# Water Quality Monitoring in the Upper Winooski River Headwaters

# 2015

**_E. coli_, chloride, alkalinity, phosphorus, nitrogen, and turbidity levels in the streams of Cabot-Marshfield-Plainfield**


**Enjoy the River! Earthwalk student-volunteers take a dip in the chilly Winooski River after an early May riparian restoration planting at Martin Bridge.**

**The Friends of the Winooski River in Cooperation with**
**The Conservation Commissions of Cabot, Marshfield, and Plainfield**
**with support from the**
**R.A. LaRosa Grants Program**

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**The Vermont Department of Environmental Conservation**
**February 2016**

**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 an endangered species.

The following report describes the results of the Headwaters Partnership 2015 monitoring. Samples were collected at 17 sites by Headwaters volunteers approximately biweekly on June 23, July 7, July 28, Aug 4, August 18, and September 1. Descriptions and locations of the sampling sites are shown in **Appendix A**. All sampling dates had dry weather with the exception of June 23, when there was moderately heavy rain during the morning sampling period. 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 for duplicate turbidity samples taken on 9/1 at Naismith Brook. The large RPD between these duplicates is probably due to the very low turbidity level in this stream (see Note, Appendix C).

***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 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, pet waste, and untreated waste (septic or sewage) wastewater. Vermont has recently updated (October 2014) its *E.coli* criteria to match 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 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 13 locations on the Winooski River on an approximately biweekly basis from July 7 to September 1, 2015. The June 23rd sampling coincided with a moderately heavy rainstorm and high flows. All other sampling dates had dry weather. This resulted in 4-5 samples per location collected under "baseflow" conditions representative of when contact recreational activities are likely to occur in the river. High *E. coli* results, therefore, are not likely to be due to the immediate runoff of rainwater into the river from pastures or streets. The results are presented in **Figure 1** as the geometric mean of 4-5 samples collected at a location. Individual sample results are presented in **Appendix B**. 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**.

The *E. coli* levels within the main stem of the Winooski River were highest at WIN71.4 and remain high down to WIN70.7, from just below the dam to below the WWTF in Plainfield village. This reach of river has been high in *E. coli* for 6 consecutive years (**Figure 2).** The reach should be listed as impaired for contact recreation, and efforts should continue in identifying the source of this contamination. In 2016 samples will be collected from the Plainfield stormwater system outfalls and catch basins and the backwater area of river immediately above the dam to try to pinpoint sources. A second reach of river is also slightly above standards. This reach starts along the "Cabot Flats" at WIN83.8 down to the hydro generation station at WIN82.8, and then slowly dissipating thru the village of Marshfield. Historically the *E. coli* levels in this reach have been sporadically high in some years while lower in other years. It is recommended that numerous locations be sampled along this reach to help identify potential sources.

**Figure 1**: *E. coli* levels in the upper Winooski River and Naismith Brook in 2015. The dotted black line indicates the VT standard for geometric mean *E. coli* levels (126 mpn/100 mL).

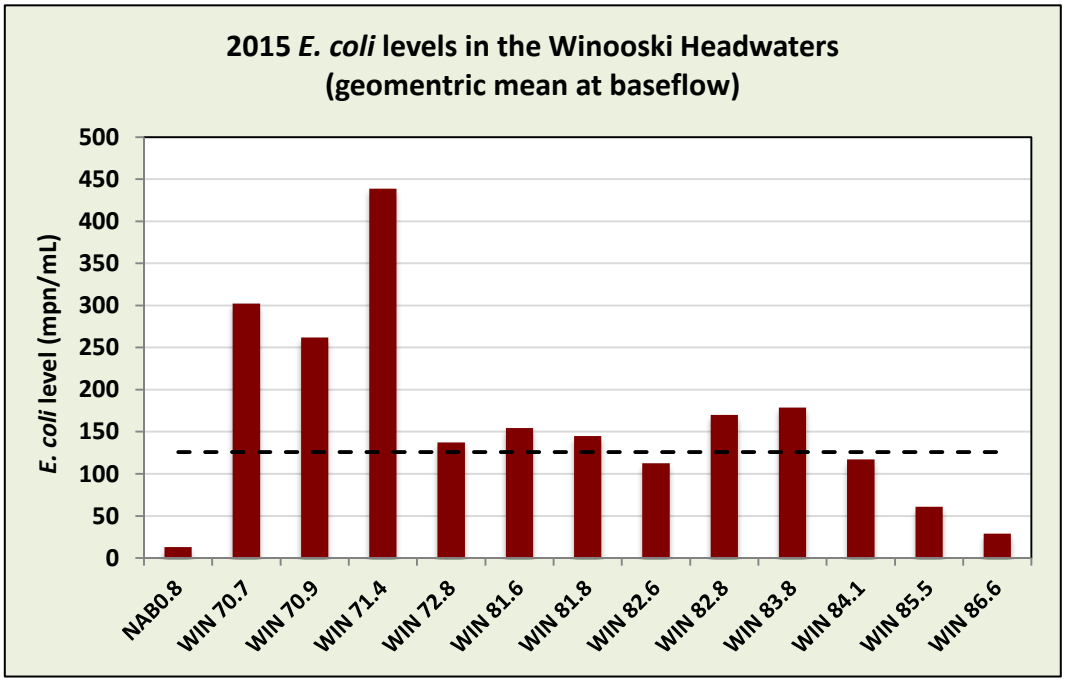
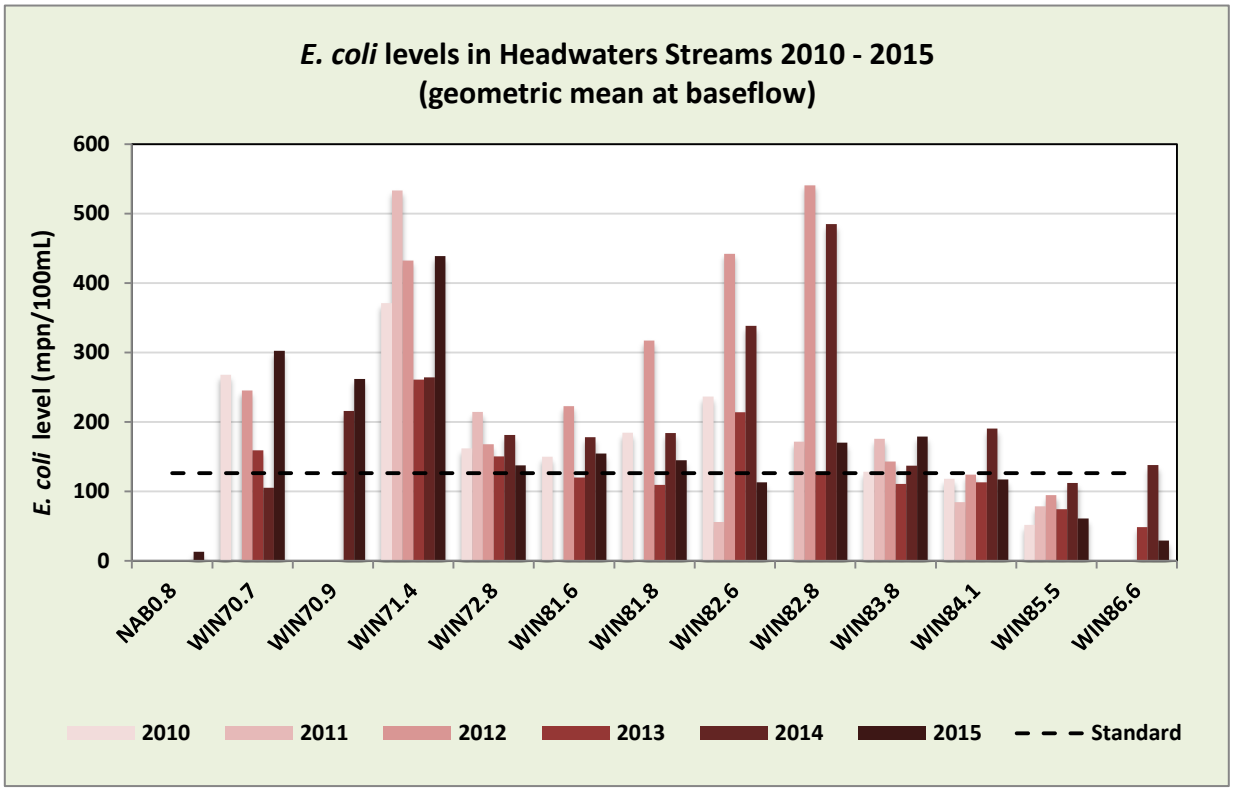


**Figure 2:** Geometric mean *E. coli* levels from 2010-2015 collected from 12 sites in the upper Winooski River and from one site on Naismith Brook at the Paradise swimming hole. Note that sampling at the NAB0.8, WIN70.9, and WIN86.6 sites began in 2015, 2014, and 2013, respectively, and that WIN 70.7 was not sampled in 2011. The Vermont standard of a geometric mean of 126 mpn/ 100 mL is shown by the dotted black line.




