

Water Quality Monitoring in the Upper Winooski River Headwaters

2012

Bacteria and Nutrients

Within the towns of Cabot-Marshfield-Plainfield

By

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pearlshell mussel in distress at martin bridge 2011

For

**Friends of the Winooski River in Cooperation with
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E.coli – Bacteria

Fecal coliform bacteria are a particular group of bacteria primarily found in human and animal intestines and wastes. *Escherichia coli* (*E. coli*) is one of the fecal coliform bacteria widely used as an indicator organism to show the presence of such wastes in water and the possible presence of pathogenic (disease-producing) organisms. When *E. coli* is found in waters, its presence is not the problem of concern itself but is rather an indicator of the presence of fecal contamination (most strains of *E. coli* are not pathogenic) from humans or animals. *E. coli* monitoring is commonly conducted to ensure that the water is safe for swimmers and other contact recreational activities; a relationship can often be established between high bacteria concentrations and its sources such as rainfall runoff from urban streets, waterfowl or other wildlife congregations, pastured animals, and untreated waste (septic) water. Bacteria are measured in organisms or colony-forming units per 100 milliliters of water (cfu/100 mL). Vermont's Class B water quality standard sets the maximum tolerable *E. coli* level at 77 colonies per 100 ml of sampled water. This is a very conservative standard and indicates a potential risk of contracting a gastrointestinal health illness of <4 people in a 1,000 after ingestion of water. The federal Environmental Protection Agency (EPA) currently recommends a slightly less stringent standard of 235 cfu/100mL. This equals a risk factor of about 8 illnesses/1,000 ingestions.

Bacti Monitoring

In 2012 the upper Winooski volunteers concentrated sampling on the main stem locations from Cabot to Plainfield. Eleven locations were on the main stem of the Winooski River, which was shown in 2010, and 2011 to have a chronic bacti problem under base flow conditions from below Cabot to Plainfield. Only one tributary was sampled in 2012, Trib B in Plainfield, because it had periodic high bacteria cts in 2011 in an attempt to identify potential bacteria source sub watersheds. Samples were collected approximately bi-weekly in 2012 from June 19th, thru Sept. 11th resulting in 5 samplings over the summer. **Table 1** below lists all sites sampled in 2012, as well as those sampled in 2010, and 2011. Maps in **Appendix 1** show the locations of all 2012 bacti sampling locations. All the bacti data are presented in **Appendix 2**.

The summer's geometric mean from all locations is presented in **Table 2**, along with years 2010 and 2011. The table illustrates where bacteria levels are chronically and acutely high along the main stem. Chronically high counts were present from just below Cabot at Larry's Ball field RM 85.5 to RM 83.4, below first farm ditch on Gould's flat. At this point bacti levels approached the EPA criteria of 235 and are well above the Vermont criteria of 77. The next downstream location sampled 82.8 is just above the GMP generating station. Bacti levels at this location doubled from the location above indicating significant non-point sources of bacteria occur between

these locations along Gould Flats Road. Bacteria levels at this location averaged over 500 well above both VT and EPA safe swimming levels. The next location downstream 83.6 just above Marshfield Village at Rt 2 bridge showed similar high levels of bacteria. This location is a short distance above the dam in Marshfield village that was removed in 2012. The removal of this dam opens up a potential kayaking run from about the 83.6 location down to the Marshfield town community center, and Creamery Brook confluence. High bacteria levels thru this reach of stream will expose kayakers and other contact recreational users of the river to a greater risk of exposure and contracting gastrointestinal related sickness. Sampling at the next location which is just below Creamery brook shows drop in bacteria levels to near the 200 ct level, indicating that bacti levels drop as you move downstream thru the village. This is likely due to dilution from Creamery brook, degradation of the bacteria themselves, and effective effluent disinfection from the Marshfield WWTF. Bacteria levels then remain at about the 200 ct level from just below Marshfield village at site 81.6 dropping off slightly at the next location sampled 72.8 the Martin Bridge. Bacti levels however do rise significantly between the Martin Bridge and the next location 71.4 below the dam in Plainfield village. At this location the bacti cts increase to about 400 again creating a greater risk of exposure and contracting gastrointestinal related sickness while swimming immediately below the Plainfield dam. The most downstream location sampled 70.7 below the Plainfield WWTF shows a drop in bacti cts to about the 200 level, again likely due to dilution from Great Brook, bacti degradation and effective effluent disinfection from the Plainfield WWTF. The only tributary resampled in 2012 was Trib B in Plainfield because in 2011 it was found to be a bacti source. The 2012 monitoring did not show this trib as a significant source of bacti. Bacti levels in Trib B dropped to below 77ct, the Vermont safe swimming standard.

