nutrient that limits the amount of aquatic plant growth in our waterbodies. Excess phosphorus in water, thus, often contributes to the growth of algae and other plants. This accelerated plant growth may eventually damage stream ecosystems by changing the balance of plants growing, causing algal blooms and by draining the oxygen levels in the water when the plants decompose. Phosphorus is often introduced into the environment through human activities such as improper waste management, over-application of fertilizers, certain industrial wastes and human disturbance of the land and its vegetation. Phosphorus binds with soil and is often carried into streams during storms when TSS levels are high. Under certain conditions, phosphorus may disassociate from the soil and dissolve in the water column, where it may become biologically available for many seasons.

Charts: 14-17: Total phosphorus results for Upper Otter Creek









According to Vermont DEC Watershed Coordinator, Ethan Swift, there is no Vermont State numerical standard for total phosphorus concentrations in streams and rivers. The General Policy states that "in all water, total phosphorous loadings shall be limited so that they will not contribute to the acceleration of eutrophication or the stimulation of the growth of aquatic biota in a manner that prevents the full support of uses." River Network information (*Testing the Waters,* Shannon Behar) states that phosphorous concentrations of 0.01 mg/L (10μg/L) or less may have measurable impact on nutrient poor upland streams, while larger rivers could be

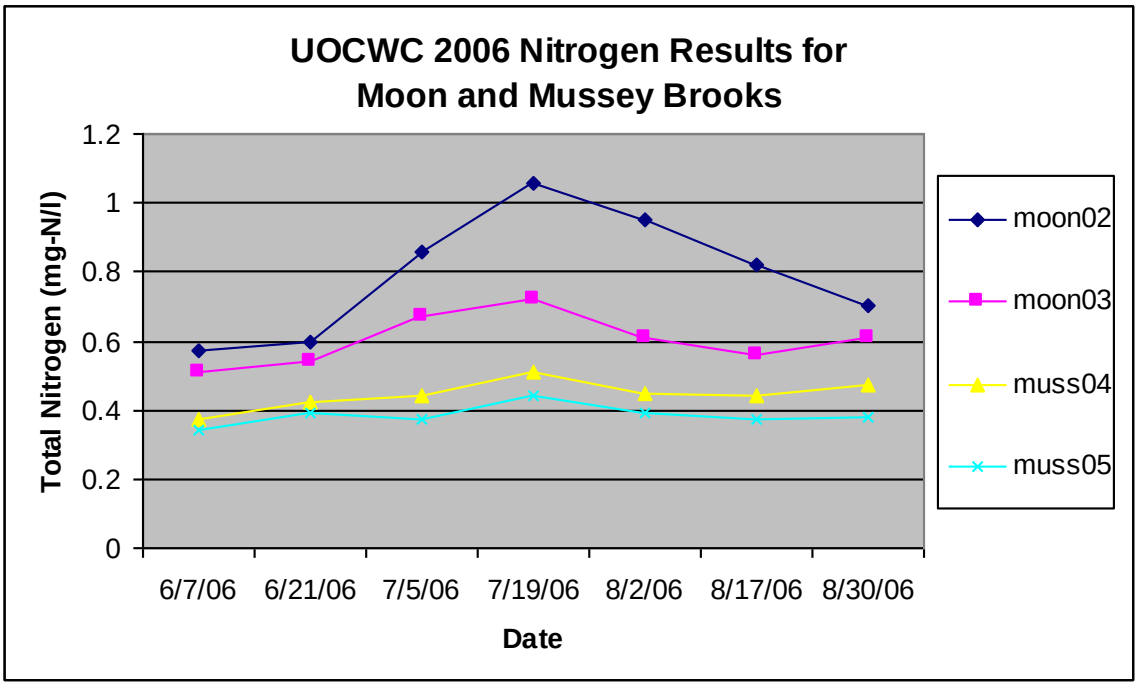
impacted when concentrations near 0.1 mg/L (100 μg/L). The phosphorus goal as per the Lake Champlain Phosphorus TMDL for the Otter Creek lake segment is 14 μg/L.

