Water Quality Monitoring in the Upper Winooski River Headwaters

2016

E. coli, chloride, alkalinity, phosphorus, nitrogen, and turbidity levels in the streams of Cabot-Marshfield-Plainfield

Marshfield Cliffs in fall color 2016

The Friends of the Winooski River in Cooperation with
The Conservation Commissions of Cabot, Marshfield, and Plainfield
with support from the
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Prepared by Steve Fiske and Shawn White for
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Water Quality Monitoring by the Winooski Headwaters Partnership

The Winooski Headwaters Partnership is composed of the Conservation Commissions of Plainfield, Marshfield, and Cabot; the Friends of the Winooski River; and community members of Headwaters towns. The Headwaters Partnership has been conducting water quality monitoring of the Winooski River and several of its tributaries since 2007. Parameters of interest have included *E. coli,* total phosphorus, total nitrogen, turbidity, chloride, alkalinity, temperature, and pH. Monitoring sites have been chosen based on recreational contact, suspected pollutant sources, locations of waste water treatment plants, and a population of a Vermont listed threatened species.

The following report describes the results of the Headwaters Partnership 2016 monitoring. Samples were collected by Headwaters volunteers approximately biweekly on, July 5/6, July 19, Aug 2, August 17, and August 30. Descriptions and locations of the sampling sites sampled for bacteria (*Escherichia coli*) , and or for water quality parameters are shown in **Appendix A**. Despite the overall dry summer in 2016 our sampling dates only saw two dates during dry weather (base flows), these occurred on the first and last sampling dates. Event runoff (collected after a rain event) occurred on the three mid summer dates. Samples were analyzed at the Vermont Department of Environmental Conservation La Rosa laboratory by laboratory staff. Individual sample results are listed in **Appendices B** and **C**. Quality assurance measures (duplicate sample relative percent differences) and control blank results are shown in **Appendices D** and **E** and met target values in all cases except the *E. coli* duplicate pair taken at WIN85.5 on 7/19, which had a relative percent difference (RPD) of 91%; the turbidity duplicates taken at NAB2.8 on 7/19 and WIN81.6 on 8/17; and the phosphorus and nitrogen duplicates taken on 8/30 at GUB1.0. With the exception of the *E. coli* duplicates, the high RPD of these pairs was likely due to the parameter measurements being so low, so that any slight difference between the two measurements resulted in a large relative percent difference.

***E. coli* Background and Results**

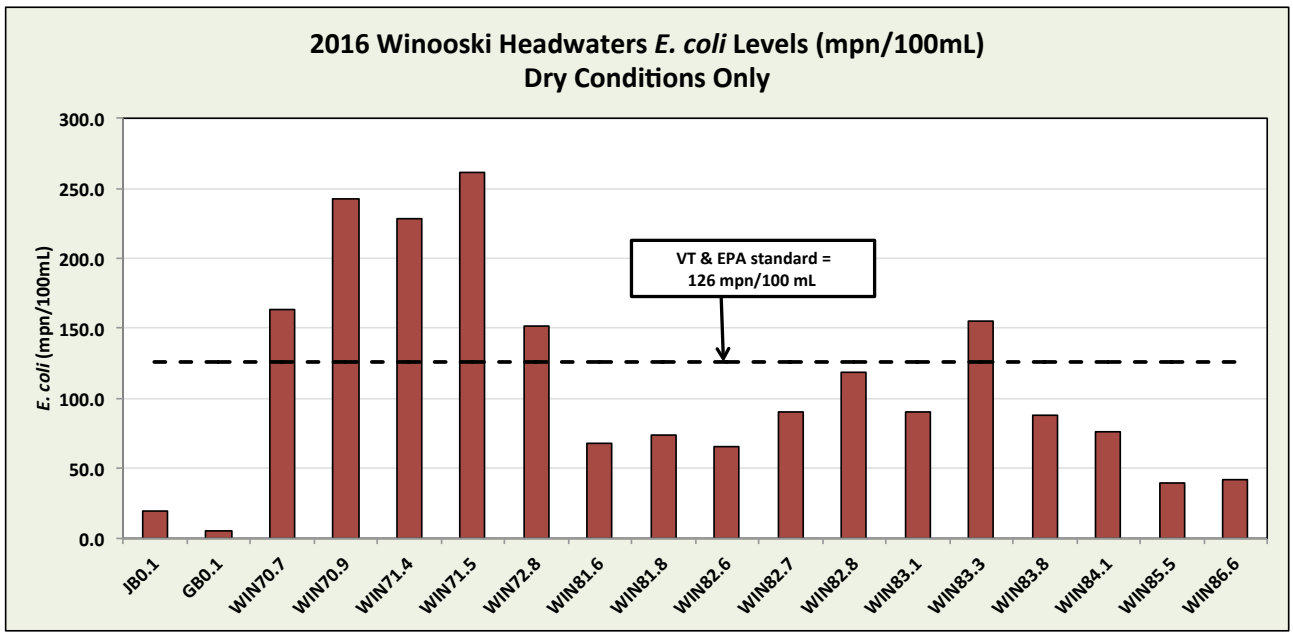
Fecal coliform bacteria are a particular group of bacteria primarily found in human and animal intestines and feces. *Escherichia coli* (*E. coli*) is one of the fecal coliform bacteria widely used as an indicator organism to detect the presence of fecal material in water and the possible presence of pathogenic (disease-producing) organisms. When *E. coli* is found in waters, its presence is not the problem of concern itself (most strains of *E.coli* are not pathogenic), but is rather an indicator of the presence of other pathogens found in fecal matter from humans or animals. *E. coli* monitoring is commonly conducted to inform people 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, pet waste, and untreated waste (septic or sewage) wastewater. Vermont's *E.coli* criteria matches the EPA recommendations: "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"*. This equals to a *risk factor of about 36 illnesses/1,000 ingestions*. The EPA also provides an *E. coli* "Beach Action

Value" (BAV) of 235 MPN/mL for single water samples. States can adopt this value and use it to close a recreational water site to the public when *E. coli* levels are above this standard.

Headwaters Partnership volunteers collected samples for *E. coli* testing at 18 locations on the Winooski River on an approximately biweekly basis for most sites starting July 5 or 6 to August 30, 2016. Site locations are presented as the River Mile (RM) of the river or stream up from its mouth. As such the highest RM, WIN86.6, is located above Cabot village, and the lowest at RM, WIN70.1 is below the Plainfield WWTF. All site descriptions are found in a table at the end of this report in **Appendix A**. Individual sample results are presented in **Appendix B**.

The results as the geometric mean of the two base flow sampling events collected at a location are presented in **Figure 1**. These results are representative of river conditions when swimming is most likely to occur. The *E. coli* levels within the main stem of the Winooski River were highest at WIN71.5, behind the co-op, and remain high thru the village of Plainfield down to WIN70.7, below the Plainfield WWTF. *E. coli* levels above the WQ standards also occurred at the Martin Bridge, just upstream of Plainfield village. In 2016 the only other reach that showed elevated levels was in the Cabot flats at RM 83.3. It should be noted, however, that this value is based on a single sample collected on the first collection date (no other sample was collected at this site).

Figure 1: *E. coli* levels in the upper Winooski River 2016 during baseflow conditions. The dotted black line indicates the VT standard for geometric mean *E. coli* levels (126 mpn/100 mL).



