Section 5-3
Bagaduce River & Tributaries (Bagaduce Watershed Association)

Refer to Chapter 4 of this document for information about sampling methods, sampling sites, and quality assurance.

Overview

The Bagaduce Watershed Association (BWA) was formed in 2002 because of interest and concern for the river. The association began sampling in 2003 and has been very active since then. The volunteer group now includes over 100 members and 9 river monitors. The group has been monitoring several freshwater streams as well as sites in the Bagaduce River estuary. In addition to monitoring, the group has also done eelgrass transplants in cooperation with Maine Department of Transportation.

The Bagaduce River is located on the coast of Maine in the eastern part of Penobscot Bay. The watershed includes seven major streams and ponds: Camp Stream, Winslow Stream, Mill Stream, Smelt Brook, Bagaduce Stream, Stony Brook, Mill Brook, Wight Pond, Snake Pond, Parker Pond, Walker Pond, Frost Pond, Black Pond, and Pierce Pond which have all been monitored at one time or another. These waterbodies drain to the Bagaduce River – an estuary that flows into Penobscot Bay. The watershed includes parts of five towns: Brooksville, Blue Hill, Castine, Penobscot, and Sedgewick. The river has a total watershed area of 125 square miles. Land use in the watershed consists primarily of forest, wetlands, low intensity residential, roads, agriculture, shoreline development, and limited commercial development. Maine Maritime Academy (MMA) is located in Castine; it has an associated ship pier, the training ship *State of Maine*, and an undergraduate oceanography program. The headwaters of the Bagaduce, especially Walker Pond, support a unique dwarf alewife (a subspecies of *Alosa pseudoharengus*), and the estuary supports some of the best remaining eelgrass beds (*Zostera marina*) found in Hancock County.

The statutory water class of the freshwater tributaries to the Bagaduce River is Class B, and the Bagaduce River estuary is Class SA/SB.[1] All freshwater lakes and ponds are Class GPA – the only State classification for lakes.

The DEP "2010 Integrated Water Quality Monitoring and Assessment Report", lists segments of the river in 2 categories:

- "Category 2: "Rivers and Streams Attaining some Designated Uses-Insufficient Information for Other Uses".
    - Bagaduce River and its tributaries

[1] See Water Classification webpage for further clarification of classification of these waters: www.maine.gov/dep/water/monitoring/classification/index.html

- "Category 2: Estuarine and Marine Waters Attaining some Designated Uses-Insufficient Information for Other Uses".
    - The Penobscot River and Bagaduce River in Castine-Penobscot. It is listed here for the Department of Marine Resources' closure of 2.5 square miles to shellfishing due to overboard discharges (on-site sewage treatment systems).

Past monitoring by BWA has indicated that some of the freshwater streams (Camp Stream, Mill Brook, Mill Stream, and Smelt Brook) experience water temperature and dissolved oxygen levels that may be of concern. Because of the rural nature of the area, most of the problems may be due to natural causes (e.g. low flow, beaver activity). Macroinvertebrate community rapid assessments were also done on Mill Stream, Mill Brook, Winslow Stream, Stoney Brook, and Camp Stream. There was a good diversity of macroinvertebrates with many mayflies, stoneflies, and caddisflies, indicating good water quality.

The overall purpose of monitoring is to assess water quality data to determine whether the river and tributaries are meeting water quality classification standards. The Bagaduce River Watershed Sampling and Analysis Plan states that the overall objectives of monitoring are to: (1) assess overall health of the Bagaduce tributaries and river; and (2) assess habitat value for native coldwater fish species.

Methods

During the 2012 field season, the volunteers monitored the Bagaduce River at four estuary sites (Bridges Point, Johnson Point Narrows, Lords Cove, and Youngs Island) and at four freshwater streams (Camp Stream, Mill Brook, Mill Stream and Winslow Stream) (Table 5-3-1 and Figures 5-3-1 through 5-3-3). All of the freshwater sites are VRMP approved sites and all of the estuary sites are VRMP non-approved sites.

Table 5-3-1: Bagaduce Watershed Association sampling sites.

VRMP Site ID	Organization Site Code	Sample Location	Class
Camp Stream-NBGCS08-VRMP	Site #1	Camp Stream	B
Mill Brook-NBGMB07-VRMP	Site #3	Mill Brook	B
Mill Stream-NBGMS02-VRMP	Site #4	Mill Stream	B
Winslow Stream-NBGWS32-VRMP	Site #2	Winslow Stream	B
Bagaduce River-NBG-BWA	Bridges Point	Bridges Point	SA/SB
Bagaduce River-NBG-BWA2	Lords Cove	Lords Cove	SA/SB
Bagaduce River-NBG153-BWA	Johnson Pt. Narrow	Johnson Pt. Narrows	SA/SB
Bagaduce River-NBG133-BWA	Youngs Island	Youngs Island	SA/SB

The freshwater sites were monitored generally 1-2 times/ month from April-September. The marine sites were monitored generally 1-2 times/month from May-October. Volunteers were encouraged to sample storm events any time there was more than one inch of rain measured at neighboring weather stations. Water temperature, dissolved oxygen (DO), specific conductance (or salinity for estuarine sites), and turbidity were monitored. Water temperature was measured with a handheld thermometer or YSI 550A meter (one marine site). Dissolved oxygen was measured with LaMotte all-liquid Titration kits (Model 5860) or YSI 550A meter (one marine site). Specific conductance was measured at Camp Stream, Mill Brook, and Winslow Stream with Oakton ECTestr 11+ conductivity pens. Salinity was measured with a refractometer. Turbidity was measured using 120 cm transparency tubes. Transparency tubes are plexiglass tubes with a secchi disk target at the bottom. Visibility is a measure of transparency (it is the distance at which the secchi target is visible at the bottom of the turbidity tube, and it ranges from 0-120 cm), and is just the opposite of turbidity. That is, a transparency tube reading of 120 cm is clear water, while 120 NTU from a turbidity meter is very cloudy and almost opaque.

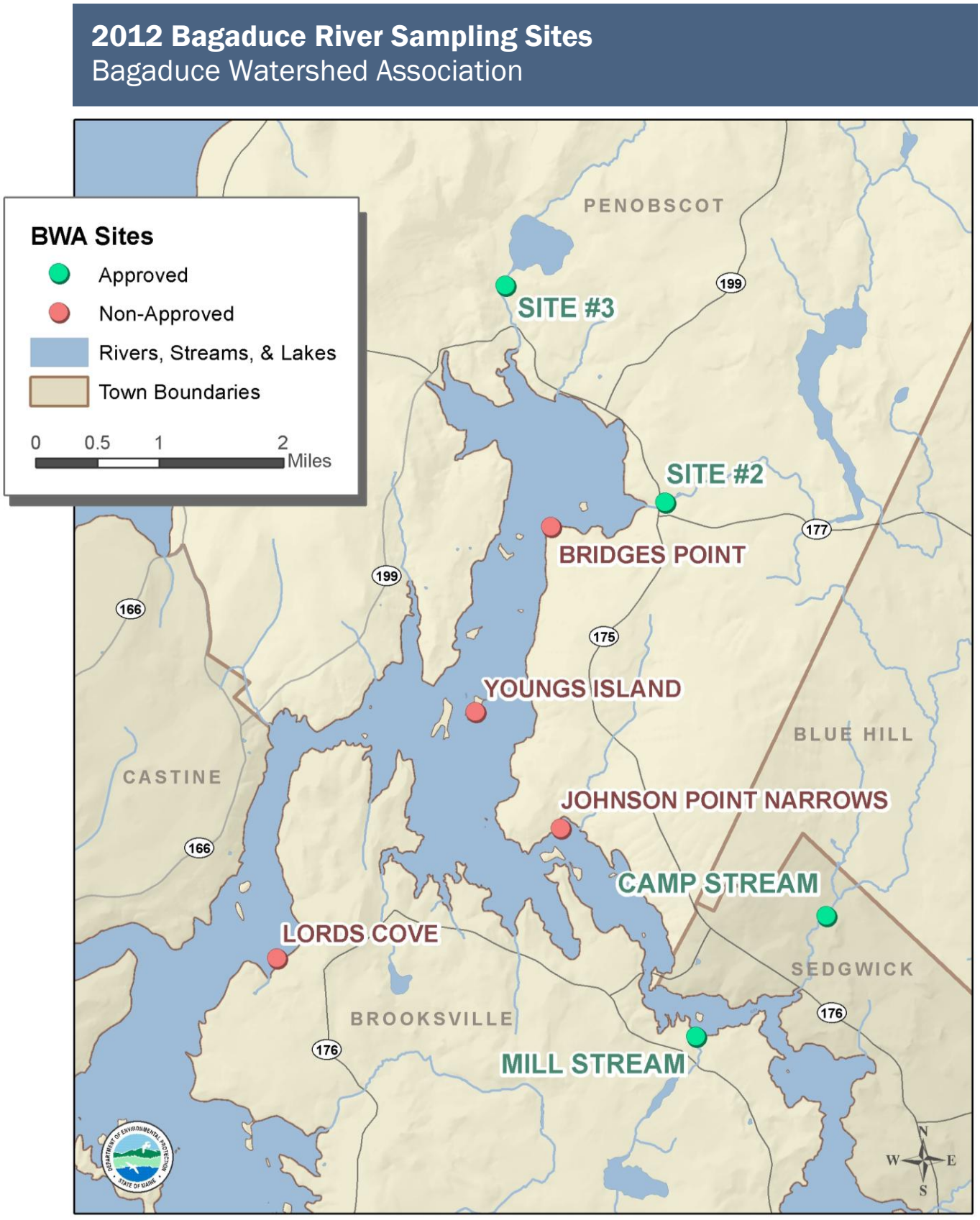

Figure 5-3-1: Map of Bagaduce Watershed Association sampling sites on the Bagaduce River and tributaries.