In summary the bacti monitoring on the main stem of the upper Winooski River showed a similar trend as that of 2011, with the highest levels of bacti in two reaches. One reach in Marshfield just below the Cabot flats at the Hydro generation station thru Marshfield village to about Creamery Brook, and the other in Plainfield village below the dam. The bacti cts in these reaches are significantly above the VT and EPA safe swimming and other contact recreation standard (including Kayaking) with the geometric mean in 2012 from 400- 500. The sources of bacti for the Marshfield village appear to be located between the Hydro generating station and upper Gould flats road. This reach of the watershed should be explored to help identify potential non- point sources and ways to mitigate them. The high bacti in the Plainfield village area are potentially from stormwater or poor municipal hookups and infrastructure leaks. These potential infrastructure village connections will be explored in 2013.

Table 1: Bacti monitoring locations for 2010, 2011, and 2012 Cabot-Marshfield-Plainfield, Vt. Shaded locations re- sampled in 2012.

River Location	Latitude	Longitude	Description
REC FIELD	44.4064	72.3084	Rec Field trib. Adjacent to Cabot rec fields above town
TRB G 0.1	44.4025	72.3109	Trib G In center of Cabot village site above main street, behind garage.
WIN 85.5	44.3984	72.3244	By Larry's Ball field below Cabot village.
TRB F 0.1	44.3928	72.3215	Trib F adjacent to Cabot Cheese treatment ponds
JB 0.1	44.3923	72.3310	Jug Brook immediately below Rt 215 in lower cabot
WIN 84.1	44.3906	72.3307	Immediately above sawmill road bridge at Cabot WWTF
WIN 83.8	44.3829	72.3325	Durant cemetery below Cabot WWTF
WIN 83.4	44.3795	72.3331	Upper Gould flats, below farm road xing 50m
WIN 82.8	44.3604	72.3353	Just above GMP generation station.
WIN 82.6	44.3519	72.3470	At Rt 2 bridge just above Marshfield Village
MOB 0.1	44.3593	72.3359	Mollys Brook, below Mollys Falls just ab confluence with Winooski
TRB E 0.1	44.3569	72.3424	Trib E. Just below Rt 215, trib entering from west by red house.
TRB D 0.1	44.3544	72.34453	Trib D enters from east side, below horse farms.
WIN 81.6	44.3501	72.3566	Below Marshfield WWTF, at flower farm
WIN 72.8	44.2871	72.4090	At Martin Bridge
WB 0.1	44.28341	72.41726	Wells Brook just Above Rt 2
TRB C 0.1	44.2815	72.4131	Trib C Below RR bed crossing.
TRB B 0.2	44.2753	72.4146	Trib B Above residential area, below agricultural land.
TRB B 0.1	44.2792	72.4176	Trib B Below RR bed crossing, below residential area in Plainfield.
WIN 71.5	44.2794	72.4201	Below Trib B confluence near coop
TRB A 0.1	44.2789	72.4241	Trib A entering from north, above Rt 2, near elder housing
WIN 71.4	44.2775	72.4258	Below Bridge and Dam in Plainfield Village
WIN 71.3	44.2758	72.4287	Above discharge at Plainfield WWTF, below Great brook.
WIN 70.7	44.2733	72.4322	Below Plainfield WWTF at rip rap bank

Bacti counts in all other reaches of the upper Winooski remain at levels above the Vt WQS level of 77, and at about the EPA standard of 235. These reaches include below the village of Cabot, lower Marshfield village to Martin Bridge, and below Plainfield village.