The Plainfield village reach of river has been high in *E. coli* for years (**Figure 2, and Table 1).** The reach, which is adjacent to the Plainfield Recreation Fields, should be considered as having a higher risk for contact recreation, and efforts should continue in identifying the source(s) of this contamination. In 2016 samples collected from behind the co-op and at Martin Bridge show the contamination is likely from multiple non-point sources. A second reach of river is also slightly above standards is the "Cabot Flats". Historically the *E. coli*

levels in this reach have been sporadically high in some years while lower in other years. In 2016 the reach of stream thru the village of Marshfield shows an improvement compared to past years, with no base flow samples above the WQ standards.

Figure 2: Showing E.coli levels over time at all locations from 2012-2016.

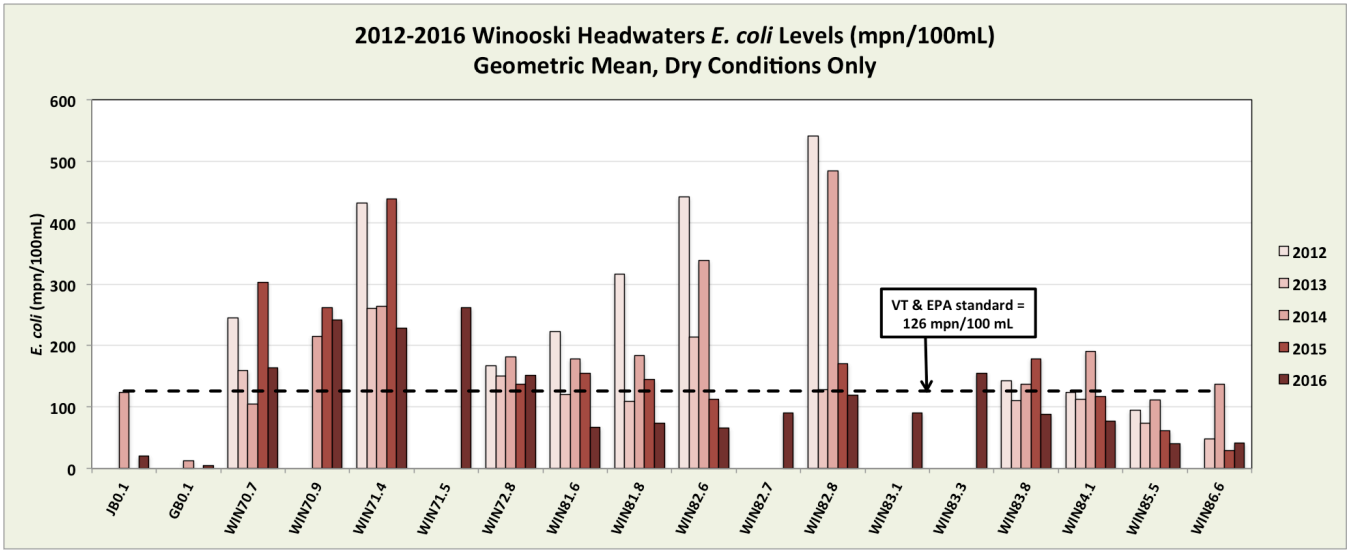


Table 1: Showing *E.coli* levels over time at all locations sampled in 2016 from 2007-2016.

	***E. coli* Geometric Mean Under Dry Conditions**								
Site ID	**2007**	**2008**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
JB0.1			67				123		20
GB0.1	39	58					12		5
WIN70.7		149	268		245	159	105	302	164
WIN70.9							215	262	242
WIN71.4	192	172	371	533	432	261	264	439	229
WIN71.5									261
WIN72.8			162	214	168	150	181	137	152
WIN81.6	256	134	150		223	120	178	154	67
WIN81.8		154	184		317	109	184	145	74
WIN82.6		41	236	56	442	214	338	113	66
WIN82.8				171	541	128	485	170	119
WIN83.1									90
WIN83.3									155
WIN83.8	187	83	128	175	143	110	137	179	88
WIN84.1			118	84	124	113	190	117	77
WIN85.5			51	78	94	74	112	61	40
WIN86.6						48	137	29	41
	Exceeds EPA standards for the annual geometric mean (126 mpn/ml)								

Figure 3 shows the 2106 *E. coli* levels in the upper Winooski River, comparing dry baseflow and event runoff flow samples. The Vermont standard of is the geometric mean of 126 mpn/100 ml. The high levels in the river under event flows coincide with high turbidity levels (**Figure 4)** in the river, together indicating stormwater runoff, and/or re-suspended river sediments are contaminated with *E. coli*. It is therefore not recommended to

swim in the Winooski river immediately following a rain event until the water clarity improves; because you are at a substantially higher risk of contracting a water-borne stomach illness. Turbidity is noticeable at about 10 NTU's.

Figure 3: 2016 *E. coli* levels in the upper Winooski River, comparing dry baseflow and event runoff flow samples. VT standard for geometric mean *E. coli* levels is 126 mpn/100 ml under baseflow conditions.