Results

Refer to Appendices A-1 and A-2 in discussion of individual site data and trends, as well as graphed data (5-3-4 through 5-3-13), at the end of this section of the report.

Precipitation

Figure 5-3-4 provides a graph of rainfall and sampling dates for the monitoring period. Rainfall data was obtained from Weather Underground (http://www.wunderground.com). Weather station choice was based on proximity and station with most complete records. If there was an airport station close by, this was chosen. This information provides an overview of rainfall events and can be useful in interpreting monitoring results for some parameters.

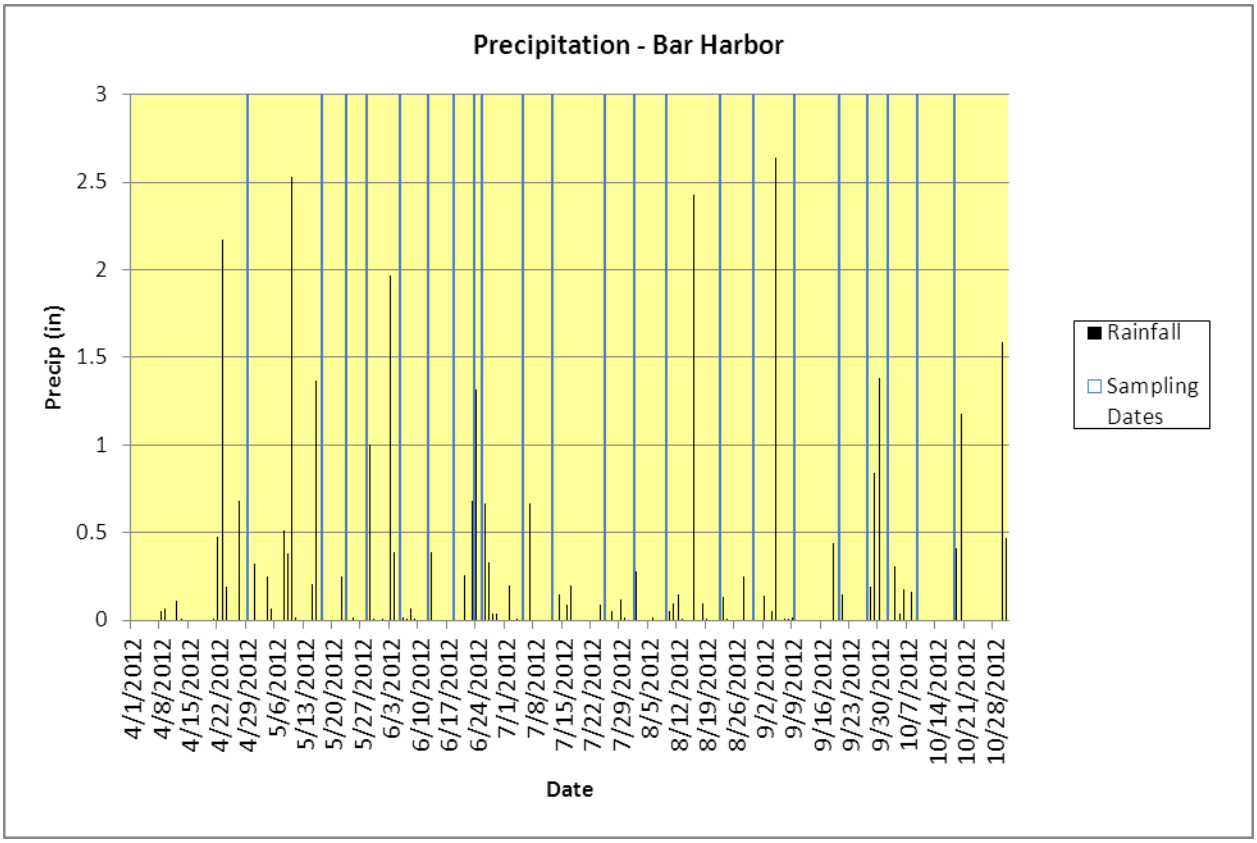

Figure 5-3-2: Seasonal Precipitation Measured at Bar Harbor

Dissolved Oxygen

Dissolved oxygen was measured 3-7 times at each of the eight sampling sites (Table 5-3-2 and Table 5-3-3). Dissolved oxygen saturation was a calculated value when both dissolved oxygen in mg/l and temperature were measured. Monitoring occurred from April to October. For freshwater, Class B criteria for DO are a minimum of 7.0 mg/l (milligrams/liter) or 75% saturation. To meet water quality criteria, both concentration and saturation standards must be met. For the Bagaduce River estuary, Class SA standards are "as naturally occurs" and Class SB standards are 85% saturation.

Table 5-3-2: A summary of minimum, maximum, and average DO concentration values (mg/l) at Bagaduce Watershed Association monitoring sites on the Bagaduce River & tributaries.

Site	Approved Site	# of Samples	Minimum Value	Maximum Value	Average Value
Camp Stream-Site #1	Y	7	5.4	7.4	6.2
Mill Brook-Site #3	Y	7	6.0	8.6	7.3
Mill Stream-Site #4	Y	3	5.8	7.6	6.7
Winslow Stream-Site#2	Y	6	5.4	8.3	6.9
Bridges Point	N	4	7.3	9.2	8.1
Johnson Pt. Narrow	N	3	7.5	8.9	8.1
Lords Cove	N	5	6.0	7.7	7.0
Youngs Island	N	5	7.0	8.4	7.4

Table 5-3-3: A summary of minimum, maximum, and average DO saturation values (%) at Bagaduce Watershed Association monitoring sites on the Bagaduce River & tributaries.

Site	Approved Site	# of Samples	Minimum Value	Maximum Value	Average Value
Camp Stream-Site #1	Y	7	59.0	72.4	66.0
Mill Brook-Site #3	Y	7	69.9	96.5	79.6
Mill Stream-Site #4	Y	3	64.4	78.6	72.1
Winslow Stream-Site #2	Y	5	62.9	79.9	72.3
Bridges Point	N	4	70.8	91.2	83.3
Johnson Pt. Narrow	N	3	75.9	109.0	8.9
Lords Cove	N	5	59.5	75.2	67.4
Youngs Island	N	5	67.9	81.4	74.9

Dissolved oxygen concentrations measured at the freshwater sites ranged from 5.4 mg/l to 8.6 mg/l. Camp Stream had its highest values in mid-June and late September with the remaining values being fairly low. Dissolved oxygen dropped below the Class B standard of 7.0 mg/l for 5 out of 7 sampling events. Percent saturation was below the Class B standard of 75% for all sampling events. Camp Stream is characterized by alternating riffles and pools, with much more slow water than active riffles in the summer time. There are also many beaver ponds. Low water, poor circulation, and high temperatures are probably at fault for summer DO problems. Mill Brook had its highest values from May to early June and September. It dropped below the Class B concentration standard for 3 out of 6 sampling events. Temperatures were warm June to early August (21°-23.4°C), but DO saturation dropped only slightly below the standard of 75%. Given that the stream originates in Pierce Pond (shallow dark water ponds can be efficient solar heat collectors), DO levels are likely due to natural causes. Mill Stream was only sampled 3 times because water levels became very low and there was little flow by mid-summer. It dropped below the Class B standard for DO concentration and saturation for 2 out of 3 sampling events. Winslow Stream had its highest values in early June and late August to September. It dropped below the Class B standard for concentration and saturation for 3 out of 6 sampling events. Overall, as noted above, dissolved oxygen levels at the freshwater sites are likely influenced by natural conditions (e.g. pond outlet flow, wetlands).

Dissolved oxygen concentrations measured in the Bagaduce estuary sites ranged from 6.0 mg/l to 9.2 mg/l and percent saturation ranged from 59.5% to 109%. Every estuary site had at least one value below the Class SB standard of 85% saturation. Bridges Point dropped below the saturation standard for 2 of 4 sampling events. Lords Cove was below the saturation standard for all samples with values ranging from 59.5% to 75.2% saturation. This is disturbing because this is the coldest site with the most marine influence (see temperature graph, Appendix A-1). On an ebb tide, Lords Cove is below the first tidal falls (which would thoroughly mix the out-going estuary water). On the flood tide, the water might be stratified and therefore not representative of the whole mass of water at Lords Cove. Johnson Point Narrows was below the saturation standard for 1 of 3 sampling events. At Youngs Island, all of the samples were below the saturation standard of 85%, with values ranging from 67.9% to 81.4%.

It is surprising that the estuary sites had values below the Class SB standard for all sites. The estuary has a strong marine influence with three tidal falls. Freshwater inputs are small and diffuse (so there should be little stratification based on salinity). On the other hand, there are large tidal flats, some coastal development, and some aquaculture. Thermal stratification could develop due to heating in the tidal flats (and might persist until it went through one of the tidal falls). Our sampling approach may also not be the best for the circumstances. Almost all of the sampling in 2011 in the estuary was done using LaMotte titration kits. Samples are collected by reaching down into the water from a boat or from the shore in a constricted area or from a dock. One concern was whether the monitors were able to obtain a representative sample by only sampling the surface. DEP staff thinks that the estuarine monitoring program would be improved by using electronic meters with probes that can be lowered on a cable. This provides a DO and temperature profile from top to bottom; this is more easily interpreted with confidence.