Due to the elevated bacti levels in the main stem it is recommended that this monitoring continue, and results be posted at town offices in a timely manner. Results could also be posted if possible where recreational uses involve swimming, kayaking and wading to alert the public of the increased risk of water ingestion while undertaking these recreational activities. The now active front porch forum could also be a vehicle to alert town's people of the bacti risk.

Table 2: The Geometric Mean Bacti Cts (GMB) from River Mile Locations on the Upper Winooski River and its Tributaries. Site locations listed from headwaters in Cabot (top) to Plainfield Village (bottom). Tribs placed where they enter the Winooski River main stem. * Indicates single sample value

Sample site identifier, and location description for 2012 sites Location – of site is presented from upper to lower within watershed	2010 GBM#/ 100ml	2011 GBM#/ 100ml	2012 GBM#/ 100ml
REC FIELD At Cabot recreation field		53	
TRB G 0.1 In village of Cabot		14	
WIN 85.5 Larry's ball field	51	107	94
TRB F 0.1 Adjacent to Cabot Creamery settling ponds		20	
JB 0.1 Jug Brook lower Cabot	67		
WIN 84.1 Above Cabot WWTF, above bridge crossing left side	118	117	124
WIN 83.8 Durant Cemetery	137	223	143
WIN 83.5 Adjacent to farm above farm road crossing		194	
WIN 83.4 Below farm road crossing and pasture drainage ditch			220
WIN 82.8 Above GMP generation station			541
MOB 0.1 Mollys Pond Brook		63	
TRIB E 0.1 Small trib from the west McCrillus Raod		51	
TRIB D 0.1 Small trib from east adjacent to horse farm		87	
WIN 82.6 RT 2 bridge in Marshfield at fire hydrant, cemetery	236	232	477
WIN 81.8 Above Marshfield WWTF, below Creamery brook	193		213
WIN 81.6 Below Marshfield WWTF, at F&W property, Flower Farm	149	95	222
WIN 78.1 Patties crossing bridge	80		
WIN 72.8 Martin bridge	162	229	167
WB 0.1 Above Rt 2 culvert crossing	70	13	
TRIB C 0.1 Below RR bed bridge crossing		31	
TRIB B 0.2		57	17*
TRIB B 0.1 Below RR bed bridge crossing		335	57
WIN 71.5 Access behind Plainfield food CoOp		280	
TRIB A 0.1 Just above senior housing – old plainfield school		34	
WIN 71.4 Below dam Plainfield Village, above Great Brook	371	488	432
WIN 71.3 Above Plainfield WWTF, access at WWTF	262		
WIN 70.7 Below Plainfield WWTF at rip rap bend in river	268		245

Water Quality Monitoring Results

Six stream reaches **Table 3** were sampled in 2012 for nutrients (total nitrogen and phosphorus),and Chloride. The samples were all collected under base flow conditions, and do not reflect runoff event stream chemistry. The results are presented in **Appendix 3** and average concentrations are in **Table 4** below. Chloride concentrations were below 10 mg/l at all sites and below the detection level of 2 mg/l at three of the tributary streams. Chloride concentrations in Vermont are primarily a reflection on the level of road salt accumulation in the groundwater. These Chloride levels are low and do not pose a threat to the aquatic life. Water quality criteria to protect the aquatic life currently begin at 230 mg/l, the chronic ALS value for Chloride.