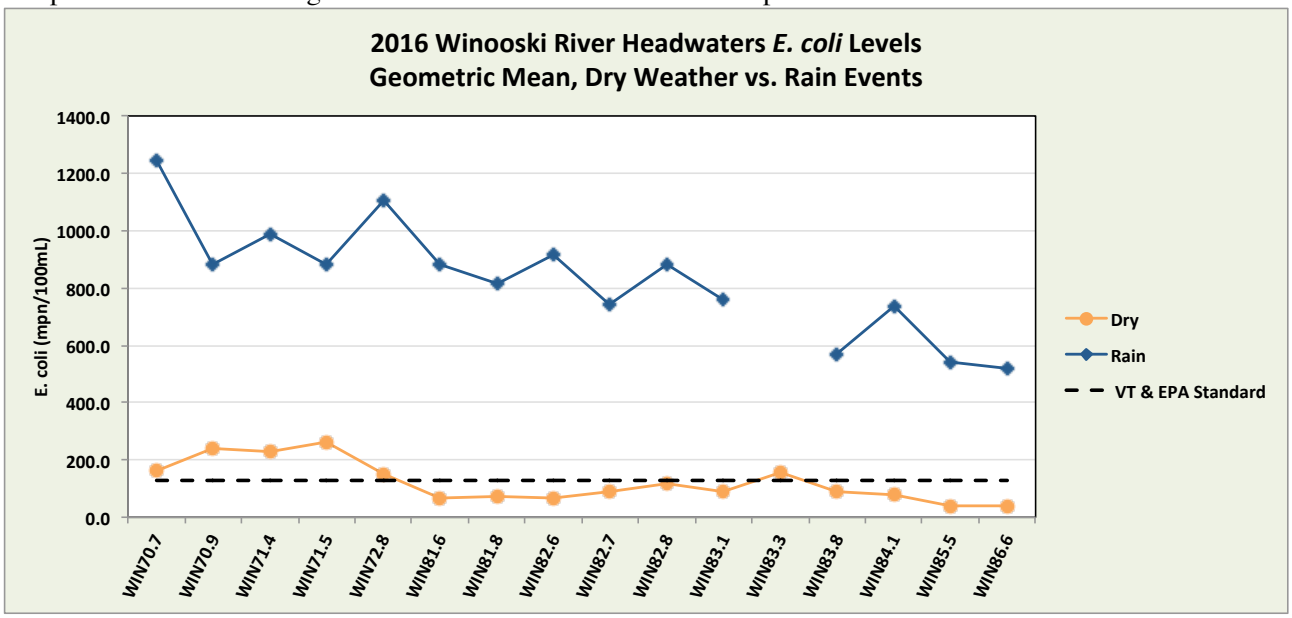
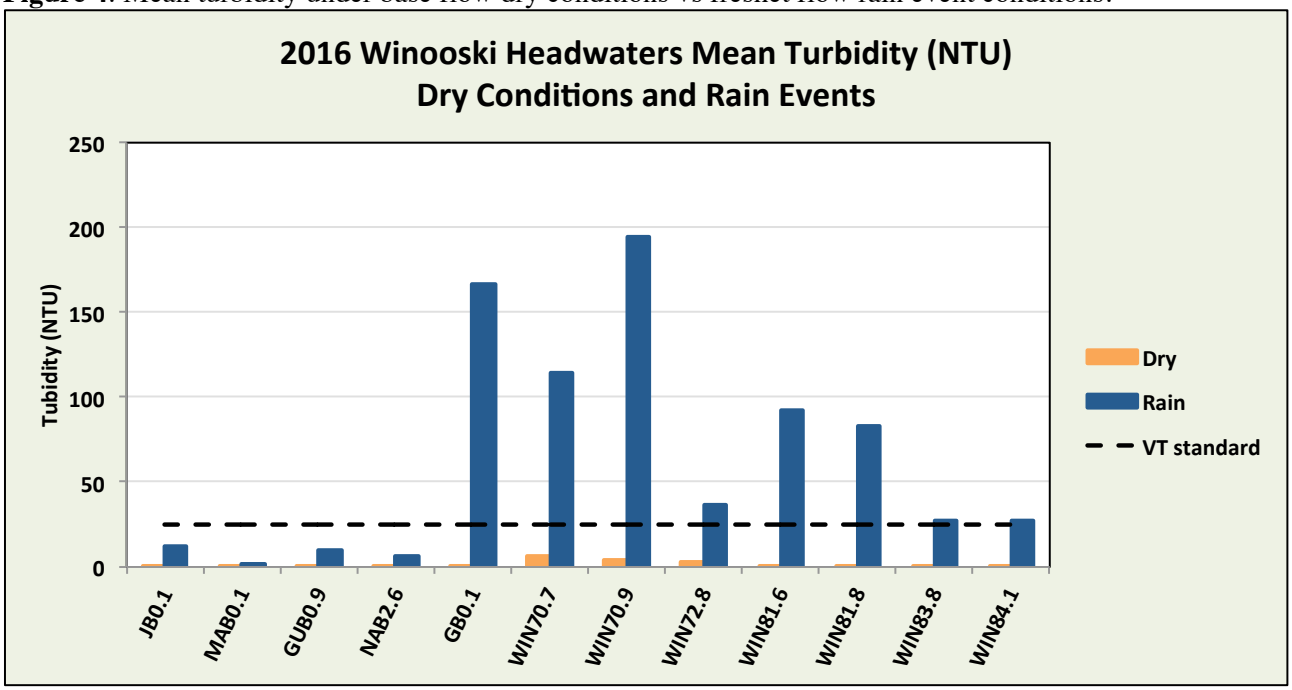


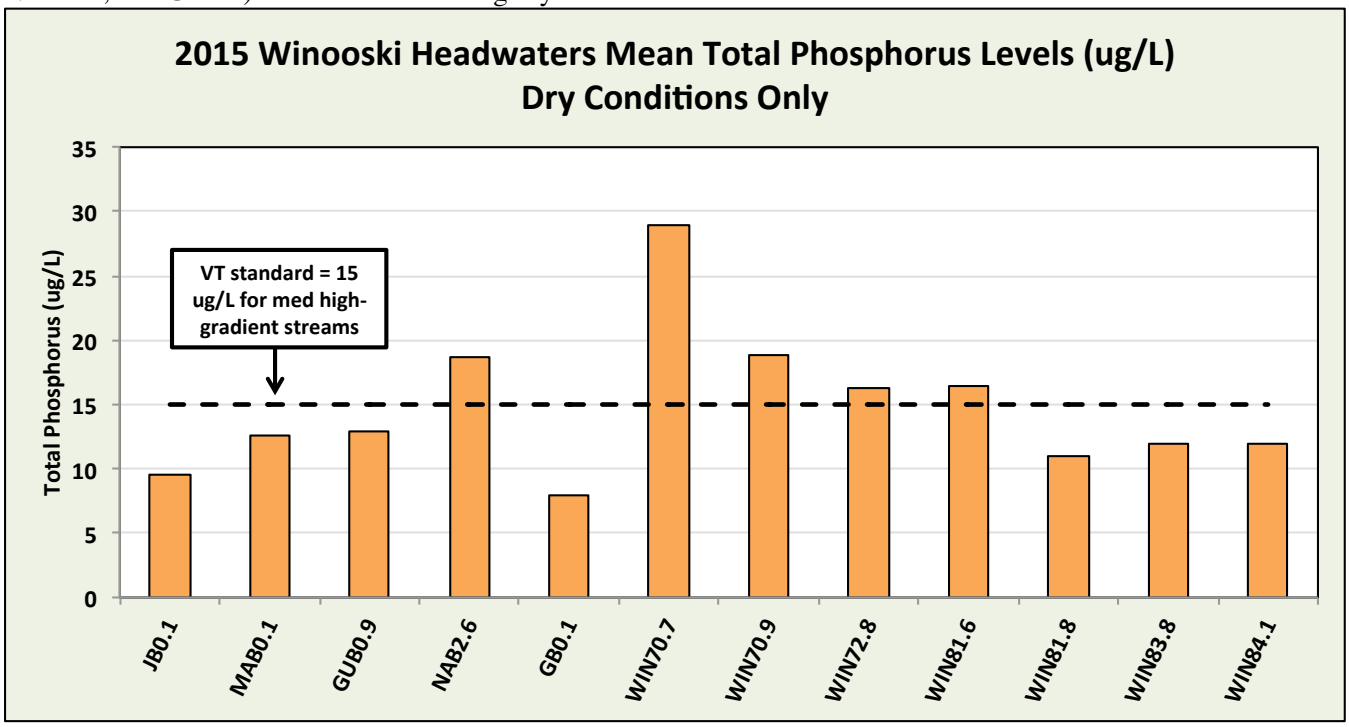
Figure 4: Mean turbidity under base flow dry conditions vs freshet flow rain event conditions.