## Alkalinity and Chloride - Results

Samples for alkalinity and chloride testing were collected once during moderate base flow conditions from 10 sites on July 28th. The results of this sampling are presented below in **Table 1** and in **Appendix C**. Alkalinity is highest (near 100mg/l) in the tributary streams Jug Brook and Great Brook, as well as in the Winooski River in Marshfield and Cabot. Alkalinity was lowest in Marshfield Brook. 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 (October 2014) adopted the chloride criteria of 230 mg/l chronic (daily mean over four day period), and 860 mg/l acute (one day mean). Overall, chloride was 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 1:** Alkalinity and Chloride collected once under base-moderate flows.

| Site | Parameter | Result | Units | Collect Date | Collect. Time | Flow type | Flow level |
|---|---|---|---|---|---|---|---|
| GB0.1 | Alkalinity | 93 | mg CaCO3/L | 7/28/2015 | 6:35:00 | base | moderate |
| JB0.1 | Alkalinity | 100 | mg CaCO3/L | 7/28/2015 | 6:23:00 | base | moderate |
| MAB0.1 | Alkalinity | 11 | mg CaCO3/L | 7/28/2015 | 6:30:00 | base | moderate |
| WIN 70.7 | Alkalinity | 61 | mg CaCO3/L | 7/28/2015 | 6:26:00 | base | moderate |
| WIN 70.9 | Alkalinity | 67 | mg CaCO3/L | 7/28/2015 | 6:16:00 | base | moderate |
| WIN81.7 | Alkalinity | 93 | mg CaCO3/L | 7/28/2015 | 7:23:00 | base | moderate |
| WIN 81.6 | Alkalinity | 95 | mg CaCO3/L | 7/28/2015 | 6:30:00 | base | moderate |
| WIN 81.8 | Alkalinity | 95 | mg CaCO3/L | 7/28/2015 | 6:30:00 | base | moderate |
| WIN 83.8 | Alkalinity | 104 | mg CaCO3/L | 7/28/2015 | 6:49:00 | base | moderate |
| WIN 84.1 | Alkalinity | 104 | mg CaCO3/L | 7/28/2015 | 6:39:00 | base | moderate |
| | | | | | | | |
| GB0.1 | Chloride | 5.1 | mg/L | 7/28/2015 | 6:35:00 | base | moderate |
| JB0.1 | Chloride | 2.0 | mg/L | 7/28/2015 | 6:23:00 | base | moderate |
| MAB0.1 | Chloride | 4.7 | mg/L | 7/28/2015 | 6:30:00 | base | moderate |
| WIN 70.7 | Chloride | 8.2 | mg/L | 7/28/2015 | 6:26:00 | base | moderate |
| WIN 70.9 | Chloride | 7.5 | mg/L | 7/28/2015 | 6:16:00 | base | moderate |
| WIN 81.6 | Chloride | 16.4 | mg/L | 7/28/2015 | 6:30:00 | base | moderate |
| WIN81.7 | Chloride | 15.1 | mg/L | 7/28/2015 | 7:23:00 | base | moderate |
| WIN 81.8 | Chloride | 16.6 | mg/L | 7/28/2015 | 6:30:00 | base | moderate |
| WIN 83.8 | Chloride | 13.1 | mg/L | 7/28/2015 | 6:49:00 | base | moderate |
| WIN 84.1 | Chloride | 12.2 | mg/L | 7/28/2015 | 6:39:00 | base | moderate |

**Nitrogen, Phosphorus, and Turbidity**

Total nitrogen (TN), phosphorus (TP), and turbidity were sampled to determine nutrient levels and compare to the VT's 2014 Water Quality Standards (WQS) nutrient criteria for wadeable streams. These nutrient criteria were derived to protect aquatic life from the detrimental effects of enrichment. The recently adopted phosphorus TP guidance values are based on the stream's "stream type". For "Small High Gradient" (SHG) streams it is 12 ug/l TP. Naismith Brook 2.6, Jug Brook, and Marshfield Brook are SHG streams. For "Medium High Gradient" MHG streams the guidance value is 15ug/l. Great Brook, Naismith Brook 0.8 and all Winooski River sites are MHG stream reaches.

**Table 2, Figures 3 and 4** show the mean nutrient levels and turbidity under low base flow conditions when the VT WQS 2014 apply. Individual sample results are listed in **Appendix C**. TN, TP, and turbidity were generally well below the Class B WQS criteria for their stream type for most streams, including below all three town waste water treatment facilities (WWTFs). Jug Brook was at the TP threshold, and the upper Naismith site NAB2.6 was over 2x the criteria for phosphorus in small high gradient streams. The 2015 phosphorus concentrations at this site were similar to those in 2014 and were elevated both years. This is surprising since the watershed above this reach is mostly forested. It is possible the stream is naturally high in nutrients from a significant wetland just above the reach. Phosphorus levels changed very little from

above to below all the WWTF's on the Winooski River. The greatest increase was above to below the Marshfield WWTF where phosphorus levels were 9.1 and 12.3 ug/l, respectively. Marshfield Brook enters the Winooski between these two locations and its nutrient level of 11.9 ug/l was also higher than that found above the Marshfield WWTF, and therefore may be partly responsible for this increase.

**Table 2.** Mean values for total nitrogen, total phosphorus, and turbidity above and below the three wastewater treatment facilities in Cabot, Marshfield, and Plainfield; at Martin Bridge, and at five tributary stream sites. These mean values were calculated based on three base/low flow samples collected on 8/4, 8/18, and 9/1, 2015. An asterisk (*) indicates a value above the VT criteria.

| Stream site location | TN mg/l | TP ug/l | Turbidity NTU |
|---|---|---|---|
| **Small, High-Gradient Stream Standards** | **2.0** | **12.0** | **10** |
| Jug Brook 0.1 | 0.26 | 12.9* | 1.9 |
| Marshfield Brook 0.1 | 0.31 | 11.9 | 1.0 |
| Naismith Brook 2.6 | 0.31 | 25.1* | 2.5 |
| **Medium High-Gradient Stream Standards** | **2.0** | **15.0** | **10** |
| Naismith Brook 0.8 | 0.23 | 11.8 | 0.6 |
| Great Brook 0.1 | 0.53 | 10.9 | 1.7 |
| WIN 81.8 above Marshfield WWTF | 0.39 | 9.1 | 0.7 |
| WIN 81.6 below Marshfield WWTF | 0.33 | 12.3 | 0.9 |
| WIN 84.1 above Cabot WWTF | 0.33 | 15.9* | 1.0 |
| WIN 83.8 below Cabot WWTF | 0.51 | 10.7 | 0.8 |
| WIN 70.9 above Plainfield WWTF | 0.32 | 12.0 | 1.8 |
| WIN 70.7 below Plainfield WWTF | 0.31 | 11.6 | 2.0 |
| WIN 72.8 Martin Bridge | 0.25 | 12.1 | 1.4 |

**Figure 3**. Mean total phosphorus at all locations sampled in 2015 under base low flow conditions. The VT standard for phosphorus in Class B, medium, high-gradient streams (15ug/mL) is shown by the dotted line. Jug Brook, a small, high-gradient stream, also slightly exceeds the VT standard of 12 ug/L for this stream type.

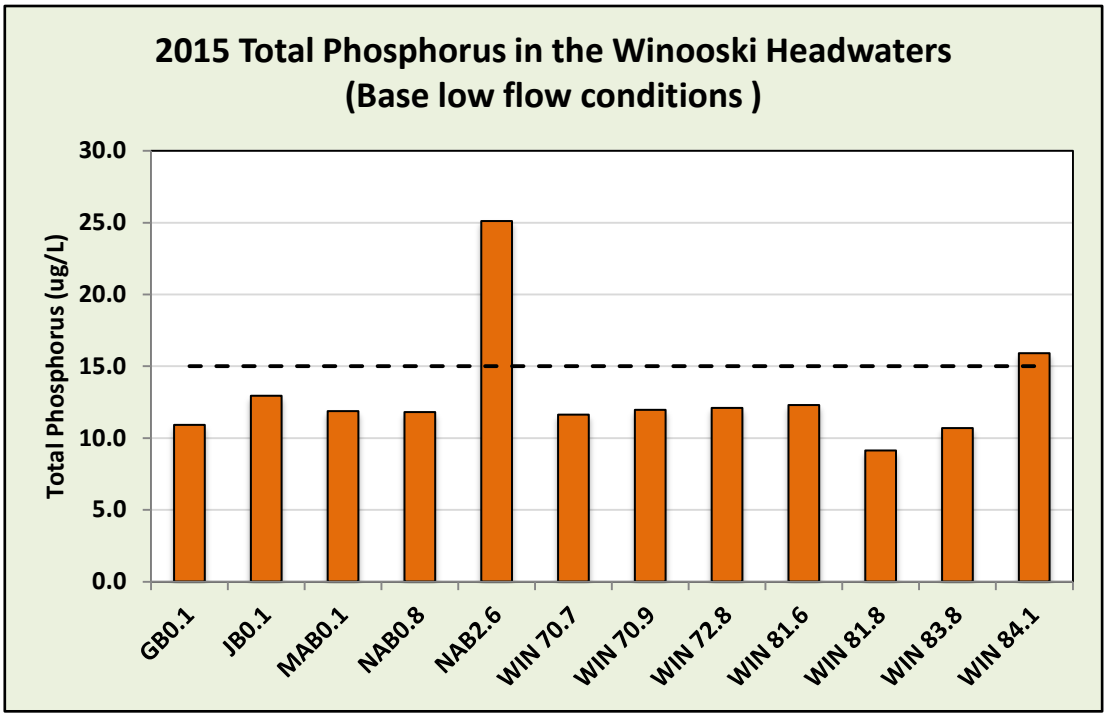



**Figure 4.** Mean total nitrogen levels at all location sampled in 2015 under base low flow conditions. The VT standard for total nitrogen is 5 mg/L for all stream types.