Nutrient concentrations were also relatively low with the exception of TNitrogen in Great Brook, which averaged 0.72 mg N/l. This is above the guidance value being considered by VT ANR, to prevent unacceptable enrichment of the stream ecosystem, and an impairment to the aquatic life of a stream. All other locations show TN to range between 20 and 28 mgN/l, 2-3 times lower then Great Brook. Total phosphorus, TP, ranged from 6 ug/l in Great Brook to 18 ug/l at the Martin Bridge. These concentrations should not cause undue algal growth, and show these streams to have very good water quality.

Table 3: Locations of water quality monitoring stream reaches sampled in 2012.

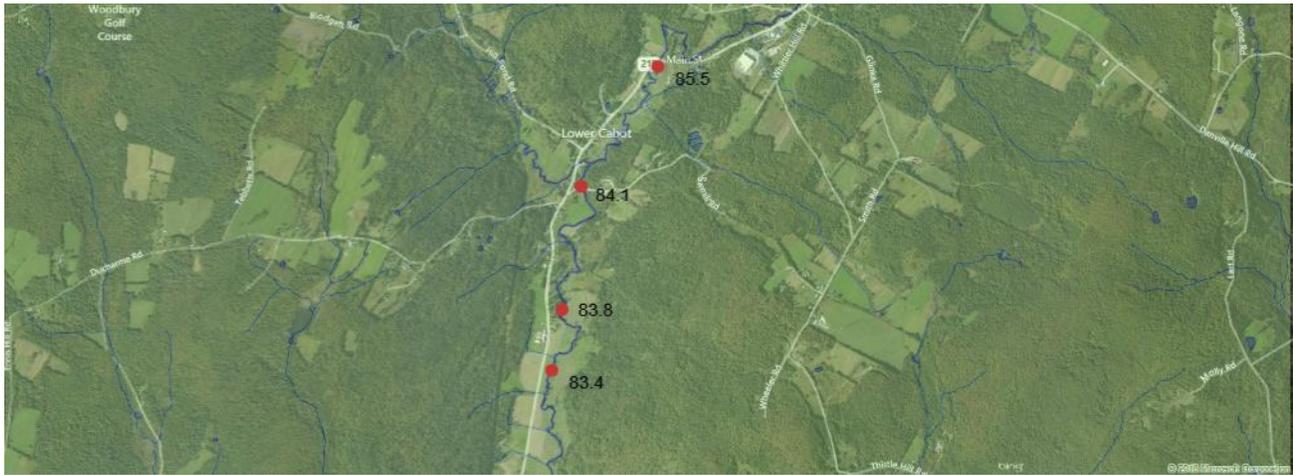
River Location	Latitude	Longitude	Description
Win 87.7	44.4204	72.3159	Located below Houston Hill Road in Cabot
JB 0.1	44.3923	72.3310	Jug Brook immediately below Rt 215 in lower Cabot.
GUB 0.9	44.3051	72.4093	Guernsey Brook below Jake Martin Road culvert.
NB 0.2	44.3012	72.3959	Naismith Brook behind Twinfield soccer field.
WIN 72.8	44.2871	72.4090	Winooski River at Martin Bridge
GB 0.1	44.2767	72.4267	Great Brook at mouth

Table 4: The average (n=4) concentration of the Water Quality parameters Chloride, Total Nitrogen, and Total Phosphorus from six small streams in the upper Winooski River, and the Martin Bridge site WIN 72.8. All samples were collected under baseflow in 2012.

Location	Year	flow	Chloride	TN	TP
units			(mg/L)	(mg-N/l)	(ug P/L)
WIN 87.9	2012	base	3.9	0.28	16.0
JB 0.1	2012	base	<2	0.26	11.3
GUB 0.1	2012	base	<2	0.24	9.3
NB 0.2	2012	base	<2	0.20	15.0
WIN 72.8	2012	base	7.3	0.27	18.1
GB 0.1	2012	base	8.8	0.72	6.0

Appendix 1: Maps showing locations of Bacteria sampling sites in the Upper Winooski River 2011.