Vermont's phosphorus river water quality standards apply under base flow conditions during the summer/fall June-October growing season. It is under these hydrologic conditions, and warm summer/fall stream

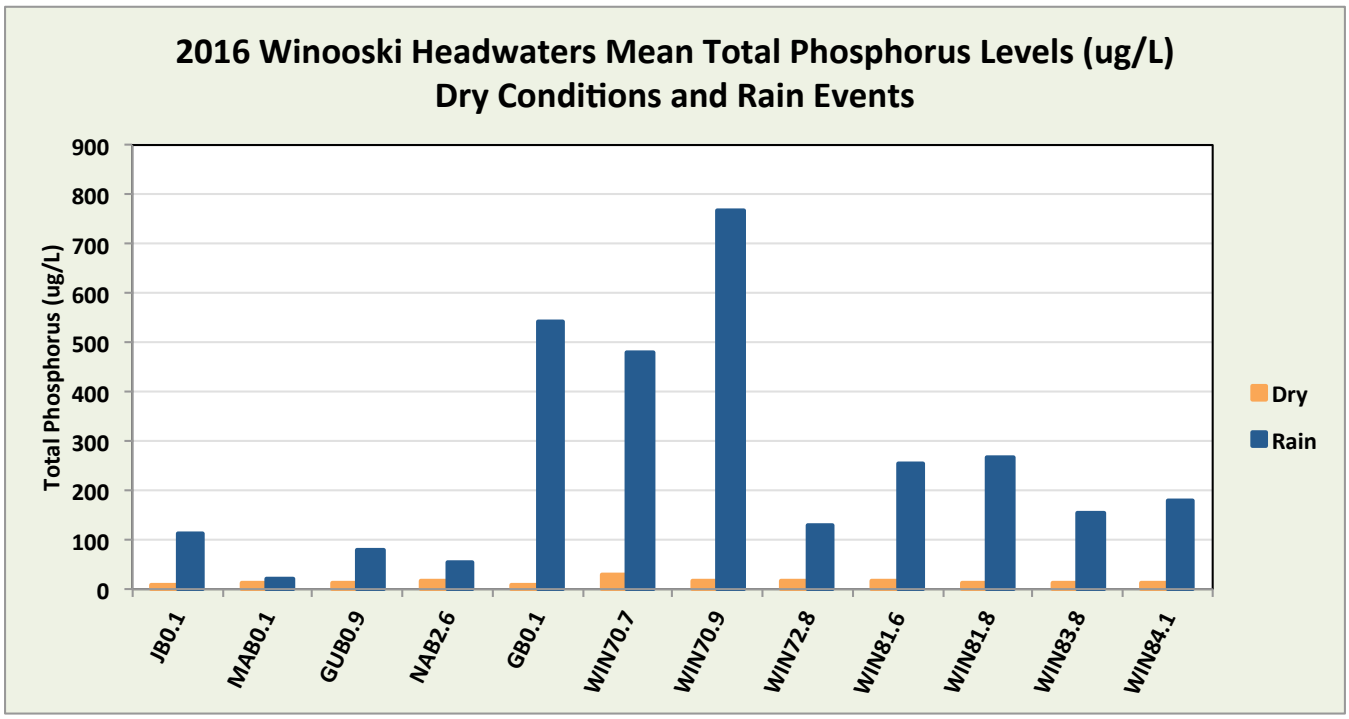
conditions that attached stream bed algae can become most prolific and potentially cause a detrimental effect on the aquatic life of a stream. The mean total phosphorus of the samples taken on the two dry-weather, base-flow sampling dates in 2016 is shown in **Figure 5**. At all but the WIN70.7 site, total phosphorus concentrations under base flow conditions were below or only slightly above the VT water quality standards for both the Small High Gradient (12ug/l) and Medium High Gradient (15ug/l) for Class B waters in 2016.

Figure 5: Mean total phosphorus levels in the Winooski Headwaters tributaries (JB0.1, MAB0.1, GUB0.9, NAB2.6, and GB0.1) and mainstem during dry low flow conditions in 2016.



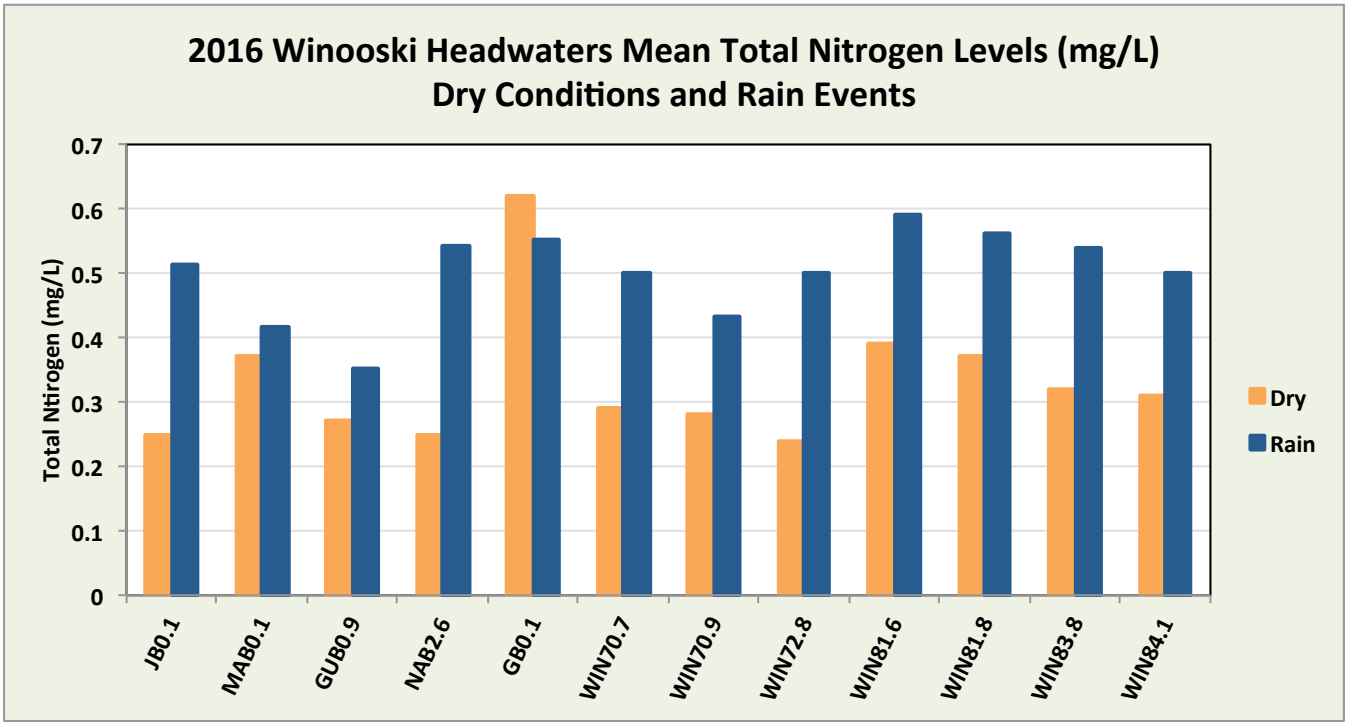
Phosphorus concentrations are also higher under turbid event flow conditions and lower under baseflow conditions as seen in **Figure 6**. The higher total phosphorus concentrations found under event flows represent phosphorus export downstream from the headwaters area. While export loading toward Lake Champlain cannot be calculated without accurate flow measures it is clear that the upper headwaters does export a significant amount of phosphorus under event flows, and the phosphorus is primarily in the particulate form. The source of this phosphorus is likely both from non point stormwater runoff from back roads, agricultural areas, logging in the watershed, and eroding stream bank sediments. The phosphorus loading during event flows is highest in the Plainfield area in large part from Great Brook, which enters the Winooski River just above the WIN 70.9 station, above the WWTF in Plainfield, below the dam. The other tributary streams show relatively low turbidity and resulting phosphorus export under both base and event flows. Of these Jug Brook has the highest event flow turbidity and phosphorus.