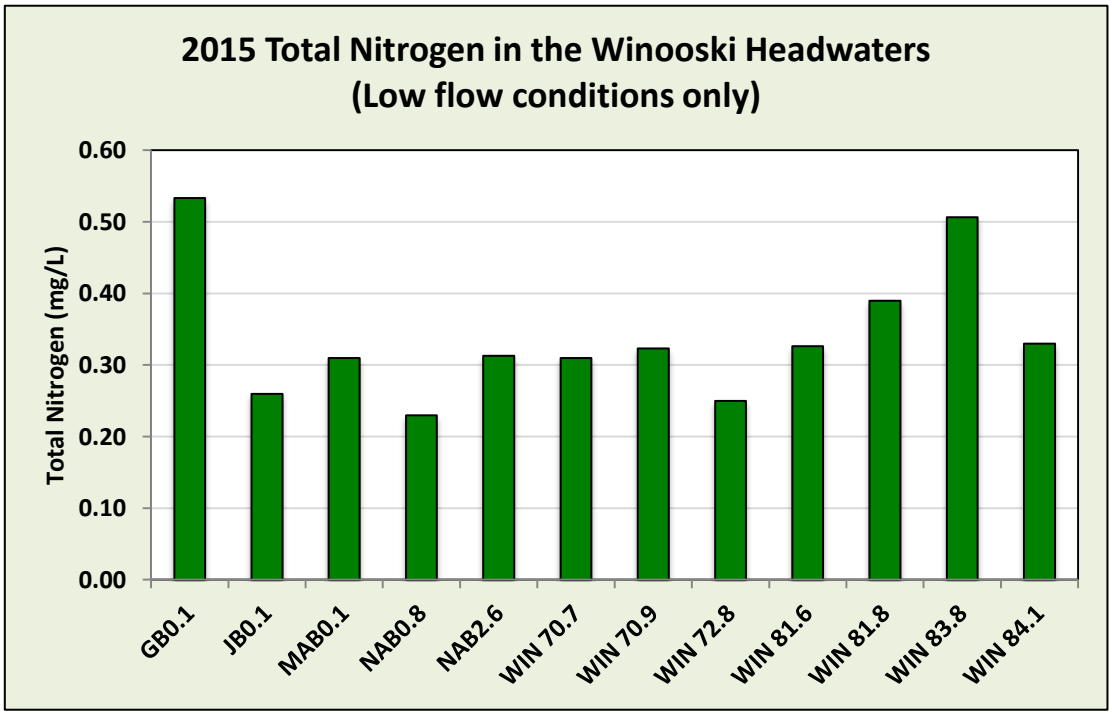
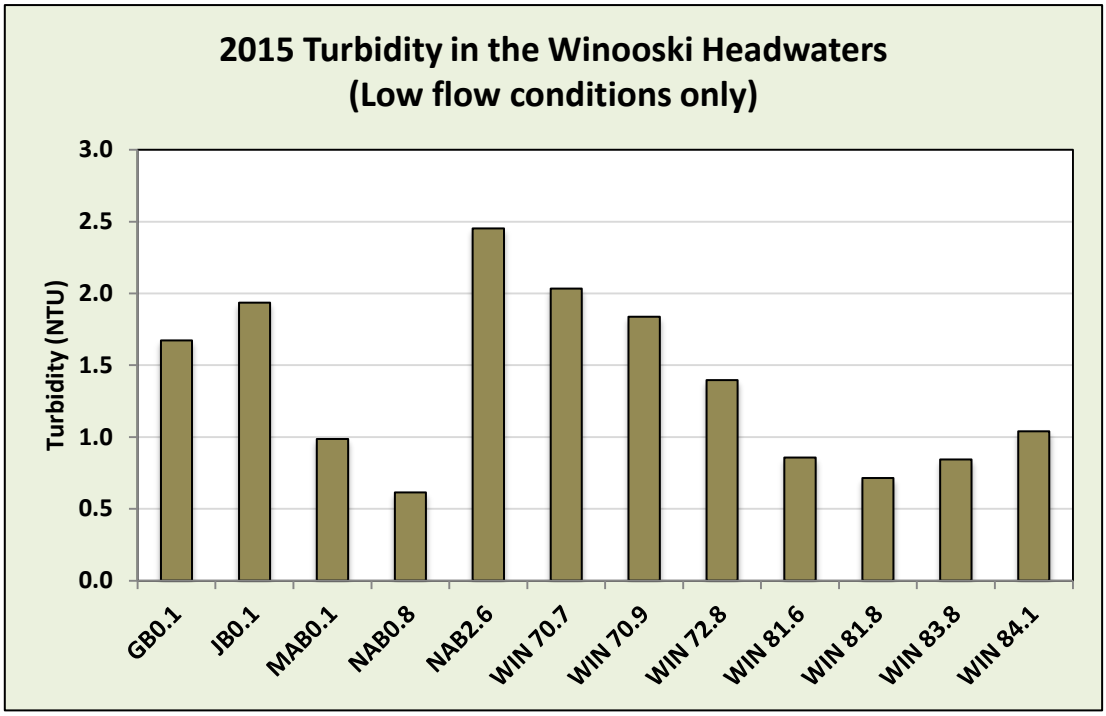


**Figure 5.** Mean turbidity levels at all location sampled in 2015 under base low flow conditions. The VT standard for turbidity in Class B streams is 10 NTU.



## Summary

**Table 3** below summarizes the results of the 2015 Winooski Headwaters Partnership water quality monitoring. Chloride, nitrogen, and turbidity levels at all sites met VT water quality standards. Phosphorus standards were exceeded at two tributary sites and one main stem site. *E. coli* levels were the biggest problem, exceeding the standard at 8 sites, and were particularly high at the three sites downstream from the Plainfield dam.

**Table 3. 2015 Headwaters Results Summary**

| Site ID and description | Sampled for: | Parameters above VT standards |
|---|---|---|
| **Winooski Tributaries** | | |
| JB0.1, Jug Brook mouth | Alkalinity, chloride, nutrients, turbidity | phosphorus |
| MAB0.1, Marshfield Brook mouth | Alkalinity, chloride, nutrients, turbidity | none |
| NAB2.6, Naismith Br @ Maple Hill | Nutrients, turbidity | phosphorus |
| NAB0.8, Naismith Br swim hole | *E. coli* | none |
| GB0.1, Great Brook mouth | Alkalinity, chloride, nutrients, turbidity | none |
| **Winooski Mainstem** | | |
| WIN 86.6, Cabot Rec Fields | *E. coli* | none |
| WIN 85.5, Larry's Ballfield | *E. coli* | none |
| WIN 84.1, Sawmill Road bridge | *E. coli,* alkalinity, chloride, nutrients, turbidity | phosphorus |
| WIN 83.8, Durant Cemetery | *E. coli,* alkalinity, chloride, nutrients, turbidity | *E. coli* |
| WIN 82.8, above GMP hydro plant | *E. coli* | *E. coli* |
| WIN 82.6, Rte 2 below Marshfield | *E. coli* | none |
| WIN 81.8, above Marshfield WWTF | *E. coli,* alkalinity, chloride, nutrients, turbidity | *E. coli* |
| WIN 81.6, below Marshfield WWTF | *E. coli,* alkalinity, chloride, nutrients, turbidity | *E. coli* |
| WIN 72.8, Martin Bridge | *E. coli* | *E. coli* |
| WIN 71.4, below Plainfield dam | *E. coli,* alkalinity, chloride, nutrients, turbidity | *E. coli* |
| WIN 70.9, above Plainfield WWTF | *E. coli,* alkalinity, chloride, nutrients, turbidity | *E. coli* |
| WIN 70.7, below Plainfield WWTF | *E. coli,* alkalinity, chloride, nutrients, turbidity | *E. coli* |

# *Appendices*

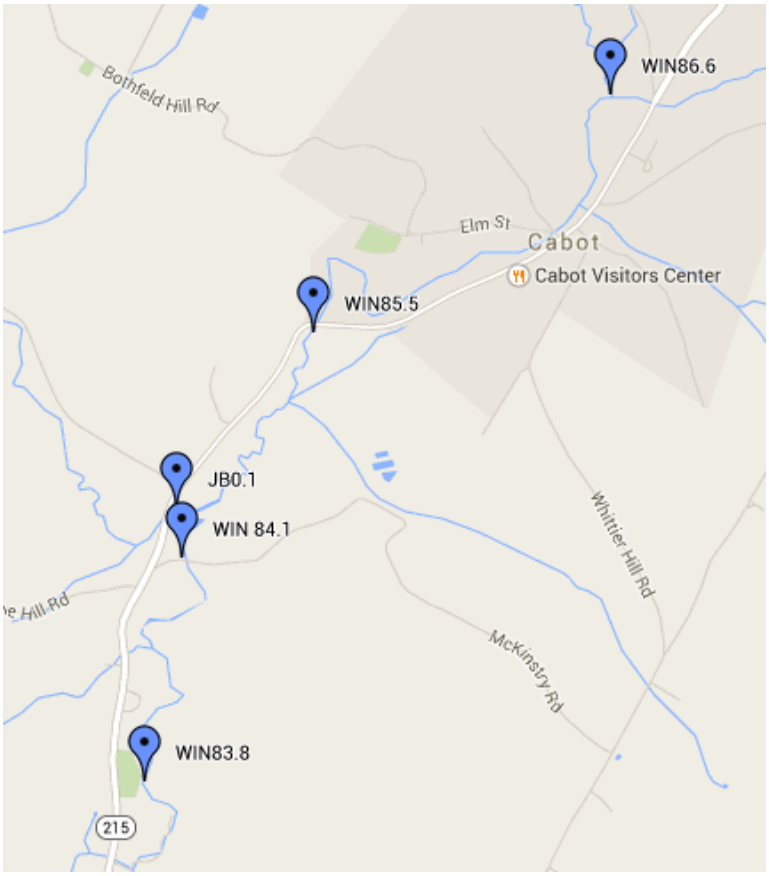
**Appendix A.** Site Descriptions and Maps