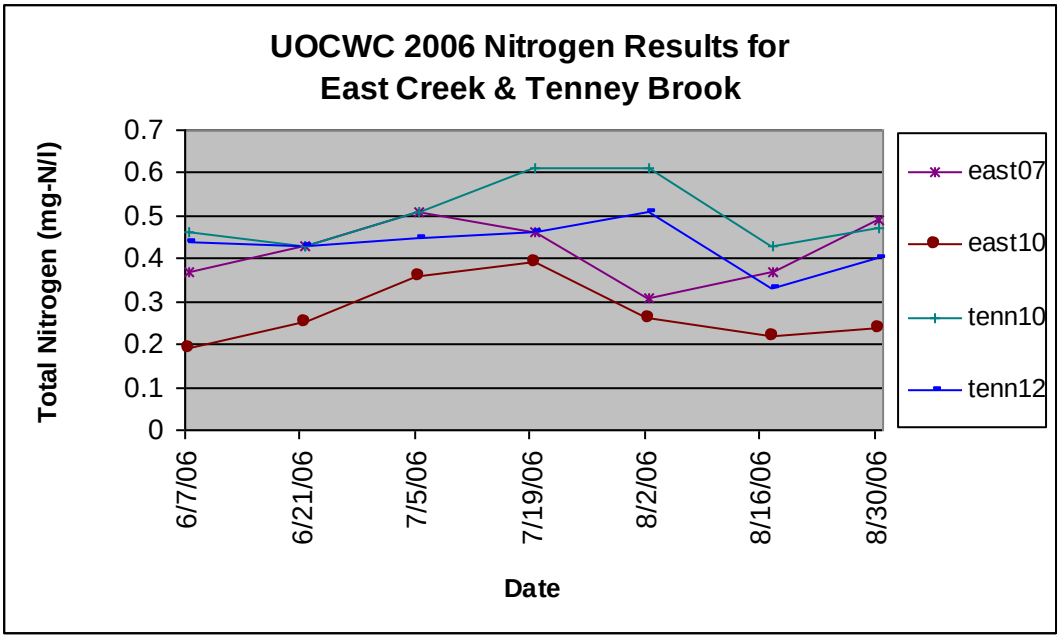
Baker Brook showed chronic high levels of Phosphorus throughout the summer. The Moon and Mussey Brooks were moderately high throughout the summer with spikes associated with the rainfall events in June. Of these sites Moon03 and Muss04 were the highest as were the furthermost downstream sites monitored. As with the E. coli, high phosphorus levels during dry periods may indicate failing septic systems or outfall pipes as the source. The Moon and Mussey are urban streams and may receive fertilizer in runoff from gardens and lawns. Other urban streams showed moderately elevated levels of phosphorus, especially the Tenney Brook site below Route 7 (Tenn10), and the furthermost downstream site on East Creek (East07). All other Otter Creek sites showed Phosphorus levels to fall within acceptable ranges. The Mill Brook sites in Danby were particularly low in comparison to other locations.