Water Temperature

Temperature was measured 3-7 times at each of the four freshwater sampling sites (Table 5-2-4) and 3-6 times at each of the four estuary sites. Monitoring occurred from May to October. Maine's Regulations Relating to Temperature (06-096 CMR Chapter 582) require that discharge of pollutants not raise the temperature of any river and stream above the EPA criteria for indigenous species (23°C maximum and 19°C weekly average) or 0.3°C (0.5°F) above the temperature that would naturally occur outside a mixing zone established by the Board of Environmental Protection. Pollutant is defined in statute as many things including dirt and heat. For tidal waters, discharge of pollutants may not raise the temperature more than 4°F (2.2°C) or more than 1.5°F (0.8°C) from June 1 to September 1, and may not cause the temperature of any tidal waters to exceed 85°F (29°C) at any point outside a mixing zone established by the Board of Environmental Protection.

Table 5-3-4: A summary of minimum, maximum, and average temperature values (°C) at Bagaduce Watershed Association monitoring sites on the Bagaduce River & tributaries.

Site	Approved Site	# of Samples	Minimum Value	Maximum Value	Average Value
Camp Stream-Site #1	Y	7	13.0	23.0	18.8
Mill Brook-Site #3	Y	7	15.3	23.4	20.0
Mill Stream-Site #4	Y	3	17.0	20.5	18.8
Winslow Stream-Site #2	Y	5	15.2	23.0	20.1
Bridges Point	N	5	14.0	21.0	17.2
Johnson Pt. Narrows	N	3	13.0	18.0	14.7
Lords Cove	N	6	11.0	17.0	13.3
Youngs Island	N	5	13.0	20.0	16.0

Temperature measured at the freshwater sites ranged from 15.2˚C to 23.4˚C (59-74°F). Mill Brook and Winslow Stream had the overall highest temperatures through the season. Mill Brook values from early June to late August ranged from 19.8°C to 23.4°C. In Winslow Stream, values from late June to late August ranged from 19.7°C -23.0°C. Camp Stream had much lower at least through June (17°C). From late July to late August, temperatures ranged from 20°C-23°C. Temperatures for Mill Stream were measured only from late May to mid-July due to very low flow there and ranged from 17.0°C -20.5°C. [See graphs at end of report]. As mentioned above in the discussion of oxygen, streams with headwater lakes can be strongly influenced by solar heating. This is a natural process and does not reflect the influence of human activities.

Temperature measured at the estuary sites ranged from 11.0ºC to 23.4˚C (43-70ºF). The highest temperatures were recorded at Bridges Point (21.0°C) and Youngs Island (20.0°C). July and August temperatures at Bridges Point ranged from 18.0°C -21.0°C. The vast mudflats of Northern Bay influence summer water quality (high temperatures) at Bridges Point. At Youngs Island, temperature was overall a

bit colder ranging from 15.0°C -20.0°C from late June to early September. At Lords Cove, the water temperature was generally the coldest, reflecting the marine influence in the lower estuary. The Johnson Point Narrows site was only sampled 3 times-early and late in the season.

Specific Conductance and Salinity

Specific conductance was measured as many as 8 times at one of the freshwater sampling sites (Table 5-3-5). Monitoring occurred from late April through October. Specific conductance is related to the amount of dissolved materials in the water. While there are no numerical standards, a relationship exists between conductivity and chloride which has numerical criteria. In general, streams located in urban areas tend to have high specific conductance due to polluted urban stormwater runoff. This may also in large part be due to salt buildup in surface and groundwater from road maintenance practices.

Table 5-3-5: A summary of minimum, maximum, and average specific conductance (µS/cm) at Bagaduce Watershed Association monitoring sites on the Bagaduce River tributaries.

Site	Approved Site	# of Samples	Minimum Value	Maximum Value	Average Value
Camp Stream-Site#1	Y	8	27	53	40
Mill Brook-Site#3	Y	7	22	59	30
Mill Stream-Site-#4	Y	--	--	--	--
Winslow Stream-Site#2	Y	5	36	50	44

Table 5-3-6: A summary of minimum, maximum, and average salinity values (ppt) at Bagaduce Watershed Association monitoring sites on the Bagaduce River.

Site	Approved Site	# of Samples	Minimum Value	Maximum Value	Average Value
Bridges Point	N	5	27	31	29
Johnson Pt. Narrows	N	3	24	31	28
Lords Cove	N	6	26	34	32
Youngs Island	N	5	23	29	26

All of the specific conductivity values were fairly consistent and ranged from 27 to 59 µS/cm for the three freshwater sites that were monitored. These values are all considered low and are similar to expected background values in undeveloped watersheds. So far, there is no evidence of road salt contamination. Salinity was measured at the estuary sites (Table 5-2-6). The range was 24-34 ppt (parts per thousand), reflecting the strong marine influence and weak/diffuse nature of the freshwater tributaries.

pH

Freshwater and estuary pH was not measured in 2011-12. In the past, the river estuary has ranged from around 7 (reflecting a freshwater source) to 8 (representing the marine influence), while tributary stream pH ranged from about 5 during high flows to around 7 during summer low flows. Some of the lowest freshwater pH values may represent a problem for native fish, especially the minnows. Brook trout are among the most acid tolerant fish species in Maine streams. Since the summer pH is high, we assume that acid rain problems are not very important in these watersheds and the low pH is probably of natural origins (organic acids from forest soils and marshes).

Turbidity / Transparency

Transparency was measured 3 to 7 times at the freshwater sites and 1-8 times in the estuary (Table 5-3-6). Transparency is a measure of the clarity of the water is related to turbidity-the amount of suspended materials in the water; including soil particles, algae, plankton and decaying vegetation. During precipitation events that are great enough to cause runoff, land use activities (e.g. construction, agriculture, logging) may contribute to increased turbidity. In order to evaluate the effects of turbidity on aquatic life, you need both intensity data (a transparency or turbidity measure) and some knowledge of the duration (in hours, days, and weeks).

Table 5-3-6: A summary of minimum, maximum, and average transparency values (cm) at Bagaduce Watershed Association monitoring sites on the Bagaduce River.

Site	Approved Site	# of Samples	Minimum Value	Maximum Value	Average Value
Camp Stream-Site #1	Y	5	89	120	109
Mill Brook-Site #3	Y	7	>120	>120	>120
Mill Stream-Site #4	Y	3	98	120	113
Winslow Stream-Site #2	Y	6	>120	>120	>120
Bridges Point	N	5	75	95	85
Johnson Pt. Narrows	N	1	86	86	86
Lords Cove	N	6	>120	>120	>120
Youngs Island	N	5	72	>120	86*

*Values >120 cm not included in mean calculation

Camp Stream and Mill Stream were the only freshwater sites with any lower transparency values (noticeable water cloudiness). Rain events do not seem to correlate with reduced transparency at Camp Stream, since for 2 out of 3 of the best transparency values significant rain events prior to sampling were noted. One low measurement was recorded for Mill Stream which occurred in mid-summer when the stream was very low.

At the estuarine sites, 3 out of 4 of the sites had lower transparency values. The worse site was Bridges Point which was sampled 5 times and had values ranging from 75-93 cm. This site is at a mud flat area where the monitor wades in to collect a sample, so perhaps this site is naturally more turbid. The Youngs Island site had 2 reduced transparency measurements (72 cm. and 103 cm.). The lowest reading was taken after noted steady rain. All the measurements at Lords Cove were >120 cm. Only 1 sample was taken at the Johnson Point Narrows site (86 cm.).

Discussion and Recommendations

There are numerous sources of pollution and other stresses to the Bagaduce River and tributary sites monitored by the Bagaduce Watershed Association that could potentially have an impact on water quality. Some of those sources of pollution and stress may include:

- Non-point source pollution (e.g., eroded soil, fertilizers, pesticides, sewage systems, heavy metals, petroleum residues, road salt, wildlife and pet feces) and polluted stormwater originating from impervious surfaces such as streets, parking lots, driveways, rooftops (even though development and roads are fairly sparse in the watershed), and from agriculture and forestry.
- Ponds and impoundments (which often create more pond-like aquatic habitat conditions that may have higher water temperatures and lower dissolved oxygen concentrations than free-flowing waters).
- Natural effects of wetlands (such as contributing waters to a stream/river that has low dissolved oxygen levels due to the decomposition of large amounts of organic matter, respiration of abundant plant matter, and low re-aeration rates that is characteristic of many wetlands).

The following are recommendations for future monitoring:

- Monitoring should include some early morning (before 8:00 am) sampling to document potential dissolved oxygen problems. Over a 24 hour period, the lowest readings occur in the early morning and highest readings in mid to late afternoon. This occurs because oxygen is used up during the night due to plant respiration; during the day, plant life is photosynthesizing. This is particularly important during the summer months of July to early September when temperatures are warmest and dissolved oxygen tends to be at the lowest levels.
- Monitoring frequency was somewhat sporadic at some of the sites with sometimes mid-season samples being missed. The most critical months to monitor are July and August as these are the months when water temperature and dissolved oxygen are at the lowest levels. Monitors should ensure that this period is monitored and skip end of season (e.g. October).
- Focus monitoring on dissolved oxygen and temperature which appear to be the parameters of primary concern, especially in the estuary. High oxygen saturation can be a sign of nutrient enrichment, so watch for algal blooms on the mud flats. Low oxygen can also be due to enrichment, usually an organic source.