***E. coli* testing sites (13 total)**

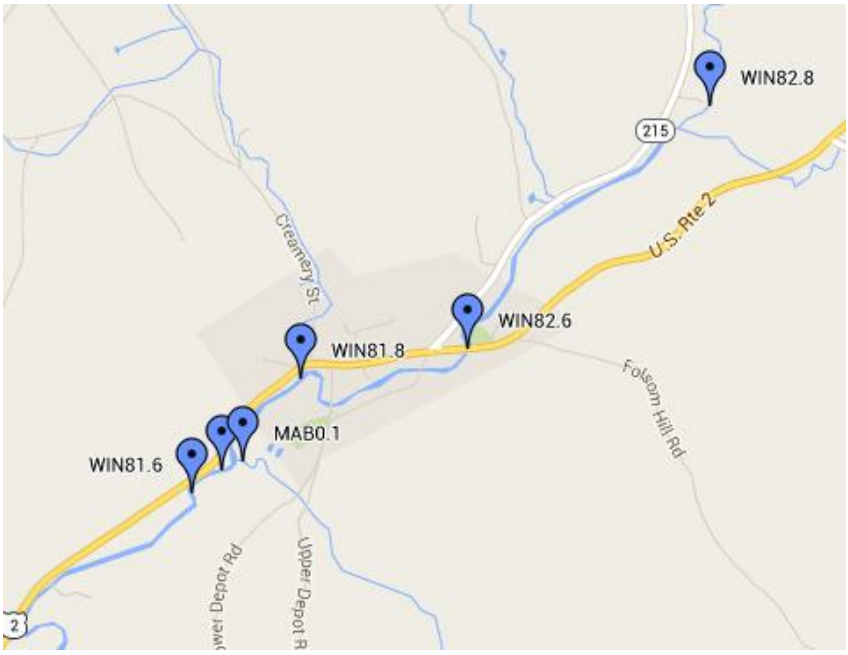
| Site ID | Lat/Long | Description |
|---|---|---|
| NAB 0.8 | 44.2981 / -72.38745 | Naismith Brook at Paradise swimming hole |
| WIN 86.6 | 44.4065 / -72.3104 | Above Cabot Plains Brook, adjacent to Cabot Rec Fields |
| WIN 85.5 | 44.3984 / -72.3244 | By Larry's ballfield below Cabot village. |
| WIN 84.1 | 44.3906 / -72.3307 | Above Sawmill Road bridge at Cabot WWTF |
| WIN 83.8 | 44.3829 / -72.3325 | Durant cemetery below Cabot WWTF |
| WIN 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 |
| 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 | At Martin Bridge |
| 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 |

**Water quality monitoring sites (13 total)**

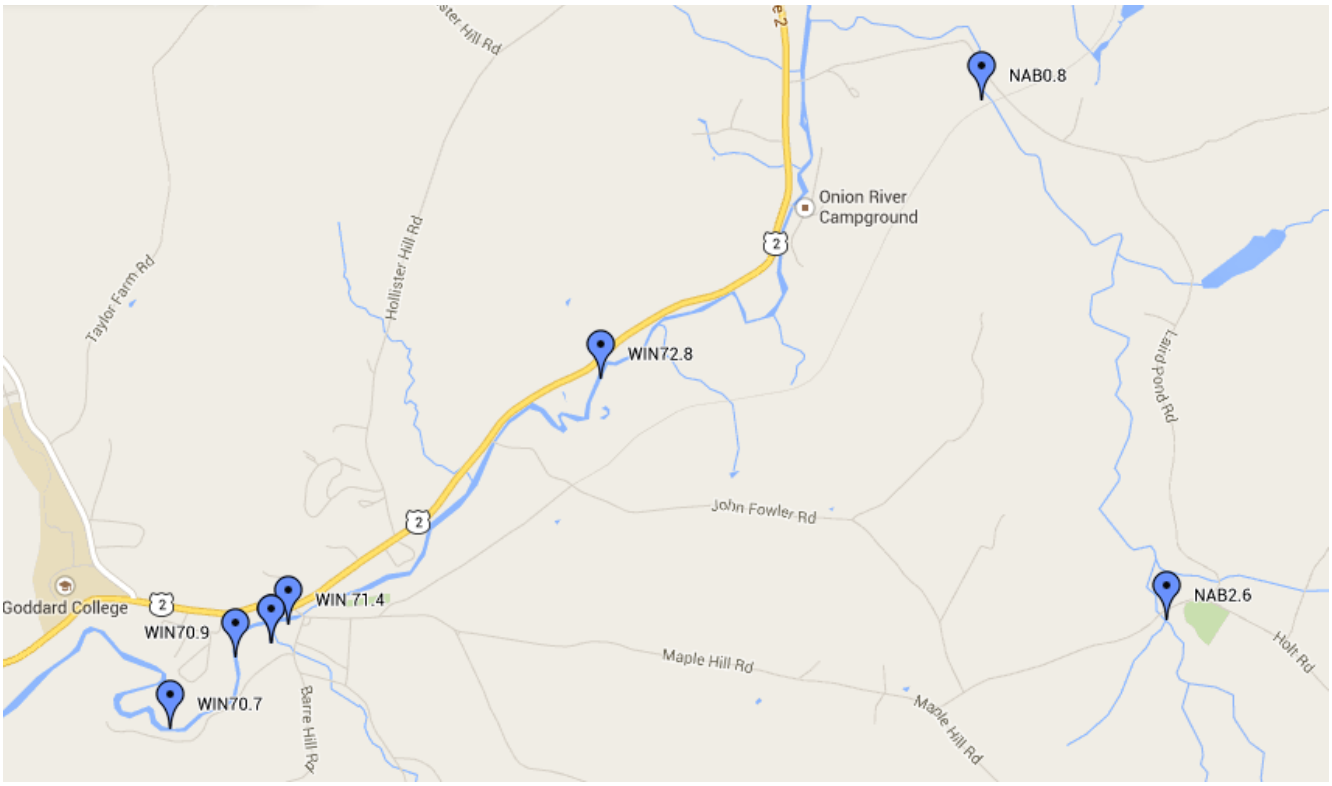
| Site ID | Lat/Long | Description |
|---|---|---|
| JB 0.1 | 44.3923 / -72.331 | Jug Brook at Route 215 in Lower Cabot |
| MAB 0.1 | 44.3482 / -72.3582 | Marshfield Brook at confluence with the Winooski River |
| NAB 0.8 | 44.2981 / -72.38745 | Naismith Brook at Paradise swimming hole |
| NAB 2.6 | 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 81.7 | ~44.3479 / -72.3591 | Below Marshfield WWTF, above Marshfield Br. confl. |
| 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 2015**




**Headwaters Partnership Marshfield, VT Sampling Sites 2015**




**Headwaters Partnership Plainfield, VT Sampling Sites 2015 (note GB0.1 is not labeled)**

**Appendix B.** 2015 *E.coli* results from the Upper Winooski Headwaters, and tributaries. Single samples values above the "Beach Action Value" of 235 mpn/100mL are highlighted in yellow, as are the geometric mean values above 126 mpn/100mL.

| Customer Sample # | Geometric Mean (criteria 126) | Result (criteria 235 max <10% ) | Units | Collect Date | Collect Time | flow type | flow level |
|---|---|---|---|---|---|---|---|
| NAB0.8 | | 6 | mpn/100ml | 7/7/2015 | 7:03:00 | base | moderate |
| NAB0.8 | | 20 | mpn/100ml | 8/4/2015 | 6:52:00 | base | low |
| NAB0.8 | | 20 | mpn/100ml | 8/18/2015 | 6:48:00 | base | low |
| NAB0.8 | | 11 | mpn/100ml | 9/1/2015 | 7:00:00 | base | low |
| NAB0.8 | GM | 13 | | | | | |
| WIN 70.7 | | 142 | mpn/100ml | 7/7/2015 | 6:45:00 | base | moderate |
| WIN 70.7 | | 517 | mpn/100ml | 7/28/2015 | 6:26:00 | base | moderate |
| WIN 70.7 | | 299 | mpn/100ml | 8/4/2015 | 6:30:00 | base | low |
| WIN 70.7 | | 105 | mpn/100ml | 8/18/2015 | 6:20:00 | base | low |
| WIN 70.7 | | 517 | mpn/100ml | 9/1/2015 | 7:45:00 | base | low |
| WIN 70.7 | GM | 302 | | | | | |
| WIN 70.9 | | 108 | mpn/100ml | 7/7/2015 | 6:35:00 | base | moderate |
| WIN 70.9 | | 816 | mpn/100ml | 7/28/2015 | 6:16:00 | base | moderate |
| WIN 70.9 | | 387 | mpn/100ml | 8/4/2015 | 6:45:00 | base | low |
| WIN 70.9 | | 172 | mpn/100ml | 8/18/2015 | 6:30:00 | base | low |
| WIN 70.9 | | 210 | mpn/100ml | 9/1/2015 | 7:35:00 | base | low |
| WIN 70.9 | GM | 262 | | | | | |
| WIN 71.4 | | 727 | mpn/100ml | 7/28/2015 | 5:44:00 | base | moderate |
| WIN 71.4 | | 299 | mpn/100ml | 8/4/2015 | 7:10:00 | base | low |
| WIN 71.4 | | 248 | mpn/100ml | 8/18/2015 | 6:55:00 | base | low |
| WIN 71.4 | | 687 | mpn/100ml | 9/1/2015 | 6:55:00 | base | low |
| WIN 71.4 | GM | 439 | | | | | |
| WIN 72.8 | | 113 | mpn/100ml | 7/7/2015 | 7:20:00 | base | moderate |
| WIN 72.8 | | 219 | mpn/100ml | 8/4/2015 | 7:10:00 | base | low |
| WIN 72.8 | | 78 | mpn/100ml | 8/18/2015 | 7:15:00 | base | low |
| WIN 72.8 | | 186 | mpn/100ml | 9/1/2015 | 6:45:00 | base | low |
| WIN 72.8 | GM | 137 | | | | | |
| WIN 81.6 | | 69 | mpn/100ml | 7/7/2015 | 6:45:00 | base | moderate |
| WIN 81.6 | | 261 | mpn/100ml | 7/28/2015 | 6:30:00 | base | moderate |
| WIN 81.6 | | 152 | mpn/100ml | 8/4/2015 | 7:00:00 | base | low |
| WIN 81.6 | | 70 | mpn/100ml | 8/18/2015 | 6:30:00 | base | low |
| WIN 81.6 | | 461 | mpn/100ml | 9/1/2015 | 7:00:00 | base | low |
| WIN 81.6 | GM | 154 | | | | | |
| WIN 81.8 | | 73 | mpn/100ml | 7/7/2015 | 6:23:00 | base | moderate |
| WIN 81.8 | | 214 | mpn/100ml | 7/28/2015 | 6:30:00 | base | moderate |
| WIN 81.8 | | 156 | mpn/100ml | 8/4/2015 | 6:35:00 | base | low |
| WIN 81.8 | | 47 | mpn/100ml | 8/18/2015 | 6:20:00 | base | low |
| WIN 81.8 | | 548 | mpn/100ml | 9/1/2015 | 7:15:00 | base | low |