Figure 6: 2016 mean total phosphorus concentrations in Winooski upper main stem and tributaries under both base and event flow river conditions.



Nitrogen concentrations under base flow conditions were low, less than 0.4 mg/l, with the exception of Great Brook, which had the highest total nitrogen recorded in 2016 of > 0.6 mg/l under base flow conditions (**Figure 7**). Great Brook has over the years had a higher total nitrogen level compared to other locations. During event flow sampling total nitrogen was higher but still relatively low at less than 0.6 mg/l at all locations. The current numerical VT WQ standard for Class B waters is not to exceed 5.0 mg/l as NO3-N at flows exceeding low median monthly flows, in Class B(1) and B(2) waters.

Figure 7: Total nitrogen (mg/l) from sampling locations in the upper Winooski watershed, under base flow and event flow conditions.



Alkalinity and Chloride - Results

Water Quality samples for alkalinity and Chloride were again collected once annually on 8/2/2016. The results of this sampling are presented below in **Table 3** and in **Appendix C**. Alkalinity is highest (near or over 100mg CaCO3/l) in the tributary streams Jug Brook and Guernsey Brook, as well as in the Winooski River in Marshfield and Cabot. Alkalinity was lowest (22mg/ CaCO3/l) in Marshfield Brook. The Winooski in the Plainfield area from Win 72.8 to 70.7 were in the moderate range (about 60 mg CaCO3/l). Alkalinity is a reflection of the bedrock and soils from these watersheds, with the low alkalinity streams draining granitic-based watersheds and high alkalinity streams draining watersheds with soils higher in calcium. Chloride was < 10mg/l in all tributaries and in the Winooski River in Plainfield. It was in the teens in the Winooski River in Marshfield and Cabot. Chloride does not become toxic to aquatic life until levels approach 230mg/l. The Vermont Water Quality standards chloride criteria is 230 mg/l chronic (daily mean over four day period), and 860 mg/l acute (one day mean). Overall, chloride was very low at all locations- indicating deicing materials such as road and sidewalk salting is not yet an issue in the upper Winooski River watershed.

Table 3 : Alkalinity and Chloride concentrations at 12 locations in the upper Winooski River. 20016

Location	Date	Alkalinity (mg CaCO3/L)	Chloride (mg/L)
MAB 0.1	8/2/2016	22	3.3
NAB 2.6	8/2/2016	62	<2.0
WIN 72.8	8/2/2016	63	7.8
WIN 70.7	8/2/2016	67	8.6
WIN 70.9	8/2/2016	68	8.8
WIN 81.6	8/2/2016	96	10.4
WIN 81.8	8/2/2016	98	11.0
GUB 1.0	8/2/2016	104	<2.0
JB 0.1	8/2/2016	106	<2.0
WIN 84.1	8/2/2016	114	10.5
WIN 83.8	8/2/2016	116	10.6
GB 0.1	8/2/2016	125	9.1