- pH monitoring was dropped in 2011. Conductivity also does not appear to be a problem during the field season. However, high conductivity due to road salt has been reported elsewhere in Maine. The highest values typically occur during the first thaw events in late winter and early summer (February to April). The BWA may want to begin their monitoring program in the freshwater streams in February to evaluate road salt impacts. Volunteers need to be careful, since this can be a dangerous time of year due to ice and high flows. Samples should not be taken if the situation is thought to be dangerous.
- Turbidity is also an issue. In the estuary, turbidity may reflect contaminated runoff and could be related to high or low oxygen values observed by volunteers. More information is needed about these issues.
- Continue monitoring at all stations to develop a long term trend database.

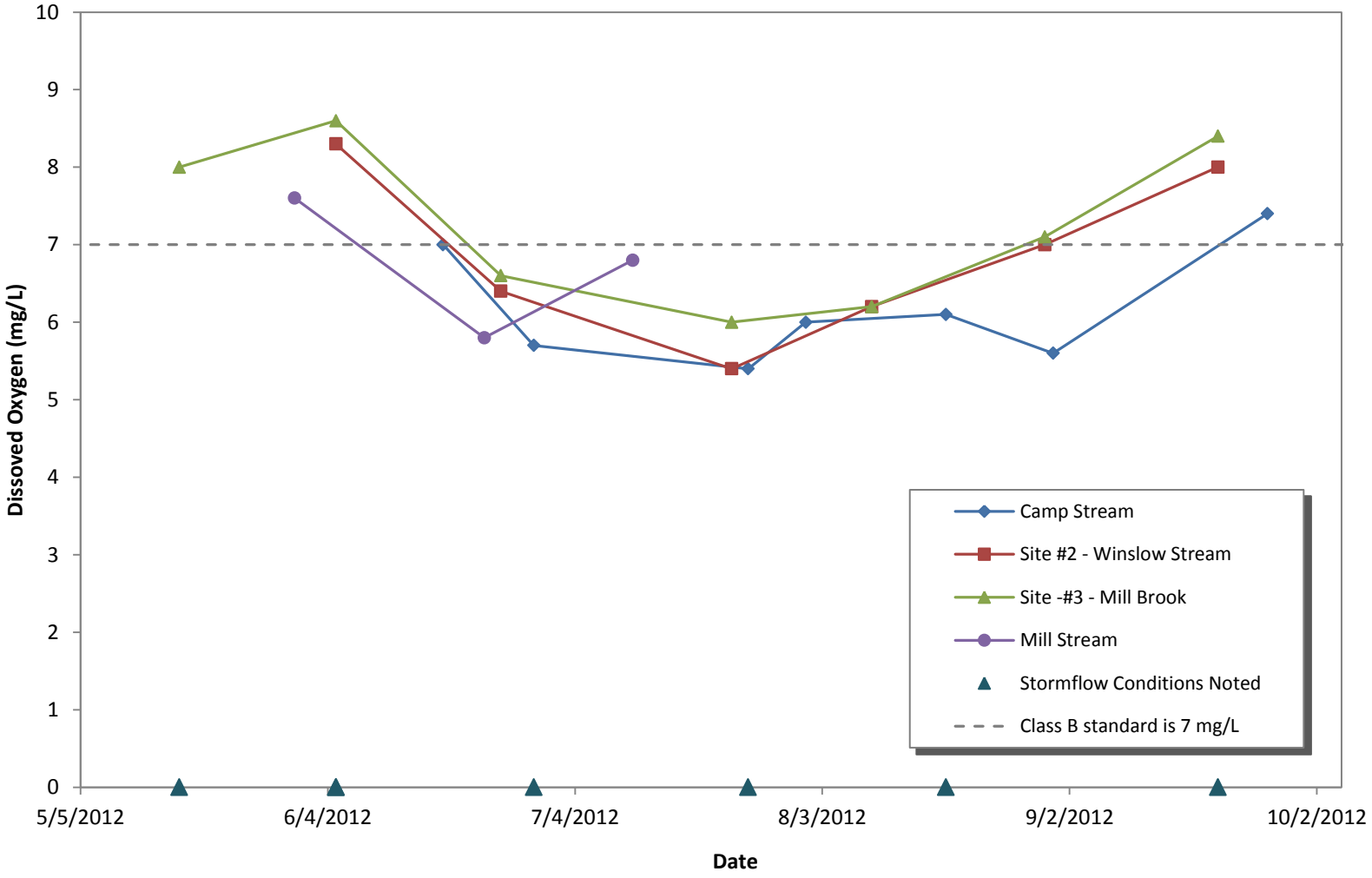

Figure 5-3-3. Dissolved oxygen concentrations of Bagaduce Watershed Association approved freshwater monitoring sites on the Bagaduce River for 2012

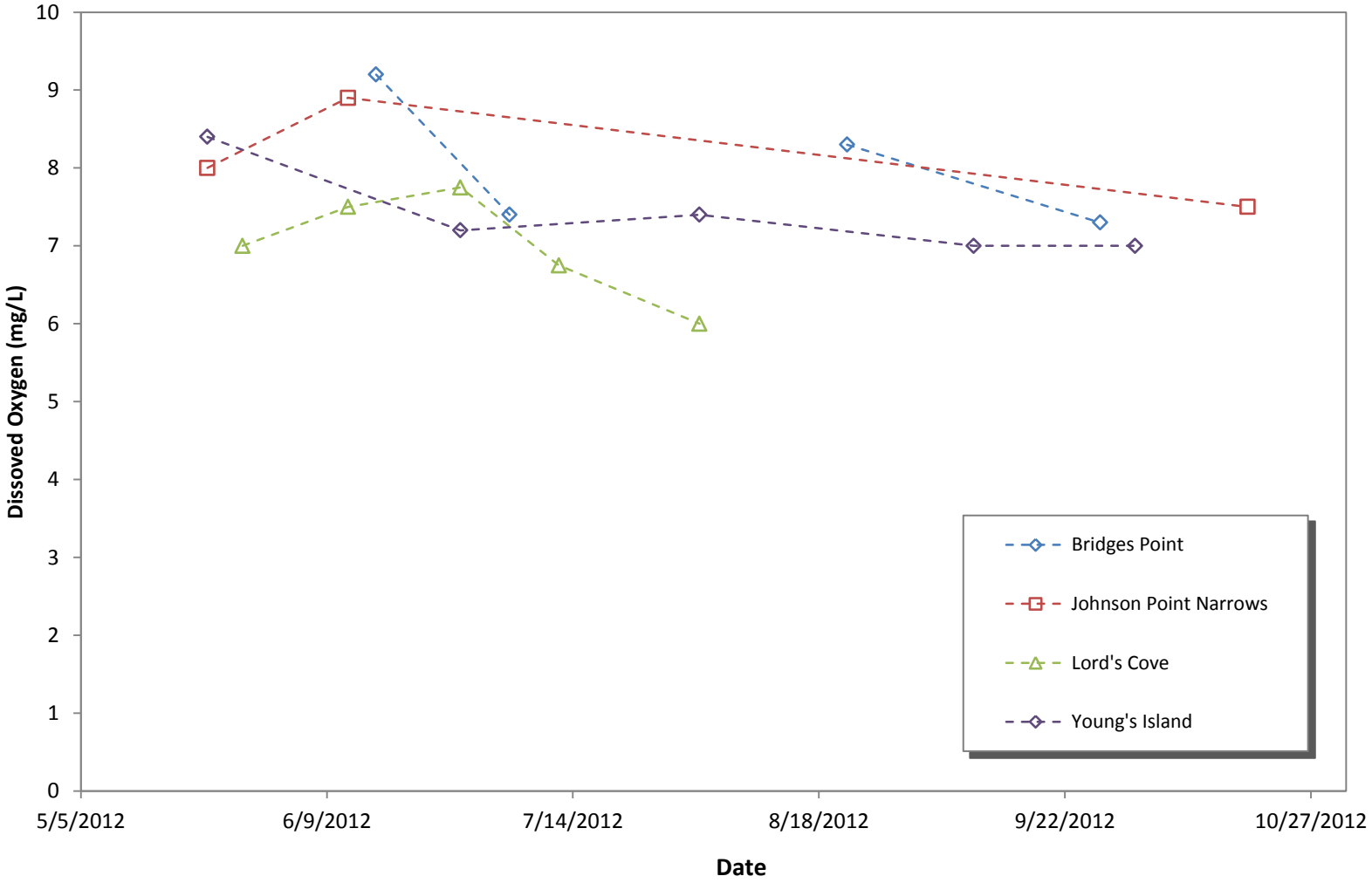

Figure 5-3-4. Dissolved Oxygen concentrations at Bagaduce Watershed Association non-approved estuary monitoring sites on the Bagaduce River for 2012