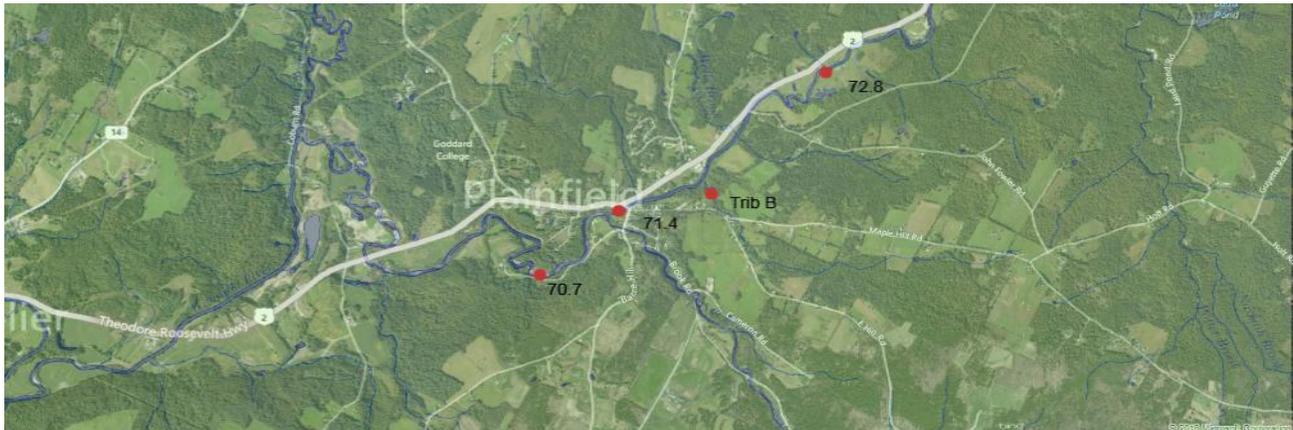
Cabot area



Marshfield Village area



Plainfield area



Appendix 2: 2012 Bacti counts by station location and date, and the geometric mean

Location	Date	flow	Final E. Coli. (mpn/100ml)
Trib B0.2	9/11/2012	base	17
TRB B 0.1	6/19/2012	base	152
TRB B 0.1	7/10/2012	base	32
TRB B 0.1	7/31/2012	base	52
TRB B 0.1	8/15/2012	base	17
TRB B 0.1	9/11/2012	base	142
TRB B 0.1	geo mean		57
WIN 70.7	6/19/2012	base	435
WIN 70.7	7/10/2012	base	183
WIN 70.7	7/31/2012	base	411
WIN 70.7	8/15/2012	base	210
WIN 70.7	9/11/2012	base	128
WIN 70.7	geo mean		245
WIN 71.4	6/19/2012	base	387
WIN 71.4	7/10/2012	base	387
WIN 71.4	7/31/2012	base	687
WIN 71.4	8/15/2012	base	727
WIN 71.4	9/11/2012	base	201
WIN 71.4	geo mean		432
WIN 72.8	6/19/2012	base	98
WIN 72.8	7/10/2012	base	687
WIN 72.8	7/31/2012	base	214
WIN 72.8	8/15/2012	base	71
WIN 72.8	9/11/2012	base	128
WIN 72.8	geo mean		167
WIN 81.6	6/19/2012	base	190
WIN 81.6	7/10/2012	base	291
WIN 81.6	7/31/2012	base	326
WIN 81.6	8/15/2012	base	127
WIN 81.6	9/11/2012	base	238
WIN 81.6	geo mean		222
WIN 81.8	6/19/2012	hydro	1553
WIN 81.8	7/10/2012	base	228
WIN 81.8	7/31/2012	base	285
WIN 81.8	8/15/2012	base	111
WIN 81.8	9/11/2012	base	285
WIN 81.8	geo mean		317