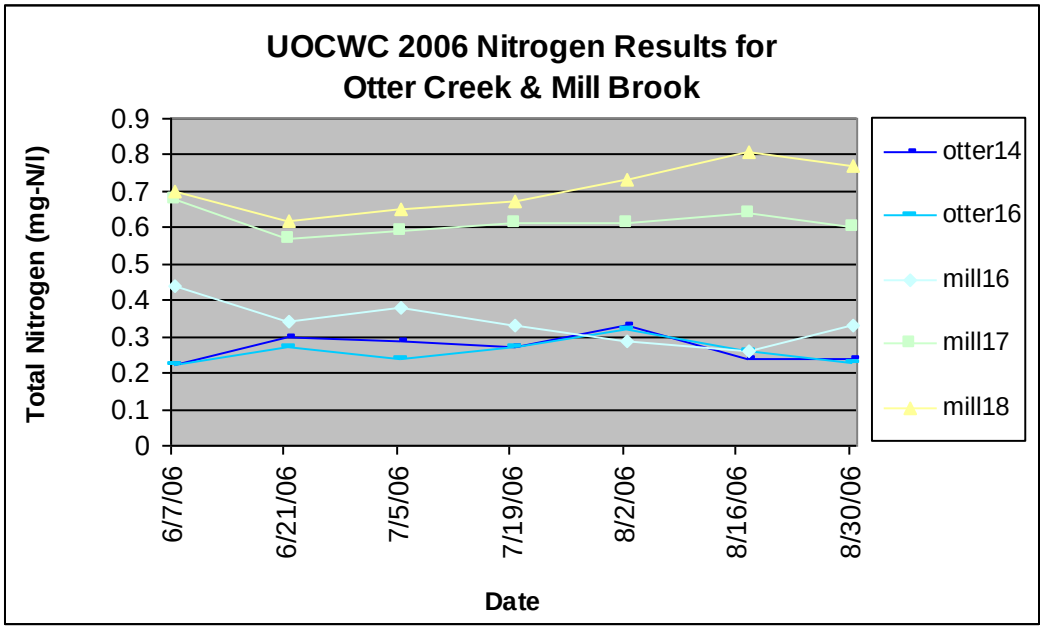
Total Nitrogen

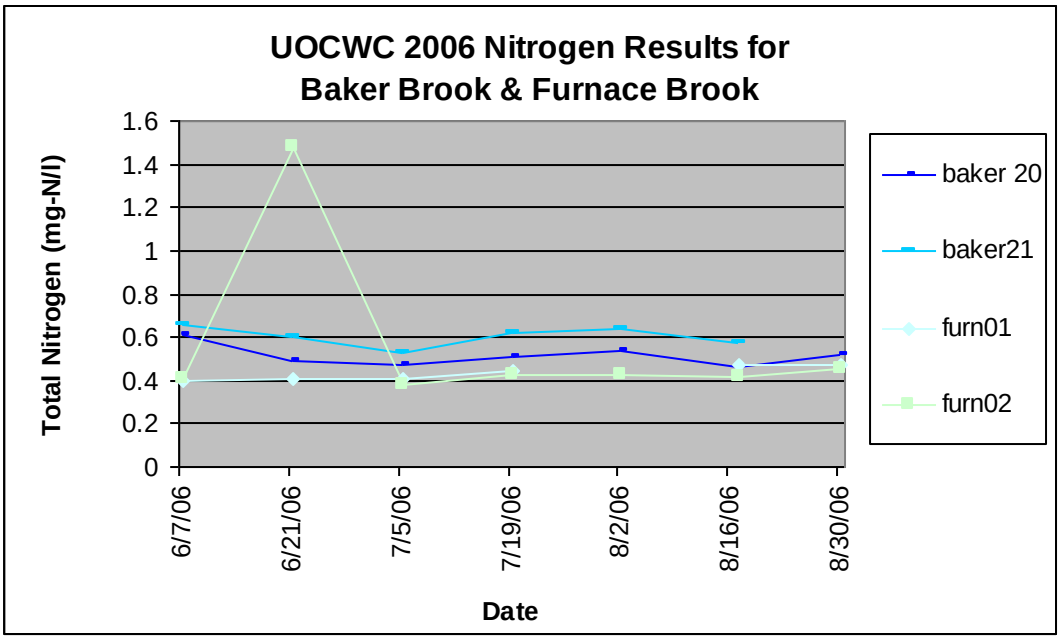
Pollutants such as sewage or manure contain high levels of nitrogen. Nitrogen may travel to groundwater or streams from fertilized fields, lawns, and golf courses, from septic system effluent or from runoff of manure.