| Customer Sample # | Geometric Mean (criteria 126) | Result (criteria 235 max <10% ) | Units | Collect Date | Collect Time | flow type | flow level |
|---|---|---|---|---|---|---|---|
| WIN 81.8 | GM | 145 | | | | | |
| WIN 82.6 | | 50 | mpn/100ml | 7/7/2015 | 6:28:00 | base | moderate |
| WIN 82.6 | | 214 | mpn/100ml | 7/28/2015 | 6:15:00 | base | moderate |
| WIN 82.6 | | 201 | mpn/100ml | 8/4/2015 | 6:17:00 | base | low |
| WIN 82.6 | | 105 | mpn/100ml | 8/18/2015 | 6:45:00 | base | low |
| WIN 82.6 | | 81 | mpn/100ml | 9/1/2015 | 7:06:00 | base | low |
| WIN 82.6 | GM | 113 | | | | | |
| WIN 82.8 | | 179 | mpn/100ml | 7/7/2015 | 6:35:00 | base | moderate |
| WIN 82.8 | | 548 | mpn/100ml | 7/28/2015 | 6:05:00 | base | moderate |
| WIN 82.8 | | 261 | mpn/100ml | 8/4/2015 | 6:10:00 | base | low |
| WIN 82.8 | | 78 | mpn/100ml | 8/18/2015 | 6:38:00 | base | low |
| WIN 82.8 | | 71 | mpn/100ml | 9/1/2015 | 6:55:00 | base | low |
| WIN 82.8 | GM | 170 | | | | | |
| Win 83.8 | | 48 | mpn/100ml | 7/7/2015 | 6:46:00 | base | moderate |
| WIN 83.8 | | 1986 | mpn/100ml | 7/28/2015 | 6:49:00 | base | moderate |
| WIN 83.8 | | 260 | mpn/100ml | 8/4/2015 | 6:43:00 | base | low |
| WIN 83.8 | | 99 | mpn/100ml | 8/18/2015 | 6:38:00 | base | low |
| WIN 83.8 | | 75 | mpn/100ml | 9/1/2015 | 7:15:00 | base | low |
| WIN 83.8 | GM | 179 | | | | | |
| Win 84.1 | | 93 | mpn/100ml | 7/7/2015 | 6:31:00 | base | moderate |
| WIN 84.1 | | 727 | mpn/100ml | 7/28/2015 | 6:39:00 | base | moderate |
| WIN 84.1 | | 135 | mpn/100ml | 8/4/2015 | 6:35:00 | base | low |
| WIN 84.1 | | 58 | mpn/100ml | 8/18/2015 | 6:32:00 | base | low |
| WIN 84.1 | | 41 | mpn/100ml | 9/1/2015 | 7:00:00 | base | low |
| WIN 84.1 | GM | 117 | | | | | |
| Win 85.5 | | 30 | mpn/100ml | 7/7/2015 | 6:16:00 | base | moderate |
| WIN 85.5 | | 613 | mpn/100ml | 7/28/2015 | 6:23:00 | base | moderate |
| WIN 85.5 | | 34 | mpn/100ml | 8/4/2015 | 6:21:00 | base | low |
| WIN 85.5 | | 56 | mpn/100ml | 8/18/2015 | 6:22:00 | base | low |
| WIN 85.5 | | 24 | mpn/100ml | 9/1/2015 | 6:45:00 | base | low |
| WIN 85.5 | GM | 61 | | | | | |
| Win 86.6 | | 17 | mpn/100ml | 7/7/2015 | 6:08:00 | base | moderate |
| WIN 86.6 | | 167 | mpn/100ml | 7/28/2015 | 6:15:00 | base | moderate |
| WIN 86.6 | | 17 | mpn/100ml | 8/4/2015 | 6:09:00 | base | low |
| WIN 86.6 | | 30 | mpn/100ml | 8/18/2015 | 6:12:00 | base | low |
| WIN 86.6 | | 13 | mpn/100ml | 9/1/2015 | 6:35:00 | base | low |
| WIN 86.6 | GM | 29 | | | | | |
| **E.coli under freshet event** | | | | | | | |
| JB 0.1 | | 56 | mpn/100ml | 6/23/2015 | 6:20:00 | freshet | moderate |
| NAB0.8 | | 308 | mpn/100ml | 6/23/2015 | 6:48:00 | freshet | moderate |
| WIN 70.7 | | 96 | mpn/100ml | 6/23/2015 | 6:20:00 | freshet | moderate |

| Customer Sample # | Geometric Mean (criteria 126) | Result (criteria 235 max <10% ) | Units | Collect Date | Collect Time | flow type | flow level |
|---|---|---|---|---|---|---|---|
| WIN 70.9 | | 133 | mpn/100ml | 6/23/2015 | 6:45:00 | freshet | moderate |
| WIN 71.4 | | 196 | mpn/100ml | 6/23/2015 | 7:00:00 | freshet | moderate |
| WIN 72.8 | | 261 | mpn/100ml | 6/23/2015 | 6:56:00 | freshet | moderate |
| WIN 81.6 | | 83 | mpn/100ml | 6/23/2015 | 6:35:00 | freshet | moderate |
| WIN 81.8 | | 345 | mpn/100ml | 6/23/2015 | 6:45:00 | freshet | moderate |
| WIN 82.6 | | 118 | mpn/100ml | 6/23/2015 | 6:30:00 | freshet | moderate |
| WIN 82.8 | | 88 | mpn/100ml | 6/23/2015 | 6:20:00 | freshet | moderate |
| WIN 83.8 | | 58 | mpn/100ml | 6/23/2015 | 6:40:00 | freshet | moderate |
| WIN 84.1 | | 30 | mpn/100ml | 6/23/2015 | 6:30:00 | freshet | moderate |
| WIN 86.6 | | 96 | mpn/100ml | 6/23/2015 | 6:09:00 | freshet | moderate |

**Appendix C.** 2015 Water Quality results by parameter and site.

| Site RM | Param | Result | Units | Collect Date | Collect Time | flow type | flow level | RemarkCode |
|---|---|---|---|---|---|---|---|---|
| GB0.1 | Alkalinity | 93.0 | mg CaCO3/L | 7/28/2015 | 6:35:00 | base | moderate | |
| JB0.1 | Alkalinity | 100.0 | mg CaCO3/L | 7/28/2015 | 6:23:00 | base | moderate | |
| MAB0.1 | Alkalinity | 11.0 | mg CaCO3/L | 7/28/2015 | 6:30:00 | base | moderate | |
| WIN 70.7 | Alkalinity | 61.0 | mg CaCO3/L | 7/28/2015 | 6:26:00 | base | moderate | |
| WIN 70.9 | Alkalinity | 67.0 | mg CaCO3/L | 7/28/2015 | 6:16:00 | base | moderate | |
| WIN 81.6 | Alkalinity | 95.0 | mg CaCO3/L | 7/28/2015 | 6:30:00 | base | moderate | mislabeld as 81.8 blank changed to 81.6 |
| WIN 81.8 | Alkalinity | 95.0 | mg CaCO3/L | 7/28/2015 | 6:30:00 | base | moderate | |
| WIN 83.8 | Alkalinity | 104.0 | mg CaCO3/L | 7/28/2015 | 6:49:00 | base | moderate | |
| WIN 84.1 | Alkalinity | 104.0 | mg CaCO3/L | 7/28/2015 | 6:39:00 | base | moderate | |
| WIN81.7 | Alkalinity | 93.0 | mg CaCO3/L | 7/28/2015 | 7:23:00 | base | moderate | |
| GB0.1 | Chloride | 5.1 | mg/L | 7/28/2015 | 6:35:00 | base | moderate | |
| JB0.1 | Chloride | 2.0 | mg/L | 7/28/2015 | 6:23:00 | base | moderate | |
| MAB0.1 | Chloride | 4.7 | mg/L | 7/28/2015 | 6:30:00 | base | moderate | |
| WIN 70.7 | Chloride | 8.2 | mg/L | 7/28/2015 | 6:26:00 | base | moderate | |
| WIN 70.9 | Chloride | 7.5 | mg/L | 7/28/2015 | 6:16:00 | base | moderate | |
| WIN 81.6 | Chloride | 16.4 | mg/L | 7/28/2015 | 6:30:00 | base | moderate | |
| WIN 81.8 | Chloride | 16.6 | mg/L | 7/28/2015 | 6:30:00 | base | moderate | |
| WIN 83.8 | Chloride | 13.1 | mg/L | 7/28/2015 | 6:49:00 | base | moderate | |
| WIN 84.1 | Chloride | 12.2 | mg/L | 7/28/2015 | 6:39:00 | base | moderate | |
| WIN81.7 | Chloride | 15.1 | mg/L | 7/28/2015 | 7:23:00 | base | moderate | |
| GB0.1 | TN | 0.26 | mg/L | 6/23/2015 | 6:30:00 | freshet | moderate | |
| GB0.1 | TN | 0.33 | mg/L | 7/7/2015 | 6:15:00 | base | moderate | |
| GB0.1 | TN | 0.34 | mg/L | 7/28/2015 | 6:35:00 | base | moderate | |
| GB0.1 | TN | 0.44 | mg/L | 8/4/2015 | 7:00:00 | base | low | |
| GB0.1 | TN | 0.52 | mg/L | 8/18/2015 | 6:48:00 | base | low | |
| GB0.1 | TN | 0.64 | mg/L | 9/1/2015 | 7:20:00 | base | low | |
| JB0.1 | TN | 0.21 | mg/L | 7/7/2015 | 6:25:00 | base | moderate | |
| JB0.1 | TN | 0.24 | mg/L | 7/28/2015 | 6:23:00 | base | moderate | |
| JB0.1 | TN | 0.26 | mg/L | 8/4/2015 | 6:26:00 | base | low | |
| JB0.1 | TN | 0.26 | mg/L | 8/18/2015 | 6:26:00 | base | low | |
| JB0.1 | TN | 0.26 | mg/L | 9/1/2015 | 7:15:00 | base | low | |
| MAB 0.1 | TN | 0.26 | mg/L | 6/23/2015 | 6:59:00 | freshet | moderate | |
| MAB0.1 | TN | 0.25 | mg/L | 7/7/2015 | 6:13:00 | base | moderate | |
| MAB0.1 | TN | 0.32 | mg/L | 7/28/2015 | 6:30:00 | base | moderate | |
| MAB0.1 | TN | 0.32 | mg/L | 8/4/2015 | 6:30:00 | base | low | |
| MAB0.1 | TN | 0.31 | mg/L | 8/18/2015 | 6:11:00 | base | low | |
| MAB0.1 | TN | 0.30 | mg/L | 9/1/2015 | 7:35:00 | base | low | |
| NAB 2.6 | TN | 0.26 | mg/L | 6/23/2015 | 6:38:00 | freshet | moderate | |
| NAB0.8 | TN | 0.25 | mg/L | 6/23/2015 | 6:48:00 | freshet | moderate | |
| NAB0.8 | TN | 0.21 | mg/L | 7/7/2015 | 7:03:00 | base | moderate | |
| NAB0.8 | TN | 0.23 | mg/L | 8/18/2015 | 6:48:00 | base | low | |
| NAB0.8 | TN | 0.23 | mg/L | 9/1/2015 | 7:00:00 | base | low | |