Appendices

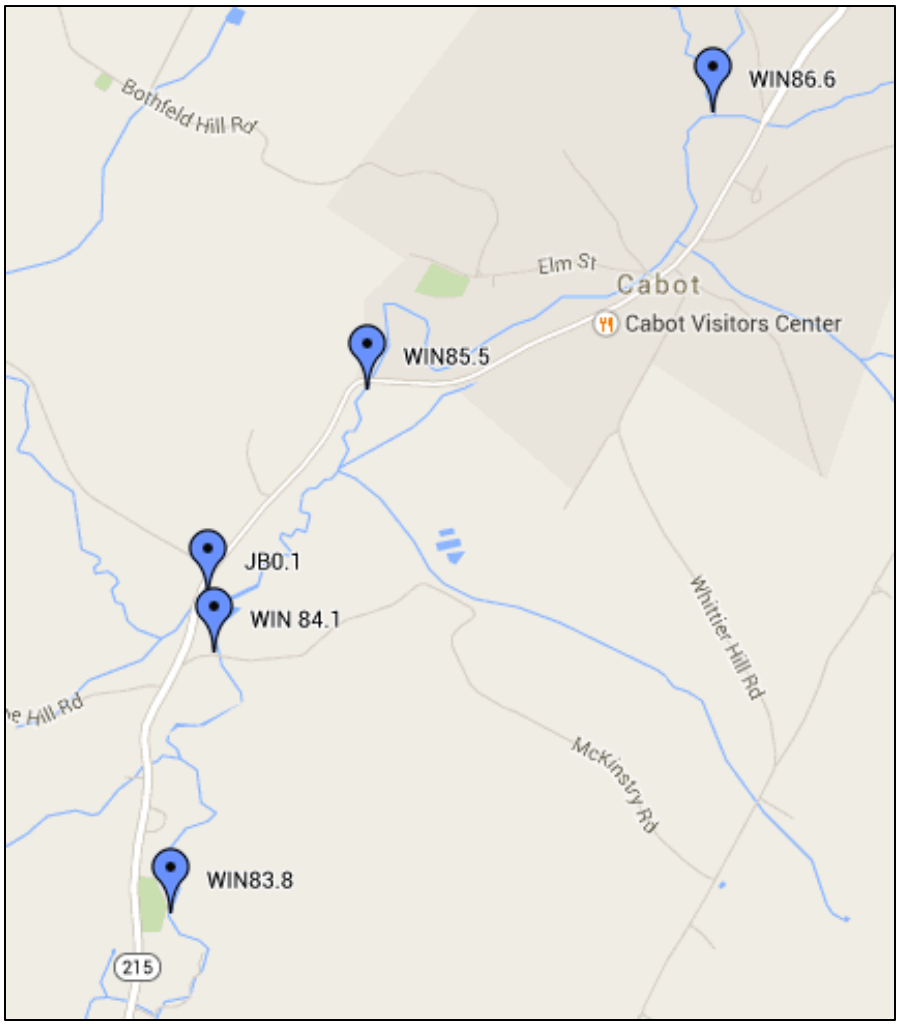
Appendix A. Site Descriptions and Maps

***E. coli* testing sites (18 total)**

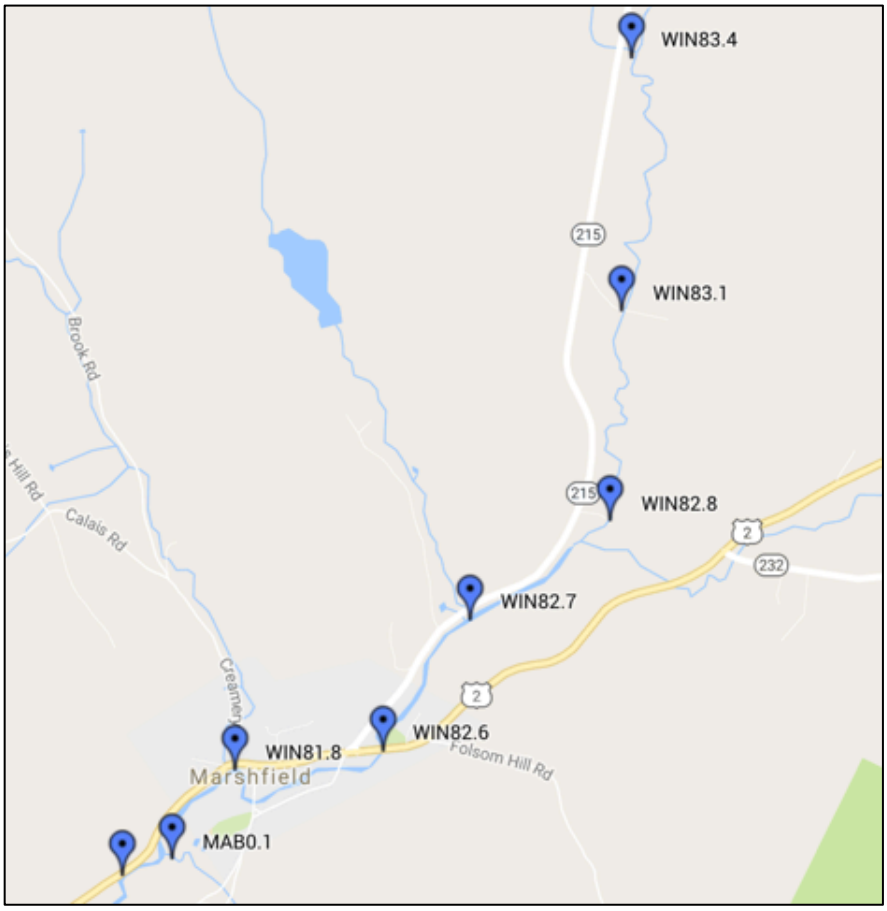
Site ID	Lat/Long	Description
WIN 86.6	44.4065 / -72.3104	Above Cabot Plains Brook, adjacent to Cabot Rec Fields
WIN 85.5	44.3984 / -72.3244	By Larry's ballfield below Cabot village.
WIN 84.7	44.3906 / -72.3307	Above sawmill road bridge at Cabot WWTF
WIN 83.8	44.3829 / -72.3325	Durant cemetery below Cabot WWTF
WIN 83.3	44.3774 / -72.3342	Below (south of) second drainage ditch below farm below Durant cemetery.
WIN 83.1	44.3651 / 72.3346	Above Graham's Green house
WIN 82.8	44.3604 / -72.3353	Just above GMP generation station.
WIN 82.7	44.35666 / -72.34255	Across from McCrillis Road, below GMP powerhouse about 0.4 mi.
WIN 82.6	44.3519 / -72.3470	At Rt 2 bridge just above Marshfield Village
WIN 81.8	44.3511 / -72.3553	Above Marshfield WWTP, below Creamery tributary
WIN 81.6	44.3472 / -72.3606	Below Marshfield WWTF, above flower farm
WIN 72.8	44.2871 / -72.4090	At Martin Bridge
WIN 71.5	44.2785/ -72.4228	Behind Plainfield Co-op Above Plainfield dam
WIN 71.4	44.2775 / -72.4258	Below dam Plainfield Village, above Great Brook
WIN 70.9	44.2758 / -72.4287	Above discharge at Plainfield WWTF
WIN 70.7	44.2733 / -72.4322	Below discharge at Plainfield WWTF
JB 0.1	44.3923 / -72.331	Jug Brook at Route 215 in Lower Cabot
GB 0.1	44.2767 / -72.4267	Great Brook just before confluence with the Winooski

Water quality monitoring sites (12 total)

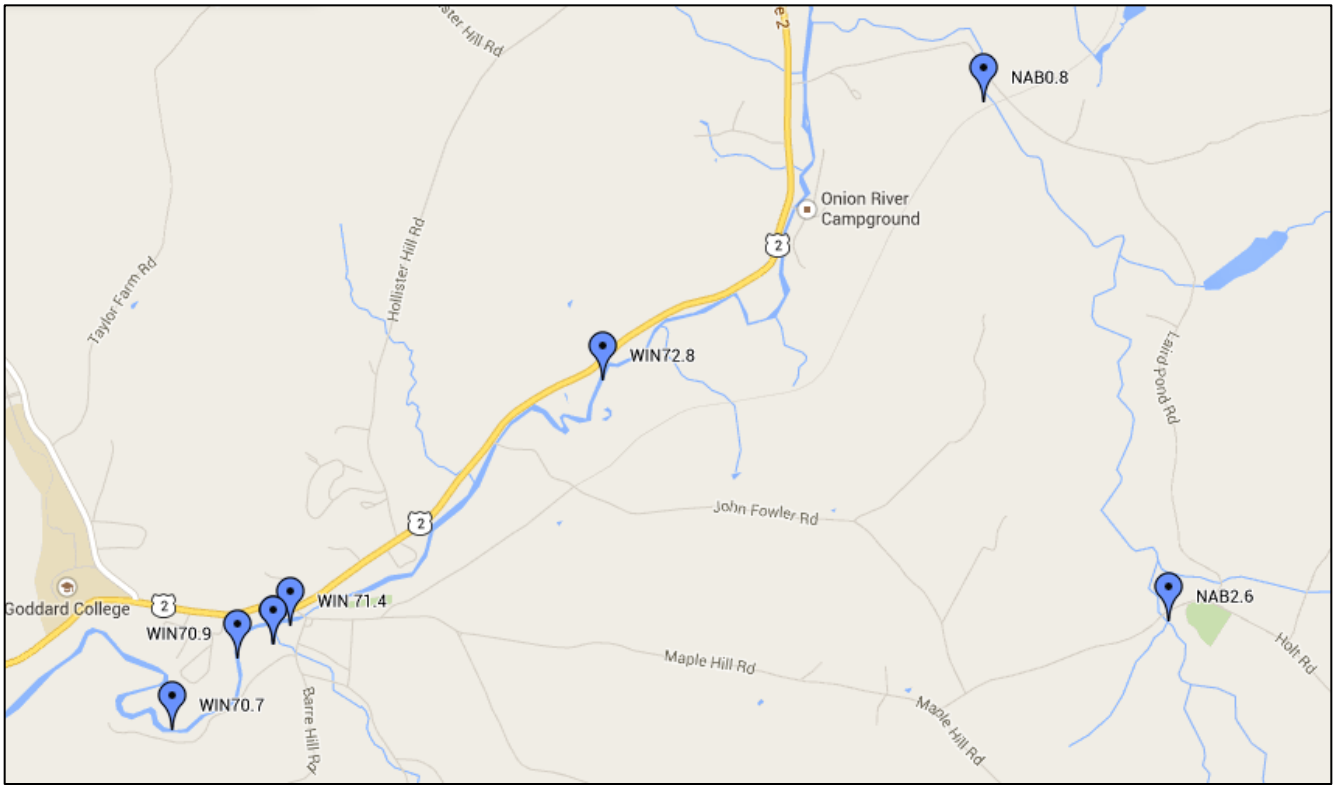
Site ID	Lat/Long	Description
JB 0.1	44.3923 / -72.331	Jug Brook at Route 215 in Lower Cabot
MAB 0.1	44.3482 / -72.3582	Marshfield Brook at confluence with the Winooski River
NAB 0.8	44.2981 / -72.38745	Naismith Brook at Paradise swimming hole
NAB 2.6	44.2776 / -72.37728	Naismith Brook at Maple Hill Road Bridge
GB 0.1	44.2767 / -72.4267	Great Brook just before confluence with the Winooski
WIN 84.1	44.3906 / -72.3307	Above sawmill road bridge at Cabot WWTF
WIN 83.8	44.3829 / -72.3325	Durant cemetery below Cabot WWTF
WIN 81.8	44.3511 / -72.3553	Above Marshfield WWTP, below Creamery tributary
WIN 81.6	44.3472 / -72.3606	Below Marshfield WWTF, at flower farm
WIN 72.8	44.2871 / 72.4090	Winooski River at Martin Bridge
WIN 70.9	44.2758 / -72.4287	Above discharge at Plainfield WWTF
WIN 70.7	44.2733 / -72.4322	Below discharge at Plainfield WWTF