Charts: 18-21: Total nitrogen results for Upper Otter Creek




UOCWC 2006 Nitrogen Results for
East Creek & Tenney Brook
Total Nitrogen (mg-N/l)
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
6/7/06
6/21/06
7/5/06
7/19/06
8/2/06
8/16/06
8/30/06
Date
east07
east10
tenn10
tenn12


UOCWC 2006 Nitrogen Results for
Otter Creek & Mill Brook
Total Nitrogen (mg-N/l)
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
6/7/06
6/21/06
7/5/06
7/19/06
8/2/06
8/16/06
8/30/06
Date
otter14
otter16
mill16
mill17
mill18



The natural level of ammonia or nitrate in surface water is typically low (less than 1 mg/L); in the effluent of wastewater treatment plants, it can range up to 30 mg/L. The Vermont Water Quality Standard for Class B waters states that $N0_3$-N concentrations shall not exceed 5.0 mg/L during certain flow conditions. The UOCWC measured total nitrogen in the water. Total nitrogen includes all of the commonly-found forms of nitrogen in the environment. The nitrate concentration listed above does not apply to the type of nitrogen that we measured.
Only two sites exceeded 1 mg/L, (Moon02 and Furn02). Furn02 is the furthermost downstream monitoring site on Furnace Brook, below the town of Pittsford and its wastewater treatment facility.

Conclusions

In conclusion, the Moon Brook and Mussey Brook (tributary to the Moon) showed consistently high nutrient, sediment and *E. coli* levels. Much of this pollution is carried to these urban creeks in stormwater. Other urban streams (Tenney Brook and East Creek) monitored this season show a similar trend. The City of Rutland has applied for, and was awarded, a grant to build settling tanks within the stormwater conveyance system in the city. The UOCWC has partnered with the City to provide education and outreach about the program and how residents of Rutland can help keep pollutants out of the stormwater entering creeks.

Data from Otter Creek sites showed an increase in turbidity and nutrient levels from upstream to downstream, perhaps indicating that NPS runoff is occurring between these two sites. Suspended solids and *E. coli* levels are higher at the downstream location, possibly indicating that wildlife could be affecting monitoring results given the extensive wetlands complex between the two sites.

Headwater tributary sites showed relatively low levels of *E. coli*, sediments and nutrients, with a few exceptions. Baker Brook, for example, had fairly high phosphorus results. This would indicate that nutrient enrichment is occurring higher in the watershed, possibly the result of the agriculture or other non-urban land use activities.

An excerpt from the 2005 Upper Otter Creek Water Quality Monitoring Report contained these recommendations for this season:

Other recommendations for next year's sampling include trying to sample directly after storm events, using rain gage data from Center Rutland and the Smokey House Center, creating a database that combines all data collected to date (chemical, buffer and geomorphic) and finally a way to quickly report E. coli results to the public.

With the exception of taking measurements after storm events and creating an umbrella database to hold all of our data, all of the goals were met from last year's report.

Appendix A

UOCWC 2006 sample Collection Training Schedule

Sample Coordinator	Nanci McGuire
QA Officer	Ethan Swift
Watershed Coordinator	Ethan Swift

	UOCWC Site Location and Descriptions
3-May-2004	2004 sites
15-May-2005	New sites for 2005
30-May-2006	New sites for 2006

	Sample Collection and Transportation Training at Vermont DEC
15-May-2006	Ethan Swift
15-May-2006	Michelle Smith
15-May-2006	Nanci McGuire

	UOCWC sample collection training
26-May-2006	Ethan Swift
	Jerry Stevens
	Trip Wescott
	Erica and Kurt Waggoner (SHC)

Appendix B- QAQC data

Table 3: Field Duplicate Analysis

The Relative Percent Difference (RPD) for duplicate averages for both turbidity and total suspended solids indicate that these mean RPD values exceed the Estimated Precision values as per the VT DEC LaRosa Laboratory Analysis Protocols for Water Samples (Table 7b) as indicated in the 2006 Water Quality Monitoring Project QAPP. This could be the result of errors in collection of the Tenney Brook samples and these duplicates (especially Tenn10).