WIN 82.6	6/19/2012	hydro	326
WIN 82.6	7/10/2012	base	517
WIN 82.6	7/31/2012	base	792
WIN 82.6	8/15/2012	base	411
WIN 82.6	9/11/2012	base	308
WIN 82.6	geo mean		477
WIN 82.8	6/19/2012	base	517
WIN 82.8	7/10/2012	base	770
WIN 82.8	7/31/2012	base	435
WIN 82.8	8/15/2012	base	411
WIN 82.8	9/11/2012	base	649
WIN 82.8	geo mean		541
WIN 83.4	6/19/2012	base	231
WIN 83.4	7/10/2012	base	161
WIN 83.4	7/31/2012	base	1553
WIN 83.4	8/15/2012	base	121
WIN 83.4	9/11/2012	base	73
WIN 83.4	geo mean		220
WIN 83.8	6/19/2012	base	162
WIN 83.8	7/10/2012	base	179
WIN 83.8	7/31/2012	base	162
WIN 83.8	8/15/2012	base	148
WIN 83.8	9/11/2012	base	86
WIN 83.8	geo mean		143
WIN 84.1	6/19/2012	base	56
WIN 84.1	7/10/2012	base	186
WIN 84.1	7/31/2012	base	162
WIN 84.1	8/15/2012	base	144
WIN 84.1	9/11/2012	base	120
WIN 84.1	geo mean		124
WIN 85.5	6/19/2012	base	50
WIN 85.5	7/10/2012	base	196
WIN 85.1	7/31/2012	base	27
WIN 85.5	8/15/2012	base	73
WIN 85.5	9/11/2012	base	387
WIN 85.5	geo mean		94

Appendix 3: Water quality results from 2012 locations.

Location	Date	units	Chloride (mg/L)	TN (mg-N/l)	TP (ug P/L)
GB 0.1	6/19/2012	base	9.1	0.73	5.0
GB 0.1	7/10/2012	base	10.2	0.84	6.4
GB 0.1	8/15/2012	base	8.5	0.68	6.0
GB 0.1	9/10/2012	base	7.4	0.61	6.4
GB 0.1	ave	base	8.8	0.72	6.0
GUB 0.1	6/19/2012	base	< 2	0.26	8.1
GUB 0.1	7/10/2012	base	< 2	0.34	12.6
GUB 0.1	8/15/2012	base	< 2	0.19	7.8
GUB 0.1	9/10/2012	base	< 2	0.15	8.6
GUB 0.1	ave	base	<2	0.24	9.3
JB 0.1	6/19/2012	base	< 2	0.30	8.4
JB 0.1	7/10/2012	base	< 2	0.25	11.6
JB 0.1	8/15/2012	base	< 2	0.22	14.3
JB 0.1	9/10/2012	base	< 2	0.28	10.9
JB 0.1	ave	base	<2	0.26	11.3
NB 0.2	6/19/2012	base	< 2	0.28	15.5
NB 0.2	7/10/2012	base	< 2	0.22	12.0
NB 0.2	8/15/2012	base	< 2	0.14	17.5
NB 0.2	9/10/2012	base	< 2	0.17	14.9
NB 0.2	ave	base	<2	0.20	15.0
WIN 72.8	6/19/2012	base	10.0	0.38	16.2
WIN 72.8	7/10/2012	base	6.8	0.27	22.2
WIN 72.8	8/15/2012	base	5.3	0.23	20.3
WIN 72.8	9/10/2012	base	7.0	0.19	13.5
WIN 72.8	ave	base	7.3	0.27	18.0
WIN 87.9	6/19/2012	base	3.2	0.28	13.6
WIN 87.9	7/10/2012	base	4.6	0.33	16.8
WIN 87.9	8/15/2012	base	4.0	0.24	17.7
WIN 87.9	9/10/2012	base	4.0	0.26	
WIN 87.9	ave	base	3.9	0.28	16.0