Headwaters Partnership Cabot, VT Sampling Sites for 2016



Headwaters Partnership Marshfield, VT Sampling Sites 2016
(the WIN 81.6 site, downstream of MAB0.1, is not labeled)



Headwaters Partnership Plainfield, VT Sampling Sites 2016 (GB0.1 is not labeled)

Appendix B. 2016 *E.coli* results from the Upper Winooski Headwaters, and tributaries.

Location	Date	Final E. Coli.(mpn/100ml)
GB0.1	8/30/2016	5
JB0.1	7/19/2016	291
JB0.1	8/17/2016	2420
JB0.1	8/2/2016	123
JB0.1	8/30/2016	20
WIN 70.7	7/5/2016	167
WIN 70.7	7/19/2016	866
WIN 70.7	8/2/2016	921
WIN 70.7	8/17/2016	2420
WIN 70.7	8/30/2016	161
WIN 70.9	7/5/2016	248
WIN 70.9	7/19/2016	687
WIN 70.9	8/2/2016	579
WIN 70.9	8/17/2016	1733
WIN 70.9	8/30/2016	236
WIN 71.4	7/5/2016	272
WIN 71.4	7/19/2016	866
WIN 71.4	8/2/2016	461
WIN 71.4	8/17/2016	2420
WIN 71.4	8/30/2016	192
WIN 71.5	7/5/2016	276
WIN 71.5	7/19/2016	687
WIN 71.5	8/2/2016	411
WIN 71.5	8/17/2016	2420
WIN 71.5	8/30/2016	248
WIN 72.8	7/5/2016	152
WIN 72.8	7/19/2016	727
WIN 72.8	8/2/2016	770
WIN 72.8	8/17/2016	2420
WIN 72.8-Blank	8/17/2016	1
WIN 72.8-Dup	8/17/2016	2420
WIN 81.6	7/6/2016	133
WIN 81.6	7/19/2016	649
WIN 81.6	8/2/2016	435
WIN 81.6	8/17/2016	2420
WIN 81.6	8/30/2016	34
WIN 81.8	7/6/2016	112
WIN 81.8	7/19/2016	770

WIN 81.8	8/2/2016	291
Win 81.8	8/17/2016	2420
WIN 81.8	8/30/2016	49
WIN 81.8-Blank	8/30/2016	1
WIN 81.8-Dup	8/30/2016	49
WIN 82.6	7/6/2016	73
WIN 82.6	7/19/2016	727
WIN 82.6	8/2/2016	435
WIN 82.6	8/17/2016	2420
WIN 82.6	8/30/2016	59
WIN 82.7	7/6/2016	120
WIN 82.7	7/19/2016	548
WIN 82.7	8/2/2016	308
WIN 82.7	8/17/2016	2420
WIN 82.7	8/30/2016	68
WIN 82.8	7/6/2016	308
WIN 82.8	7/19/2016	649
WIN 82.8	8/2/2016	435
WIN 82.8-BLANK	8/2/2016	1
WIN 82.8-DUP	8/2/2016	387
WIN 82.8	8/17/2016	2420
WIN 82.8	8/30/2016	46
WIN 83.1	7/5/2016	193
WIN 83.1	7/19/2016	687
WIN 83.1	8/2/2016	261
WIN 83.1	8/17/2016	2420
WIN 83.1	8/30/2016	42
WIN 83.3	7/5/2016	155
WIN 83.8	7/5/2016	190
WIN 83.8	7/19/2016	276
WIN 83.8	8/2/2016	276
WIN 83.8	8/17/2016	2420
WIN 83.8	8/30/2016	41
WIN 84.1	7/5/2016	166
WIN 84.1	7/19/2016	225
WIN 84.1	8/17/2016	2420
WIN 84.1	8/30/2016	35
WIN 85.5	7/5/2016	40
Win 85.5	7/19/2016	411
WIN 85.5-Blank	7/19/2016	1
WIN 85.5-Dup	7/19/2016	153

WIN 85.5	8/2/2016	161
WIN 85.5	8/17/2016	2420
WIN 85.5	8/30/2016	40
WIN 86.6	7/5/2016	26
WIN 86.6-Blank	7/5/2016	1
Win 86.6-DUP	7/5/2016	28
WIN 86.6	7/19/2016	365
WIN 86.6	8/2/2016	156
WIN 86.6	8/17/2016	2420
WIN 86.6	8/30/2016	67

Appendix C. 2016 Winooski Headwaters Alkalinity, Chloride, Total Nitrogen (TN), Total Phosphorus (TP), and Turbidity results by parameter and site.

Location	Date	Alkalinity (mg CaCO3/L)	Chloride (mg/L)	TN (mg-N/l)	TP(µg P/L)	Turbidity (NTU)
GB 0.1	7/5/2016			0.54	8.9	1
GB 0.1	7/19/2016			0.39	19.1	8
GB 0.1	8/2/2016	125	9.1	0.57	7.9	1
GB 0.1	8/17/2016			0.70	1600.0	492
GB 0.1	8/30/2016			0.70	7.1	0
GUB 1.0	7/5/2016			0.27	17.2	0
GUB 1.0	7/19/2016			0.24	15.7	1
GUB 1.0	8/2/2016	104	2.0	0.28	10.5	0
GUB 1.0	8/17/2016			0.54	141.0	27
GUB 1.0	8/30/2016			0.27	8.7	0
GUB 1.0-Blank	8/30/2016			0.10	7.1	0
GUB 1.0-Dup	8/30/2016			0.38	13.7	0
JB 0.1	7/5/2016			0.24	9.6	1
JB 0.1-Blank	7/5/2016			0.10	6.4	0
JB 0.1-Dup	7/5/2016			0.24	11.2	1
JB 0.1	7/19/2016			0.27	25.6	5
JB 0.1	8/2/2016	106	2.0	0.24	9.3	1
JB 0.1	8/17/2016			1.03	297.0	31
JB 0.1	8/30/2016			0.26	9.6	0
MAB 0.1	7/5/2016			0.34	13.6	1
MAB 0.1	7/19/2016			0.32	13.1	1
MAB 0.1	8/2/2016	22	3.3	0.36	11.0	1
MAB 0.1	8/17/2016			0.57	41.8	5
MAB 0.1	8/30/2016			0.40	11.6	1
NAB 2.6	7/5/2016			0.26	24.0	0
NAB 2.6	7/19/2016			0.26	16.2	1
NAB 2.6-Blank	7/19/2016			0.10	6.6	0
NAB 2.6-Dup	7/19/2016			0.25	17.1	1
NAB 2.6	8/2/2016	62	2.0	0.64		0
NAB 2.6	8/17/2016			0.73	95.9	17
NAB 2.6	8/30/2016			0.24	13.5	0
WIN 70.7	7/5/2016			0.26	23.4	5
WIN 70.7	7/19/2016			0.28	48.4	12
WIN 70.7	8/2/2016	67	8.6	0.34	24.0	7
WIN 70.7	8/17/2016			0.88	914.0	324
WIN 70.7	8/30/2016			0.28	15.2	2
WIN 70.9	7/5/2016			0.27	22.3	5