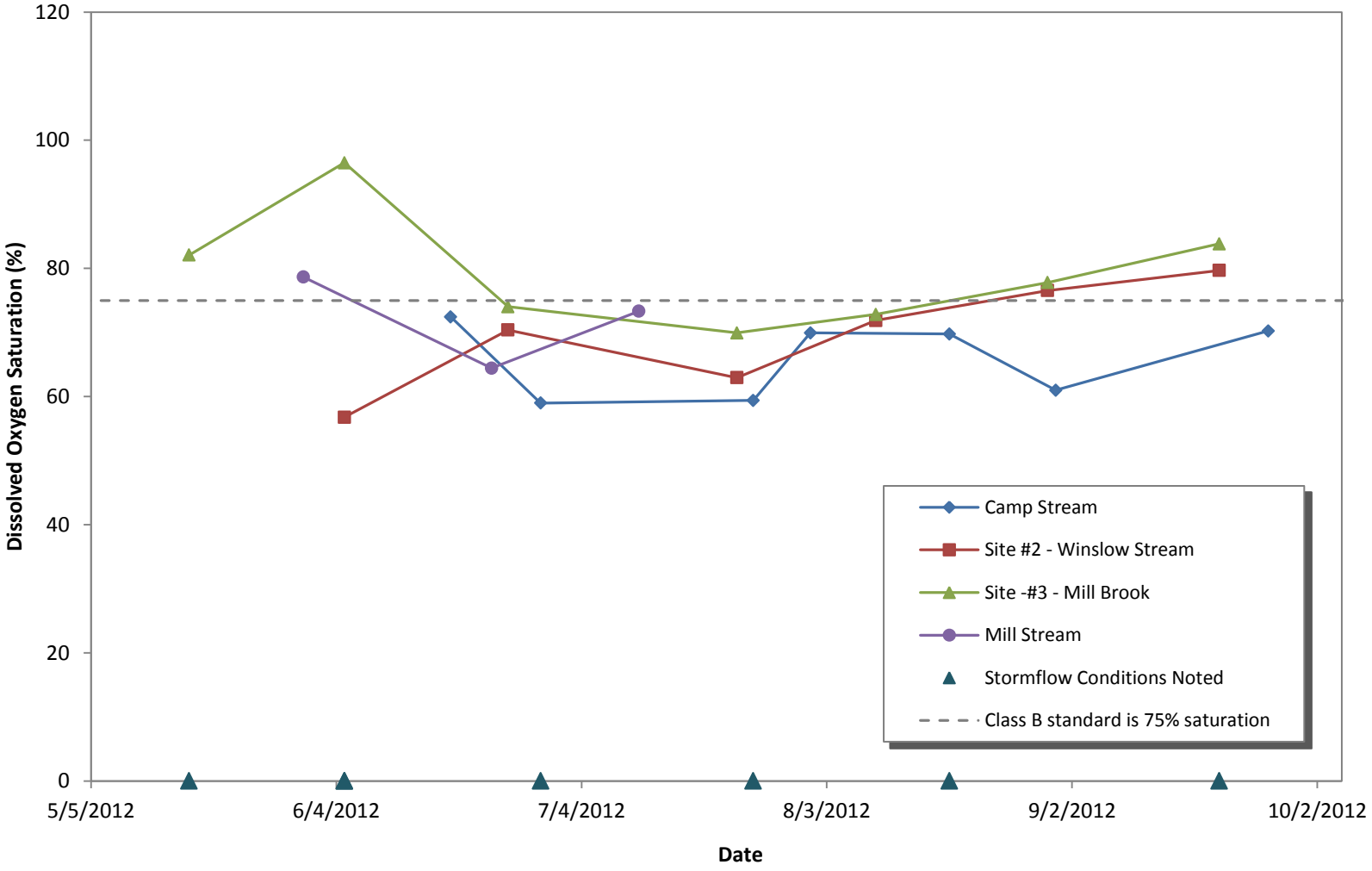

Figure 5-3-5. Dissolved oxygen % saturation of Bagaduce Watershed Association approved freshwater monitoring sites on the Bagaduce River for 2012

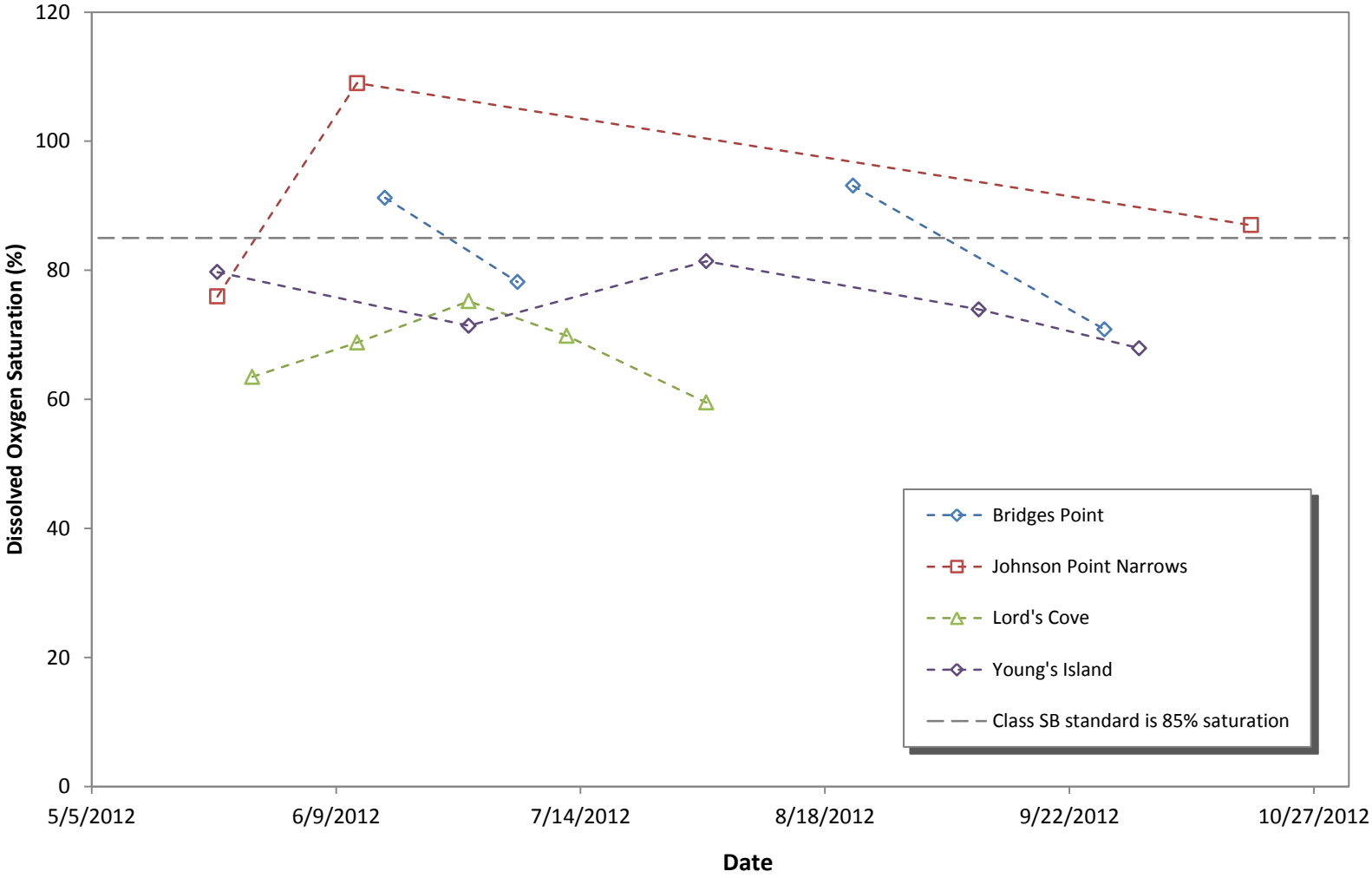

Figure 5-3-6. Dissolved oxygen % saturation at Bagaduce Watershed Association non-approved estuary monitoring sites on the Bagaduce River for 2012