| Site RM | Param | Result | Units | Collect Date | Collect Time | flow type | flow level | RemarkCode |
|---|---|---|---|---|---|---|---|---|
| NAB2.6 | TN | 0.22 | mg/L | 7/7/2015 | 6:54:00 | base | moderate | |
| NAB2.6 | TN | 0.37 | mg/L | 8/4/2015 | 6:37:00 | base | low | |
| NAB2.6 | TN | 0.30 | mg/L | 8/18/2015 | 6:33:00 | base | low | |
| NAB2.6 | TN | 0.27 | mg/L | 9/1/2015 | 6:15:00 | base | low | |
| WIN 70.7 | TN | 0.25 | mg/L | 6/23/2015 | 6:20:00 | freshet | moderate | |
| WIN 70.7 | TN | 0.23 | mg/L | 7/7/2015 | 6:45:00 | base | moderate | |
| WIN 70.7 | TN | 0.27 | mg/L | 7/28/2015 | 6:26:00 | base | moderate | |
| WIN 70.7 | TN | 0.33 | mg/L | 8/4/2015 | 6:30:00 | base | low | |
| WIN 70.7 | TN | 0.30 | mg/L | 8/18/2015 | 6:20:00 | base | low | |
| WIN 70.7 | TN | 0.30 | mg/L | 9/1/2015 | 7:45:00 | base | low | |
| WIN 70.9 | TN | 0.26 | mg/L | 6/23/2015 | 6:45:00 | freshet | moderate | |
| WIN 70.9 | TN | 0.26 | mg/L | 7/7/2015 | 6:35:00 | base | moderate | |
| WIN 70.9 | TN | 0.29 | mg/L | 7/28/2015 | 6:16:00 | base | moderate | |
| WIN 70.9 | TN | 0.34 | mg/L | 8/4/2015 | 6:45:00 | base | low | |
| WIN 70.9 | TN | 0.31 | mg/L | 8/18/2015 | 6:30:00 | base | low | |
| WIN 70.9 | TN | 0.32 | mg/L | 9/1/2015 | 7:35:00 | base | low | |
| WIN 72.8 | TN | 0.25 | mg/L | 6/23/2015 | 6:56:00 | freshet | moderate | |
| WIN 72.8 | TN | 0.21 | mg/L | 7/7/2015 | 7:20:00 | base | moderate | |
| WIN 72.8 | TN | 0.24 | mg/L | 8/4/2015 | 7:10:00 | base | low | |
| WIN 72.8 | TN | 0.26 | mg/L | 8/18/2015 | 7:12:00 | base | low | |
| WIN 72.8 | TN | 0.25 | mg/L | 9/1/2015 | 6:45:00 | base | low | |
| WIN 81.6 | TN | 0.29 | mg/L | 6/23/2015 | 6:35:00 | freshet | moderate | |
| WIN 81.6 | TN | 0.30 | mg/L | 7/7/2015 | 6:45:00 | base | moderate | |
| WIN 81.6 | TN | 0.52 | mg/L | 7/28/2015 | 6:30:00 | base | moderate | |
| WIN 81.6 | TN | 0.25 | mg/L | 8/4/2015 | 7:00:00 | base | low | |
| WIN 81.6 | TN | 0.28 | mg/L | 8/18/2015 | 6:30:00 | base | low | |
| WIN 81.6 | TN | 0.45 | mg/L | 9/1/2015 | 7:00:00 | base | low | |
| WIN 81.7 | TN | 0.30 | mg/L | 6/23/2015 | 6:50:00 | freshet | moderate | |
| WIN 81.8 | TN | 0.28 | mg/L | 6/23/2015 | 6:45:00 | freshet | moderate | |
| Win 81.8 | TN | 0.29 | mg/L | 7/7/2015 | 6:23:00 | base | moderate | |
| WIN 81.8 | TN | 0.51 | mg/L | 7/28/2015 | 6:30:00 | base | moderate | |
| WIN 81.8 | TN | 0.30 | mg/L | 8/4/2015 | 6:35:00 | base | low | |
| WIN 81.8 | TN | 0.48 | mg/L | 9/1/2015 | 6:35:00 | base | low | |
| WIN 83.8 | TN | 0.31 | mg/L | 6/23/2015 | 6:40:00 | freshet | moderate | |
| Win 83.8 | TN | 0.32 | mg/L | 7/7/2015 | 6:46:00 | base | moderate | |
| WIN 83.8 | TN | 0.37 | mg/L | 7/28/2015 | 6:49:00 | base | moderate | |
| WIN 83.8 | TN | 0.33 | mg/L | 8/4/2015 | 6:43:00 | base | low | |
| WIN 83.8 | TN | 0.32 | mg/L | 8/18/2015 | 6:38:00 | base | low | |
| WIN 83.8 | TN | 0.87 | mg/L | 9/1/2015 | 7:15:00 | base | low | |
| WIN 84.1 | TN | 0.21 | mg/L | 6/23/2015 | 6:30:00 | freshet | moderate | |
| WIN 84.1 | TN | 0.35 | mg/L | 6/23/2015 | 6:30:00 | freshet | moderate | |
| Win 84.1 | TN | 0.30 | mg/L | 7/7/2015 | 6:31:00 | base | moderate | |
| WIN 84.1 | TN | 0.39 | mg/L | 7/28/2015 | 6:39:00 | base | moderate | |
| WIN 84.1 | TN | 0.35 | mg/L | 8/4/2015 | 6:35:00 | base | low | |

| Site RM | Param | Result | Units | Collect Date | Collect Time | flow type | flow level | RemarkCode |
|---|---|---|---|---|---|---|---|---|
| WIN 84.1 | TN | 0.33 | mg/L | 8/18/2015 | 6:32:00 | base | low | |
| WIN 84.1 | TN | 0.31 | mg/L | 9/1/2015 | 7:00:00 | base | low | |
| WIN81.7 | TN | 0.31 | mg/L | 7/28/2015 | 7:23:00 | base | moderate | |
| GB0.1 | TP | 26.5 | ug P/L | 6/23/2015 | 6:30:00 | freshet | moderate | |
| GB0.1 | TP | 5.2 | ug P/L | 7/7/2015 | 6:15:00 | base | moderate | |
| GB0.1 | TP | 46.4 | ug P/L | 7/28/2015 | 6:35:00 | base | moderate | |
| GB0.1 | TP | 12.4 | ug P/L | 8/4/2015 | 7:00:00 | base | low | |
| GB0.1 | TP | 246.0 | ug P/L | 8/18/2015 | 6:48:00 | base | low | |
| GB0.1 | TP | 9.4 | ug P/L | 9/1/2015 | 7:20:00 | base | low | |
| JB0.1 | TP | 6.7 | ug P/L | 7/7/2015 | 6:25:00 | base | moderate | |
| JB0.1 | TP | 11.3 | ug P/L | 7/28/2015 | 6:23:00 | base | moderate | |
| JB0.1 | TP | 7.3 | ug P/L | 8/4/2015 | 6:26:00 | base | low | |
| JB0.1 | TP | 17.7 | ug P/L | 8/18/2015 | 6:26:00 | base | low | |
| JB0.1 | TP | 13.8 | ug P/L | 9/1/2015 | 7:15:00 | base | low | |
| MAB 0.1 | TP | 15.5 | ug P/L | 6/23/2015 | 6:59:00 | freshet | moderate | |
| MAB0.1 | TP | 12.9 | ug P/L | 7/7/2015 | 6:13:00 | base | moderate | |
| MAB0.1 | TP | 13.3 | ug P/L | 7/28/2015 | 6:30:00 | base | moderate | |
| MAB0.1 | TP | 10.9 | ug P/L | 8/4/2015 | 6:30:00 | base | low | |
| MAB0.1 | TP | 12.6 | ug P/L | 8/18/2015 | 6:11:00 | base | low | |
| MAB0.1 | TP | 12.1 | ug P/L | 9/1/2015 | 7:35:00 | base | low | |
| NAB 2.6 | TP | 18.9 | ug P/L | 6/23/2015 | 6:38:00 | freshet | moderate | |
| NAB0.8 | TP | 24.8 | ug P/L | 6/23/2015 | 6:48:00 | freshet | moderate | |
| NAB0.8 | TP | 16.7 | ug P/L | 7/7/2015 | 7:03:00 | base | moderate | |
| NAB0.8 | TP | 10.7 | ug P/L | 8/4/2015 | 6:52:00 | base | low | |
| NAB0.8 | TP | 11.6 | ug P/L | 8/18/2015 | 6:48:00 | base | low | |
| NAB0.8 | TP | 13.1 | ug P/L | 9/1/2015 | 7:00:00 | base | low | |
| NAB2.6 | TP | 15.6 | ug P/L | 7/7/2015 | 6:54:00 | base | moderate | |
| NAB2.6 | TP | 31.3 | ug P/L | 8/4/2015 | 6:37:00 | base | low | |
| NAB2.6 | TP | 21.5 | ug P/L | 8/18/2015 | 6:33:00 | base | low | |
| NAB2.6 | TP | 22.5 | ug P/L | 9/1/2015 | 6:15:00 | base | low | |
| WIN 70.7 | TP | 27.9 | ug P/L | 6/23/2015 | 6:20:00 | freshet | moderate | |
| WIN 70.7 | TP | 20.5 | ug P/L | 7/7/2015 | 6:45:00 | base | moderate | |
| WIN 70.7 | TP | 26.3 | ug P/L | 7/28/2015 | 6:26:00 | base | moderate | |
| WIN 70.7 | TP | 11.1 | ug P/L | 8/4/2015 | 6:30:00 | base | low | |
| WIN 70.7 | TP | 12.0 | ug P/L | 8/18/2015 | 6:20:00 | base | low | |
| WIN 70.7 | TP | 11.8 | ug P/L | 9/1/2015 | 7:45:00 | base | low | |
| WIN 70.9 | TP | 25.6 | ug P/L | 6/23/2015 | 6:45:00 | freshet | moderate | |
| WIN 70.9 | TP | 14.9 | ug P/L | 7/7/2015 | 6:35:00 | base | moderate | |
| WIN 70.9 | TP | 31.4 | ug P/L | 7/28/2015 | 6:16:00 | base | moderate | |
| WIN 70.9 | TP | 12.0 | ug P/L | 8/4/2015 | 6:45:00 | base | low | |
| WIN 70.9 | TP | 11.7 | ug P/L | 8/18/2015 | 6:30:00 | base | low | |
| WIN 70.9 | TP | 12.2 | ug P/L | 9/1/2015 | 7:35:00 | base | low | |
| WIN 72.8 | TP | 26.8 | ug P/L | 6/23/2015 | 6:56:00 | freshet | moderate | |
| WIN 72.8 | TP | 19.2 | ug P/L | 7/7/2015 | 7:20:00 | base | moderate | |