WIN 70.9	7/19/2016			0.26	34.7	10
WIN 70.9	8/2/2016	68	8.8	0.32	22.6	5
WIN 70.9	8/17/2016			0.72	1500.0	569
WIN 70.9	8/30/2016			0.29	15.3	2
WIN 72.8	7/5/2016			0.23	18.8	4
WIN 72.8	7/19/2016			0.26	30.6	10
WIN 72.8	8/2/2016	63	7.9	0.30	18.4	3
WIN 72.8	8/17/2016			0.94	230.0	97
WIN 72.8	8/30/2016			0.27	13.6	2
WIN 81.6	7/5/2016				16.4	1
WIN 81.6	7/19/2016			0.29	32.0	9
WIN 81.6	8/2/2016	96	10.4	0.32	15.5	2
WIN 81.6	8/17/2016			1.16	478.0	266
WIN 81.6-Blank	8/17/2016			0.10	5.0	0
WIN 81.6-Dup	8/17/2016			1.15	467.0	203
WIN 81.6	8/30/2016			0.39	16.4	1
WIN 81.8	7/5/2016			0.34	11.7	1
WIN 81.8	7/19/2016			0.31	30.9	9
WIN 81.8	8/2/2016	98	11.0	0.30	13.6	2
WIN 81.8	8/17/2016			1.08	505.0	237
WIN 81.8	8/30/2016			0.39	10.3	1
WIN 83.8	7/5/2016			0.32	14.1	1
WIN 83.8	7/19/2016			0.30	29.5	8
WIN 83.8	8/2/2016	116	10.6	0.38	14.0	2
WIN 83.8	8/17/2016			0.94	295.8	71
WIN 83.8	8/30/2016			0.32	9.9	1
WIN 84.1	7/5/2016			0.30	13.3	2
WIN 84.1	7/19/2016			0.30		11
WIN 84.1	8/2/2016	114	10.5	0.29	16.5	2
WIN 84.1-BLANK	8/2/2016	1	2.0	0.10	5.0	0
WIN 84.1-DUP	8/2/2016	114	10.3	0.29	15.6	2
WIN 84.1	8/17/2016			0.91	345.0	68
WIN 84.1	8/30/2016			0.32	10.6	1

Appendix D. Quality assurance measures for *E. coli*, phosphorous, nitrogen, and turbidity sampling in 2016

Location	Date	RPD, Alkalinity	RPD, Chloride	RPD, *E. coli*	RPD, TN	RPD, TP	RPD, Turbidity
WIN86.6	7/5/2106			8%			
WIN85.5	7/19/2016			91%			
WIN82.8	8/2/2016			12%			
WIN72.8	8/17/2016			0%			
WIN81.8	8/30/2016			0%			
GUB 1.0	8/30/2016				34%	44%	5%
JB 0.1	7/5/2016				0%	15%	8%
NAB 2.6	7/19/2016				4%	5%	21%
WIN 81.6	8/17/2016				1%	2%	27%
WIN 84.1	8/2/2016	0%	2%		0%	6%	10%
Mean RPD	**2016**	**0%**	**2%**	**22%**	**8%**	**15%**	**8%**

Note: The mean relative percent difference value for the duplicates is high due to the high RPD between the turbidity samples taken at Naismith Brook and WIN 81.6, and the nitrogen and phosphorus samples taken at GUB1.0. The levels in these samples were very low, which caused the RPD to be unusually large and the mean RPD for turbidity to exceed the target value.

Target RPD for duplicate field samples:

Alkalinity	<15% (for values > 20 mg/l)
Chloride	≤ 5%
E. coli	≤ 50%
Nitrogen	≤ 50%
Phosphorus	≤ 30%
Turbidity	≤ 15%

Appendix E. Results from field blanks.

Sample Number	Location	Date	Parameter	Units	Symbol	Result
160952-08	WIN 84.1-BLANK	8/2/16	Alkalinity	mg/l	<	1
160952-08	WIN 84.1-BLANK	8/2/16	Chloride	mg/l	<	2
160782-03	WIN 86.6-Blank	7/5/16	*E. coli*	mpn/100ml	<	1
160783-04	WIN 85.5-Blank	7/19/16	*E. coli*	mpn/100ml	<	1
160951-09	WIN 82.8-BLANK	8/2/16	*E. coli*	mpn/100ml	<	1
161090-14	WIN 72.8-Blank	8/17/16	*E. coli*	mpn/100ml	<	1
161232-11	WIN 81.8-Blank	8/30/16	*E. coli*	mpn/100ml	<	1
160784-03	JB 0.1-Blank	7/5/16	Total N	mg/l	<	0.1
160785-06	NAB 2.6-Blank	7/19/16	Total N	mg/l	<	0.1
160952-08	WIN 84.1-BLANK	8/2/16	Total N	mg/l	<	0.1
161091-11	WIN 81.6-Blank	8/17/16	Total N	mg/l	<	0.1
161233-05	GUB 1.0-Blank	8/30/16	Total N	mg/l	<	0.1
160784-03	JB 0.1-Blank	7/5/16	Total P	µg/l		6.38
160785-06	NAB 2.6-Blank	7/19/16	Total P	µg/l		6.6
160952-08	WIN 84.1-BLANK	8/2/16	Total P	µg/l	<	5
161091-11	WIN 81.6-Blank	8/17/16	Total P	µg/l	<	5
161233-05	GUB 1.0-Blank	8/30/16	Total P	µg/l		7.12
160784-03	JB 0.1-Blank	7/5/16	Turbidity	NTU	<	0.2
160785-06	NAB 2.6-Blank	7/19/16	Turbidity	NTU	<	0.2
160952-08	WIN 84.1-BLANK	8/2/16	Turbidity	NTU	<	0.2
161091-11	WIN 81.6-Blank	8/17/16	Turbidity	NTU	<	0.2
161233-05	GUB 1.0-Blank	8/30/16	Turbidity	NTU	<	0.2
160782-03	WIN 86.6-Blank	7/5/16	*E. coli*	mpn/100ml	<	1
160783-04	WIN 85.5-Blank	7/19/16	*E. coli*	mpn/100ml	<	1
160951-09	WIN 82.8-BLANK	8/2/16	*E. coli*	mpn/100ml	<	1
161090-14	WIN 72.8-Blank	8/17/16	*E. coli*	mpn/100ml	<	1
161232-11	WIN 81.8-Blank	8/30/16	*E. coli*	mpn/100ml	<	1