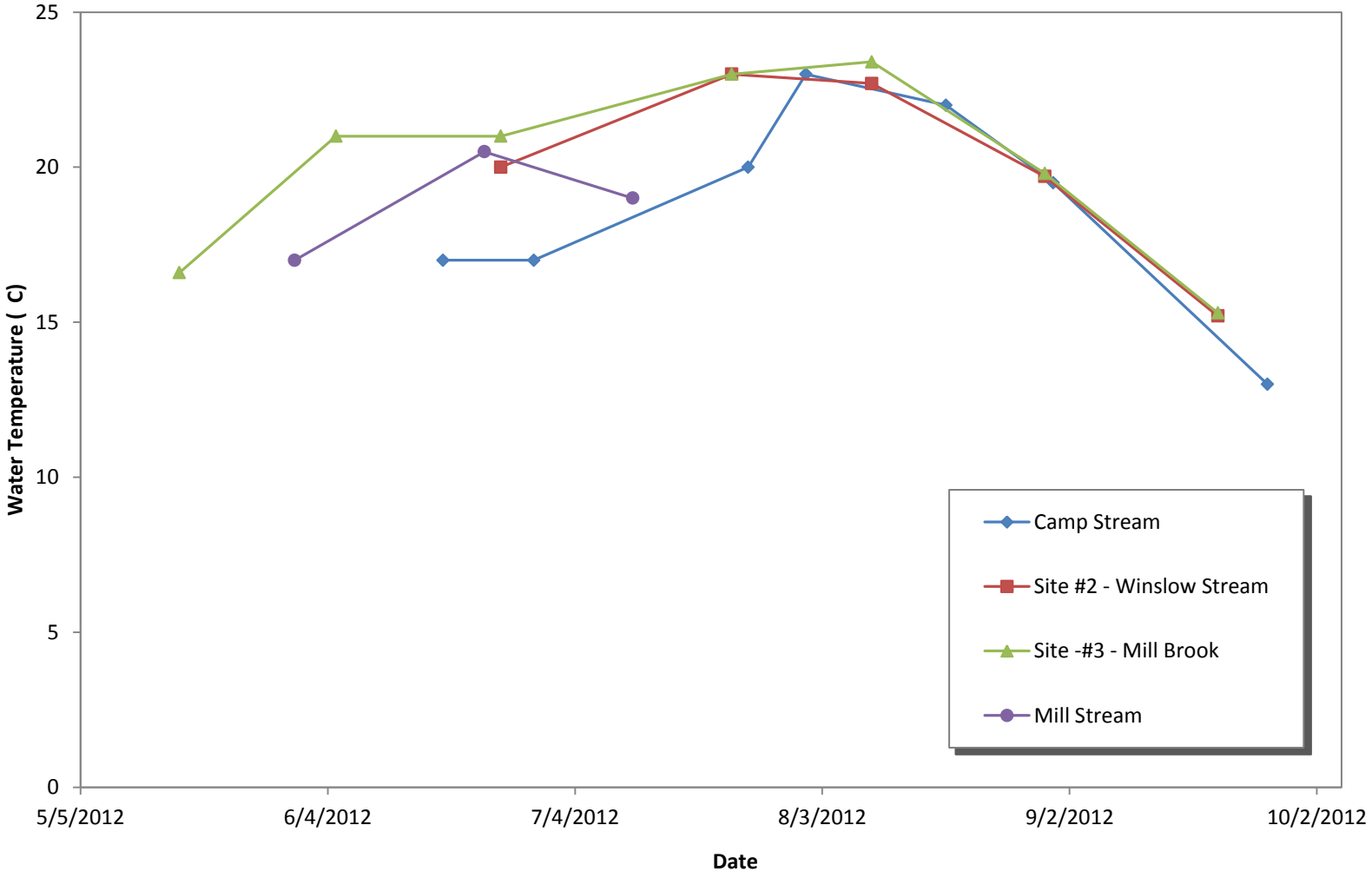

Figure 5-3-7. Water Temperatres at Bagaduce Watershed Association approved freshwater monitoring sites on the Bagaduce River for 2012

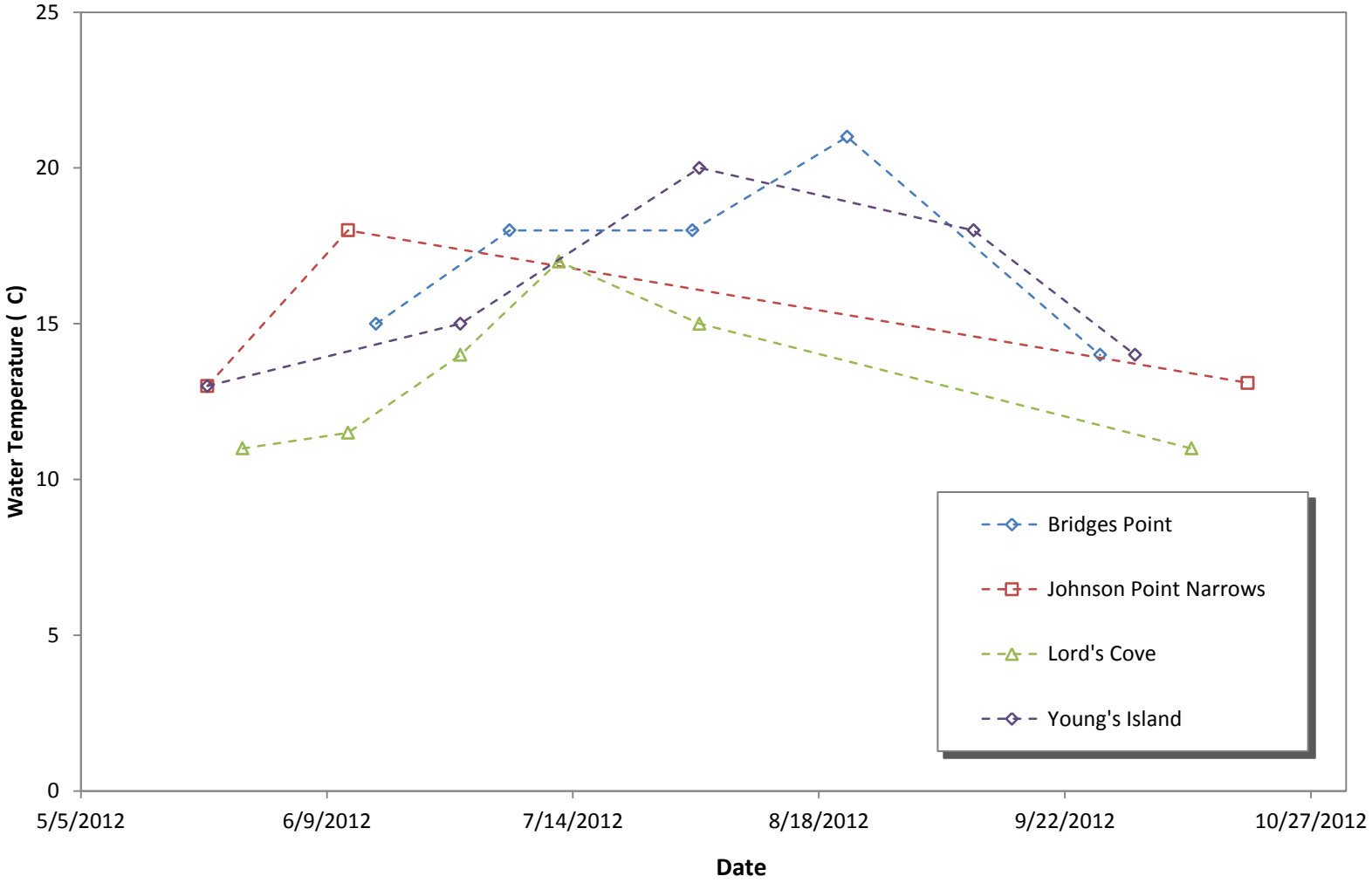

Figure 5-3-8. Water Temperatres at Bagaduce Watershed Association non-approved estuary monitoring sites on the Bagaduce River for 2012

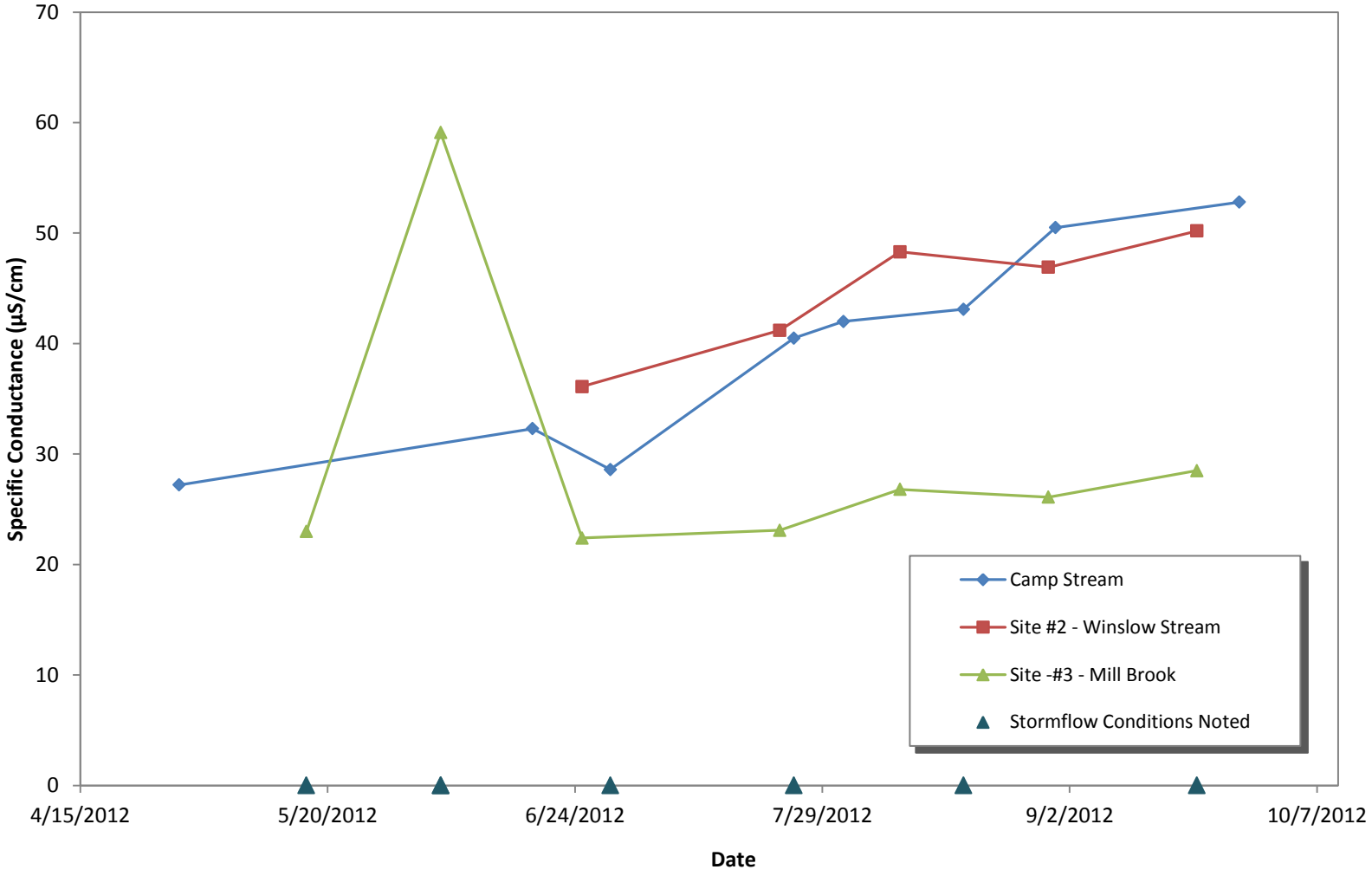

Figure 5-3-9. Specific Conductance at Bagaduce Watershed Association approved freshwater monitoring sites on the Bagaduce River for 2012