Sample Number	Location	Date	Test	Duplicate	Result	Mean Diff	Actual-Duplicate	RPD Dupe Avg
060625-18	tenn 10	8/30/2006	E. coli.	96	73	84.5	-23	27.2189
060624-06	east10	8/17/2006	E. coli	10	13	11.5	3	26.0869
060527-12	Mill 17	8/2/2006	E. coli.	118	133	125.5	15	11.9522
060526-11	Mill 16	7/19/2006	E. coli	162	148	155	-14	9.0322
060465-08	Tenn 12	7/5/2006	E.coli	48	56	52	8	15.3846
060464-10	Otter 16	6/21/2006	E. coli.	161	114	137.5	-47	34.1818
060418-01	Moon 02	6/7/2006	E. coli	131	172	151.5	41	27.0627
								21.5599

Sample Number	Location	Date	Test	Duplicate	Result	Mean Diff	Actual-Duplicate	Dupe Avg
060625-07	tenn10	8/30/2006	Nitrogen, Total - Persulfate	0.46	0.47	0.465	0.01	2.1505
060624-06	east10	8/17/2006	Nitrogen, Total - Persulfate	0.22	0.22	0.22	0	0
060527-12	Mill 17	8/2/2006	Nitrogen, Total - Persulfate	0.63	0.61	0.62	-0.02	3.225
060526-11	Mill 16	7/19/2006	Nitrogen, Total - Persulfate	0.33	0.33	0.33	0	0
060464-10	Otter 16	6/21/2006	Nitrogen, Total - Persulfate	0.26	0.27	0.265	0.01	3.773
060418-01	Moon 02	6/7/2006	Nitrogen, Total - Persulfate	0.58	0.57	0.575	-0.01	1.739

								1.814583333
Sample Number	**Location**	**Date**	**Test**	**Duplicate**	**Result**	**Mean Diff**	**Actual-Duplicate**	**Dupe Avg**
060625-07	tenn10	8/30/2006	Phosphorus	24.1	23.4	23.75	-0.7	2.9473
060624-06	east10	8/17/2006	Phosphorus	12.3	13.3	12.8	1	7.8125
060527-12	Mill 17	8/2/2006	Phosphorus	12	12.2	12.1	0.2	1.6528
060526-11	Mill 16	7/19/2006	Phosphorus	13.8	13	13.4	-0.8	5.9701
060464-10	Otter 16	6/21/2006	Phosphorus	15.2	14.6	14.9	-0.6	4.0268
060418-01	Moon 02	6/7/2006	Phosphorus	14.3	14	14.15	-0.3	2.1201
								4.088266667
Sample Number	**Location**	**Date**	**Test**	**Duplicate**	**Result**	**Mean Diff**	**Actual-Duplicate**	**Dupe Avg**
060625-07	tenn10	8/30/2006	Solids, Total Suspended	5.38	2	3.69	-3.38	91.5989
060624-06	east10	8/17/2006	Solids, Total Suspended	1.6	2.2	1.9	0.6	31.5789
060527-12	Mill 17	8/2/2006	Solids, Total Suspended	2.1	2.1	2.1	0	0
060526-11	Mill 16	7/19/2006	Solids, Total Suspended	2.6	3.11	2.855	0.51	17.8634
060465-08	Tenn 12	7/5/2006	Solids, Total Suspended	1.4	2.8	2.1	1.4	66.6667
060464-10	Otter 16	6/21/2006	Solids, Total Suspended	4.74	3.8	4.27	-0.94	22.0141
060418-01	Moon 02	6/7/2006	Solids, Total Suspended	3.81	2.42	3.115	-1.39	44.6227
								39.1921

Sample Number	Location	Date	Test	Duplicate	Result	Mean Diff	Actual-Duplicate	Dupe Avg
060625-07	tenn10	8/30/2006	Turbidity	4.04	2.67	3.355	-1.37	40.8345
060624-06	east10	8/17/2006	Turbidity	2.19	2.41	2.3	0.22	9.5652
060527-12	Mill 17	8/2/2006	Turbidity	0.76	1.06	0.91	0.3	32.967
060526-11	Mill 16	7/19/2006	Turbidity	1.22	1.04	1.13	-0.18	15.9292
060465-08	Tenn 12	7/5/2006	Turbidity	3.72	4.24	3.98	0.52	13.0653
060464-10	Otter 16	6/21/2006	Turbidity	1.7	2.23	1.965	0.53	26.972
060418-01	Moon 02	6/7/2006	Turbidity	1.42	1.51	1.465	0.09	6.1433
								20.78235714