| Site RM | Param | Result | Units | Collect Date | Collect Time | flow type | flow level | RemarkCode |
|---|---|---|---|---|---|---|---|---|
| WIN 72.8 | TP | 10.8 | ug P/L | 8/4/2015 | 7:10:00 | base | low | |
| WIN 72.8 | TP | 12.7 | ug P/L | 8/18/2015 | 7:12:00 | base | low | |
| WIN 72.8 | TP | 12.8 | ug P/L | 9/1/2015 | 6:45:00 | base | low | |
| WIN 81.6 | TP | 18.4 | ug P/L | 6/23/2015 | 6:35:00 | freshet | moderate | |
| WIN 81.6 | TP | 11.9 | ug P/L | 7/7/2015 | 6:45:00 | base | moderate | |
| WIN 81.6 | TP | 18.5 | ug P/L | 7/28/2015 | 6:30:00 | base | moderate | |
| WIN 81.6 | TP | 10.5 | ug P/L | 8/4/2015 | 7:00:00 | base | low | |
| WIN 81.6 | TP | 11.4 | ug P/L | 8/18/2015 | 6:30:00 | base | low | BIAS HIGH? |
| WIN 81.6 | TP | 15.0 | ug P/L | 9/1/2015 | 7:00:00 | base | low | |
| WIN 81.7 | TP | 21.1 | ug P/L | 6/23/2015 | 6:50:00 | freshet | moderate | |
| WIN 81.8 | TP | 19.9 | ug P/L | 6/23/2015 | 6:45:00 | freshet | moderate | |
| Win 81.8 | TP | 8.5 | ug P/L | 7/7/2015 | 6:23:00 | base | moderate | |
| WIN 81.8 | TP | 17.4 | ug P/L | 7/28/2015 | 6:30:00 | base | moderate | |
| WIN 81.8 | TP | 7.4 | ug P/L | 8/4/2015 | 6:35:00 | base | low | |
| WIN 81.8 | TP | 9.2 | ug P/L | 8/18/2015 | 6:20:00 | base | low | BIAS HIGH? |
| WIN 81.8 | TP | 10.8 | ug P/L | 9/1/2015 | 6:35:00 | base | low | |
| WIN 83.8 | TP | 18.9 | ug P/L | 6/23/2015 | 6:40:00 | freshet | moderate | |
| Win 83.8 | TP | 12.1 | ug P/L | 7/7/2015 | 6:46:00 | base | moderate | |
| WIN 83.8 | TP | 29.0 | ug P/L | 7/28/2015 | 6:49:00 | base | moderate | |
| WIN 83.8 | TP | 8.9 | ug P/L | 8/4/2015 | 6:43:00 | base | low | |
| WIN 83.8 | TP | 10.7 | ug P/L | 8/18/2015 | 6:38:00 | base | low | |
| WIN 83.8 | TP | 12.5 | ug P/L | 9/1/2015 | 7:15:00 | base | low | |
| WIN 84.1 | TP | 14.0 | ug P/L | 6/23/2015 | 6:30:00 | freshet | moderate | |
| WIN 84.1 | TP | 18.4 | ug P/L | 6/23/2015 | 6:30:00 | freshet | moderate | |
| Win 84.1 | TP | 11.4 | ug P/L | 7/7/2015 | 6:31:00 | base | moderate | |
| WIN 84.1 | TP | 28.1 | ug P/L | 7/28/2015 | 6:39:00 | base | moderate | |
| WIN 84.1 | TP | 11.5 | ug P/L | 8/4/2015 | 6:35:00 | base | low | |
| WIN 84.1 | TP | 13.9 | ug P/L | 8/18/2015 | 6:32:00 | base | low | |
| WIN 84.1 | TP | 22.3 | ug P/L | 9/1/2015 | 7:00:00 | base | low | |
| WIN81.7 | TP | 61.6 | ug P/L | 7/28/2015 | 7:23:00 | base | moderate | |
| GB0.1 | Turbidity | 5.5 | NTU | 6/23/2015 | 6:30:00 | freshet | moderate | |
| GB0.1 | Turbidity | 0.4 | NTU | 7/7/2015 | 6:15:00 | base | moderate | |
| GB0.1 | Turbidity | 23.8 | NTU | 7/28/2015 | 6:35:00 | base | moderate | |
| GB0.1 | Turbidity | 2.5 | NTU | 8/4/2015 | 7:00:00 | base | low | |
| GB0.1 | Turbidity | 1.6 | NTU | 8/18/2015 | 6:48:00 | base | low | |
| GB0.1 | Turbidity | 0.9 | NTU | 9/1/2015 | 7:20:00 | base | low | |
| JB0.1 | Turbidity | 1.2 | NTU | 7/7/2015 | 6:25:00 | base | moderate | |
| JB0.1 | Turbidity | 1.8 | NTU | 7/28/2015 | 6:23:00 | base | moderate | |
| JB0.1 | Turbidity | 0.6 | NTU | 8/4/2015 | 6:26:00 | base | low | |
| JB0.1 | Turbidity | 3.8 | NTU | 8/18/2015 | 6:26:00 | base | low | |
| JB0.1 | Turbidity | 1.4 | NTU | 9/1/2015 | 7:15:00 | base | low | |
| MAB 0.1 | Turbidity | 1.3 | NTU | 6/23/2015 | 6:59:00 | freshet | moderate | |
| MAB0.1 | Turbidity | 0.6 | NTU | 7/7/2015 | 6:13:00 | base | moderate | |
| MAB0.1 | Turbidity | 0.9 | NTU | 7/28/2015 | 6:30:00 | base | moderate | |