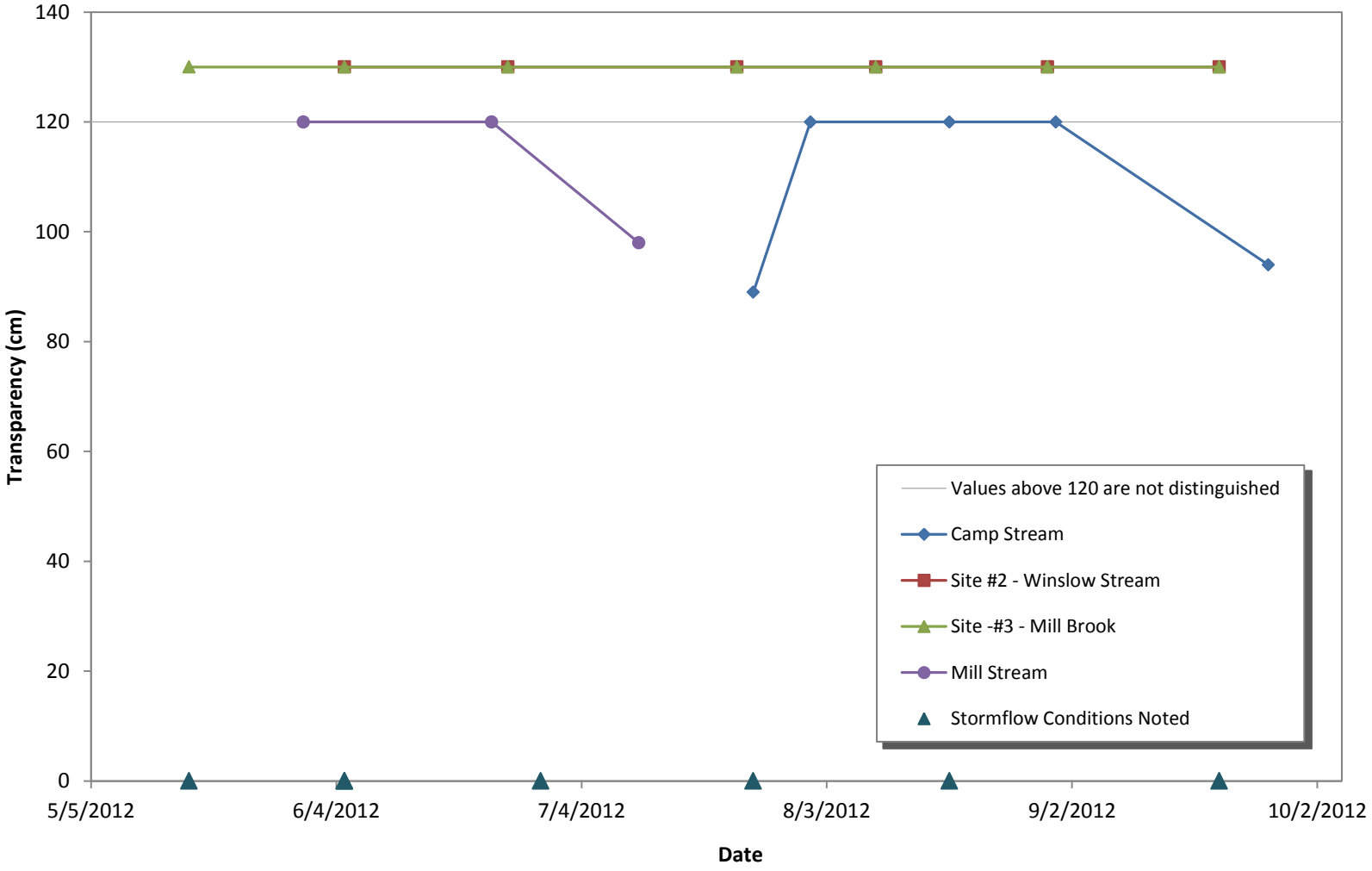

Figure 5-3-10. Transparency values at Bagaduce Watershed Association approved freshwater monitoring sites on the Bagaduce River for 2011 2012

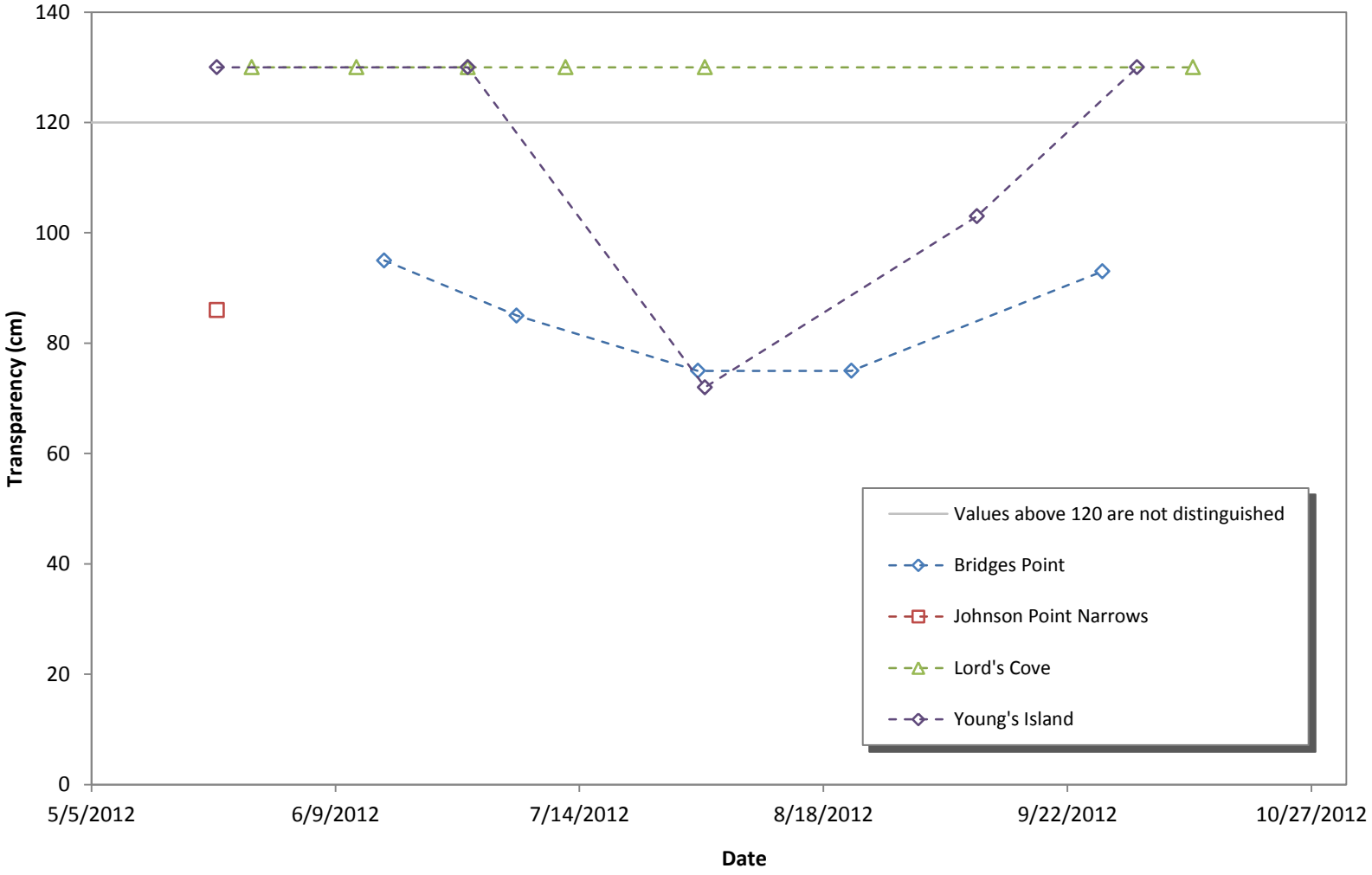

Figure 5-3-11. Dissolved Oxygen concentrations at Bagaduce Watershed Association non-approved estuary monitoring sites on the Bagaduce River for 2012

Appendix A-1. 2012 water quality data for "Approved" and "Non-Approved" sites. Non-Approved sites do not yet meet official VRMP sample location criteria and/or require further inspection and review.
* Sampling depths are only reported for Tier 1 VRMP sites.
** "N" = normal environmental sample ; "D" = field duplicate; "D.O." = dissolved oxygen; "Spec. Cond" = specific conductance; "Turb" = turbidity; "TSS" = total suspended solids"
Refer to Appendix A-2 for observational data and quality assurance/quality control (QA/QC) notes.