| Site RM | Param | Result | Units | Collect Date | Collect Time | flow type | flow level | RemarkCode |
|---|---|---|---|---|---|---|---|---|
| MAB0.1 | Turbidity | 0.8 | NTU | 8/4/2015 | 6:30:00 | base | low | |
| MAB0.1 | Turbidity | 1.2 | NTU | 8/18/2015 | 6:11:00 | base | low | |
| MAB0.1 | Turbidity | 0.9 | NTU | 9/1/2015 | 7:35:00 | base | low | |
| NAB 2.6 | Turbidity | 1.9 | NTU | 6/23/2015 | 6:38:00 | freshet | moderate | |
| NAB0.8 | Turbidity | 14.9 | NTU | 6/23/2015 | 6:48:00 | freshet | moderate | |
| NAB0.8 | Turbidity | 0.6 | NTU | 7/7/2015 | 7:03:00 | base | moderate | |
| NAB0.8 | Turbidity | 0.5 | NTU | 8/4/2015 | 6:52:00 | base | low | |
| NAB0.8 | Turbidity | 0.7 | NTU | 8/18/2015 | 6:48:00 | base | low | |
| NAB0.8 | Turbidity | 0.7 | NTU | 9/1/2015 | 7:00:00 | base | low | |
| NAB2.6 | Turbidity | 0.8 | NTU | 7/7/2015 | 6:54:00 | base | moderate | |
| NAB2.6 | Turbidity | 5.2 | NTU | 8/4/2015 | 6:37:00 | base | low | |
| NAB2.6 | Turbidity | 1.1 | NTU | 8/18/2015 | 6:33:00 | base | low | |
| NAB2.6 | Turbidity | 1.0 | NTU | 9/1/2015 | 6:15:00 | base | low | |
| WIN 70.7 | Turbidity | 5.5 | NTU | 6/23/2015 | 6:20:00 | freshet | moderate | |
| WIN 70.7 | Turbidity | 2.9 | NTU | 7/7/2015 | 6:45:00 | base | moderate | |
| WIN 70.7 | Turbidity | 11.2 | NTU | 7/28/2015 | 6:26:00 | base | moderate | |
| WIN 70.7 | Turbidity | 2.3 | NTU | 8/4/2015 | 6:30:00 | base | low | |
| WIN 70.7 | Turbidity | 1.3 | NTU | 8/18/2015 | 6:20:00 | base | low | |
| WIN 70.7 | Turbidity | 2.5 | NTU | 9/1/2015 | 7:45:00 | base | low | |
| WIN 70.9 | Turbidity | 5.5 | NTU | 6/23/2015 | 6:45:00 | freshet | moderate | |
| WIN 70.9 | Turbidity | 2.3 | NTU | 7/7/2015 | 6:35:00 | base | moderate | |
| WIN 70.9 | Turbidity | 6.7 | NTU | 7/28/2015 | 6:16:00 | base | moderate | |
| WIN 70.9 | Turbidity | 2.0 | NTU | 8/4/2015 | 6:45:00 | base | low | |
| WIN 70.9 | Turbidity | 1.4 | NTU | 8/18/2015 | 6:30:00 | base | low | |
| WIN 70.9 | Turbidity | 2.1 | NTU | 9/1/2015 | 7:35:00 | base | low | |
| WIN 72.8 | Turbidity | 5.4 | NTU | 6/23/2015 | 6:56:00 | freshet | moderate | |
| WIN 72.8 | Turbidity | 2.5 | NTU | 7/7/2015 | 7:20:00 | base | moderate | |
| WIN 72.8 | Turbidity | 1.5 | NTU | 8/4/2015 | 7:10:00 | base | low | |
| WIN 72.8 | Turbidity | 1.2 | NTU | 8/18/2015 | 7:12:00 | base | low | |
| WIN 72.8 | Turbidity | 1.5 | NTU | 9/1/2015 | 6:45:00 | base | low | |
| WIN 81.6 | Turbidity | 2.2 | NTU | 6/23/2015 | 6:35:00 | freshet | moderate | |
| WIN 81.6 | Turbidity | 1.0 | NTU | 7/7/2015 | 6:45:00 | base | moderate | |
| WIN 81.6 | Turbidity | 0.8 | NTU | 7/28/2015 | 6:30:00 | base | moderate | |
| WIN 81.6 | Turbidity | 0.6 | NTU | 8/4/2015 | 7:00:00 | base | low | |
| WIN 81.6 | Turbidity | 1.0 | NTU | 8/18/2015 | 6:30:00 | base | low | |
| WIN 81.6 | Turbidity | 1.0 | NTU | 9/1/2015 | 7:00:00 | base | low | |
| WIN 81.7 | Turbidity | 3.0 | NTU | 6/23/2015 | 6:50:00 | freshet | moderate | |
| WIN 81.8 | Turbidity | 2.3 | NTU | 6/23/2015 | 6:45:00 | freshet | moderate | |
| Win 81.8 | Turbidity | 0.6 | NTU | 7/7/2015 | 6:23:00 | base | moderate | |
| WIN 81.8 | Turbidity | 2.0 | NTU | 7/28/2015 | 6:30:00 | base | moderate | |
| WIN 81.8 | Turbidity | 0.4 | NTU | 8/4/2015 | 6:35:00 | base | low | |
| WIN 81.8 | Turbidity | 0.7 | NTU | 8/18/2015 | 6:20:00 | base | low | |
| WIN 81.8 | Turbidity | 1.1 | NTU | 9/1/2015 | 6:35:00 | base | low | |
| WIN 83.8 | Turbidity | 2.6 | NTU | 6/23/2015 | 6:40:00 | freshet | moderate | |

| Site RM | Param | Result | Units | Collect Date | Collect Time | flow type | flow level | RemarkCode |
|---|---|---|---|---|---|---|---|---|
| Win 83.8 | Turbidity | 0.7 | NTU | 7/7/2015 | 6:46:00 | base | moderate | |
| WIN 83.8 | Turbidity | 5.1 | NTU | 7/28/2015 | 6:49:00 | base | moderate | |
| WIN 83.8 | Turbidity | 0.4 | NTU | 8/4/2015 | 6:43:00 | base | low | |
| WIN 83.8 | Turbidity | 0.9 | NTU | 8/18/2015 | 6:38:00 | base | low | |
| WIN 83.8 | Turbidity | 1.2 | NTU | 9/1/2015 | 7:15:00 | base | low | |
| WIN 84.1 | Turbidity | 1.1 | NTU | 6/23/2015 | 6:30:00 | freshet | moderate | |
| Win 84.1 | Turbidity | 1.3 | NTU | 7/7/2015 | 6:31:00 | base | moderate | |
| WIN 84.1 | Turbidity | 4.2 | NTU | 7/28/2015 | 6:39:00 | base | moderate | |
| WIN 84.1 | Turbidity | 0.8 | NTU | 8/4/2015 | 6:35:00 | base | low | |
| WIN 84.1 | Turbidity | 0.5 | NTU | 8/18/2015 | 6:32:00 | base | low | |
| WIN 84.1 | Turbidity | 1.8 | NTU | 9/1/2015 | 7:00:00 | base | low | |
| WIN81.7 | Turbidity | 1.6 | NTU | 7/28/2015 | 7:23:00 | base | moderate | |

**Appendix D. Quality Assurance Measures for alkalinity, chloride, *E. coli*, phosphorous, nitrogen, and turbidity Sampling in 2015**

| Date | Site ID | Sample Type | Relative Percent Difference Between Duplicate Pairs (RPD) |
|---|---|---|---|
| 6/23/15 | WIN86.6 | *E. coli* | 25.9% |
| | WIN81.7 | Total Nitrogen | 3.4% |
| | | Total Phosphorus | 1.9% |
| | | Turbidity | 4.2% |
| 7/7/15 | WIN84.1 | *E. coli* | 0% |
| | | Total Nitrogen | 3.3% |
| | | Total Phosphorus | 1.8% |
| | | Turbidity | 2.4% |
| 7/28/15 | WIN81.8 | Alkalinity | 1.1% |
| | | Chloride | 1.9% |
| | | *E. coli* | 4.7% |
| | | Total Nitrogen | 4.0% |
| | | Total Phosphorus | 6.5% |
| | | Turbidity | 2.0% |
| 8/4/15 | WIN72.8 | *E. coli* | 1.1% |
| | | Total Nitrogen | 11.8% |
| | | Total Phosphorus | 4.7% |
| | | Turbidity | 4.8% |
| 8/18/15 | WIN70.9 | *E. coli* | 25.4% |
| | WIN72.8 | Total Nitrogen | 0% |
| | | Total Phosphorus | 1.6% |
| | | Turbidity | 7.5% |
| 9/1/15 | NAB0.8 | *E. coli* | 1.4 % |
| | | Total Nitrogen | 4.3 % |
| | | Total Phosphorus | 11.3 % |
| | | Turbidity | 76.3% |
| **Mean Relative Percent Difference (Mean RPD)** | | **Alkalinity** | **1.1%** |
| | | **Chloride** | **1.9%** |
| | | ***E. coli*** | **13.4%** |
| | | **Total Nitrogen** | **4.4%** |
| | | **Total Phosphorus** | **4.6%** |
| | | **Turbidity** | ***16.2%** |

Note: The mean relative percent difference value for the turbidity duplicates is high due to the high RPD between the samples taken on 9/1/15 at Naismith Brook. The turbidity levels in these samples were very low (0.67 and 0.30 NTU), 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 | ≤ 5% |
| Chloride | ≤ 5% |
| *E. coli* | ≤ 50% |
| Nitrogen | ≤ 50% |
| Phosphorus | ≤ 30% |
| Turbidity | ≤ 15% |

**Appendix E.** Results from field blanks.

| Customer Sample # | Param | Symbol | Result | Units | Collect Date | Collect Time |
|---|---|---|---|---|---|---|
| WIN 86.6 - Blank | Coliform, E. coli | < | 1 | mpn/100ml | 6/23/2015 | 6:09:00 |
| WIN 84.1 - Blank | Coliform, E. coli | < | 1 | mpn/100ml | 7/7/2015 | 6:31:00 |
| WIN 72.8-Blank | Coliform, E. coli | < | 1 | mpn/100ml | 8/4/2015 | 7:10:00 |
| WIN 70.9-BLANK | Coliform, E. coli | < | 1 | mpn/100ml | 8/18/2015 | 6:30:00 |
| NAB0.8-Blank | Coliform, E. coli | < | 1 | mpn/100ml | 9/1/2015 | 7:00:00 |
| | | | | | | |
| WIN 81.7 Blank | Nitrogen, Total - Persulfate | < | 0.1 | mg/L | 6/23/2015 | 6:50:00 |
| WIN 84.1 - Blank | Nitrogen, Total - Persulfate | < | 0.1 | mg/L | 7/7/2015 | 6:31:00 |
| WIN 72.8-Blank | Nitrogen, Total - Persulfate | < | 0.1 | mg/L | 8/4/2015 | 7:10:00 |
| WIN 72.8-BLANK | Nitrogen, Total - Persulfate | < | 0.1 | mg/L | 8/18/2015 | 7:14:00 |
| NAB0.8-BLANK | Nitrogen, Total - Persulfate | < | 0.1 | mg/L | 9/1/2015 | 7:00:00 |
| | | | | | | |
| WIN 81.7 Blank | Phosphorus | < | 5 | ug P/L | 6/23/2015 | 6:50:00 |
| WIN 84.1 - Blank | Phosphorus | < | 5 | ug P/L | 7/7/2015 | 6:31:00 |
| WIN 72.8-Blank | Phosphorus | | 8.96 | ug P/L | 8/4/2015 | 7:10:00 |
| WIN 72.8-BLANK | Phosphorus | < | 5 | ug P/L | 8/18/2015 | 7:14:00 |
| NAB0.8-BLANK | Phosphorus | < | 5 | ug P/L | 9/1/2015 | 7:00:00 |
| | | | | | | |
| WIN 81.7 Blank | Turbidity | < | 0.2 | NTU | 6/23/2015 | 6:50:00 |
| WIN 84.1 - Blank | Turbidity | < | 0.2 | NTU | 7/7/2015 | 6:31:00 |
| WIN 72.8-Blank | Turbidity | < | 0.2 | NTU | 8/4/2015 | 7:10:00 |
| WIN 72.8-BLANK | Turbidity | | 0.21 | NTU | 8/18/2015 | 7:14:00 |
| NAB0.8-BLANK | Turbidity | < | 0.2 | NTU | 9/1/2015 | 7:00:00 |