Organization Site Code	VRMP Site ID	Date	Time	** Sample Type Qualifier	* Sample Depth	Depth Unit	Water Temp (DEG C)	** D.O. Sat. (%)	** D.O. (MG/L)	** Spec. Cond. (US/CM)	Salinity (PPTH)	Turb-idity (CM)	** TSS (MG/L)	E Coli Bacteria (MPN/ 100ML)	Entero-cocci (MPN/ 100ML)
Bagaduce River, Bagaduce Watershed Association - Approved Sites:															
CAMP STREAM	CAMP STREAM - NBGCS08 - VRMP	4/29/2012		N						27.2					
CAMP STREAM	CAMP STREAM - NBGCS08 - VRMP	6/18/2012	12:10 PM	N			17	72.4	7	32.3					
CAMP STREAM	CAMP STREAM - NBGCS08 - VRMP	6/29/2012	11:30 PM	N			17	59	5.7	28.6					
CAMP STREAM	CAMP STREAM - NBGCS08 - VRMP	6/29/2012	11:30 PM	D					5.8						
CAMP STREAM	CAMP STREAM - NBGCS08 - VRMP	7/25/2012	11:30 PM	N			20	59.4	5.4	40.5		89			
CAMP STREAM	CAMP STREAM - NBGCS08 - VRMP	8/1/2012	2:45 PM	N			23	69.9	6	42		120			
CAMP STREAM	CAMP STREAM - NBGCS08 - VRMP	8/18/2012	2:50 PM	N			22	69.8	6.1	43.1		120			
CAMP STREAM	CAMP STREAM - NBGCS08 - VRMP	8/31/2012	2:55 PM	N			19.5	61	5.6	50.5		120			
CAMP STREAM	CAMP STREAM - NBGCS08 - VRMP	9/26/2012	1:20 PM	N			13	70.2	7.4	52.8		94			
MILL STREAM	MILL STREAM - NBGMS02 - VRMP	5/31/2012	6:30 AM	N			17	78.6	7.6			120			
MILL STREAM	MILL STREAM - NBGMS02 - VRMP	6/23/2012	7:45 AM	N			20.5	64.4	5.8			120			
MILL STREAM	MILL STREAM - NBGMS02 - VRMP	7/11/2012	6:15 AM	N			19	73.3	6.8			98			
SITE #2	WINSLOW STREAM - NBGWS32 - VRMP	6/5/2012	9:00 AM	N				56.8	8.3			>120			
SITE #2	WINSLOW STREAM - NBGWS32 - VRMP	6/25/2012	9:00 AM	N			20	70.4	6.4	36.1		>120			
SITE #2	WINSLOW STREAM - NBGWS32 - VRMP	7/23/2012	9:30 AM	N			23	63	5.4	41.2		>120			
SITE #2	WINSLOW STREAM - NBGWS32 - VRMP	8/9/2012	9:10 AM	N			22.7	71.9	6.2	48.3		>120			
SITE #2	WINSLOW STREAM - NBGWS32 - VRMP	8/30/2012	10:00 AM	N			19.7	76.5	7	46.9		>120			
SITE #2	WINSLOW STREAM - NBGWS32 - VRMP	9/20/2012	9:35 AM	N			15.2	79.7	8	50.2		>120			
SITE #3	MILL BROOK - NBGMB07 - VRMP	5/17/2012	9:05 AM	N			16.6	82.1	8	23		>120			
SITE #3	MILL BROOK - NBGMB07 - VRMP	6/5/2012	8:30 AM	N			21	96.5	8.6	59.1		>120			
SITE #3	MILL BROOK - NBGMB07 - VRMP	6/25/2012	8:35 AM	N			21	74	6.6	22.4		>120			
SITE #3	MILL BROOK - NBGMB07 - VRMP	7/23/2012	9:05 AM	N			23	69.9	6	23.1		>120			
SITE #3	MILL BROOK - NBGMB07 - VRMP	8/9/2012	8:45 AM	N			23.4	72.8	6.2	26.8		>120			
SITE #3	MILL BROOK - NBGMB07 - VRMP	8/30/2012	9:30 AM	N			19.8	77.8	7.1	26.1		>120			
SITE #3	MILL BROOK - NBGMB07 - VRMP	9/20/2012	9:10 AM	N			15.3	83.8	8.4	28.5		>120			

Organization Site Code	VRMP Site ID	Date	Time	** Sample Type Qualifier	* Sample Depth	Depth Unit	Water Temp (DEG C)	** D.O. Sat. (%)	** D.O. (MG/L)	** Spec. Cond. (US/CM)	Salinity (PPTH)	Turb-idity (CM)	** TSS (MG/L)	E Coli Bacteria (MPN/ 100ML)	Entero-cocci (MPN/ 100ML)
Bagaduce River, Bagaduce Watershed Association - Non-Approved Sites:															
BRIDGES POINT	BAGADUCE RIVER - NBG - BWA	6/16/2012	10:20 AM	N			15	91.2	9.2		28	95			
BRIDGES POINT	BAGADUCE RIVER - NBG - BWA	7/5/2012	11:00 AM	N			18	78.2	7.4		27	85			
BRIDGES POINT	BAGADUCE RIVER - NBG - BWA	7/31/2012	10:00 AM	N			18				30	75			
BRIDGES POINT	BAGADUCE RIVER - NBG - BWA	8/22/2012	3:40 PM	N			21	93.1	8.3		31	75			
BRIDGES POINT	BAGADUCE RIVER - NBG - BWA	9/27/2012	9:45 AM	N			14	70.8	7.3		28	93			
JOHNSON POINT NARROWS	BAGADUCE RIVER - NBG153 - BWA	5/23/2012	1:50 PM	N			13	75.9	8		31	86			
JOHNSON POINT NARROWS	BAGADUCE RIVER - NBG153 - BWA	6/12/2012	5:15 PM	N			18	109	8.9		24				
JOHNSON POINT NARROWS	BAGADUCE RIVER - NBG153 - BWA	10/18/2012	2:15 PM	N			13.1	87	7.5		30				
LORDS COVE	BAGADUCE RIVER - NBG - BWA2	5/28/2012	9:00 AM	N			11	63.5	7		32	>120			
LORDS COVE	BAGADUCE RIVER - NBG - BWA2	6/12/2012	9:10 AM	N			11.5	68.8	7.5		39	>120			
LORDS COVE	BAGADUCE RIVER - NBG - BWA2	6/28/2012	8:30 AM	N			14	75.2	7.75		26	>120			
LORDS COVE	BAGADUCE RIVER - NBG - BWA2	7/12/2012	9:10 AM	N			17	69.8	6.75		30	>120			
LORDS COVE	BAGADUCE RIVER - NBG - BWA2	8/1/2012	8:30 AM	N			15	59.5	6		33	>120			
LORDS COVE	BAGADUCE RIVER - NBG - BWA2	10/10/2012	9:30 AM	N			11				31	>120			
YOUNGS ISLAND	BAGADUCE RIVER - NBG133 - BWA	5/23/2012	11:20 AM	N			13	79.7	8.4		23	>120			
YOUNGS ISLAND	BAGADUCE RIVER - NBG133 - BWA	6/28/2012	7:30 PM	N			15	71.4	7.2		26	>120			
YOUNGS ISLAND	BAGADUCE RIVER - NBG133 - BWA	8/1/2012	4:20 PM	N			20	81.4	7.4		27	72			
YOUNGS ISLAND	BAGADUCE RIVER - NBG133 - BWA	9/9/2012	6:45 PM	N			18	73.9	7		27	103			
YOUNGS ISLAND	BAGADUCE RIVER - NBG133 - BWA	10/2/2012	9:00 AM	N			14	67.9	7		29	>120			

Appendix A-2. 2012 observational data and quality assurance/quality control (QA/QC) notes for "approved" and "non-approved" sites.
** "N" = normal environmental sample; "D" = field duplicate; "L" = lab duplicate; "D.O." = dissolved oxygen; "Spec. Cond" = specific conductance; "Turb"= turbidity
Refer to Appendix A-1 for water quality data

Organization Site Code	VRMP Site ID	Date	Time	** Sample Type Qualifier	Flow	Stage	Air Temp (°C)	Sample Location	Current Weather	Air Condition	Past 24HR Weather	Habitat	Tide Stage	Water Appearance	Comments
Bagaduce River, Bagaduce Watershed Association - Approved Sites:															
CAMP STREAM	CAMP STREAM - NBGCS08 - VRMP	4/29/2012		N											EARLY SPRING CONDUCTIVITY MEASUREMENT ONLY.
CAMP STREAM	CAMP STREAM - NBGCS08 - VRMP	6/18/2012	12:10 PM	N	BASE FLOW	MED	18	WADING	PARTLY CLOUDY	CALM	CLEAR	RUN		MED STAINED	NON-WADEABLE/MID-DEPTH
CAMP STREAM	CAMP STREAM - NBGCS08 - VRMP	6/29/2012	11:30 PM	N	STORM FLOW	HIGH	19	WADING	CLEAR	BREEZE	HEAVY RAIN	RUN		MED STAINED	STREAM HIGH-MUCH RAIN NON-WADEABLE/MID-DEPTH
CAMP STREAM	CAMP STREAM - NBGCS08 - VRMP	6/29/2012	11:30 PM	D				WADING							STREAM HIGH-MUCH RAIN NON-WADEABLE/MID-DEPTH
CAMP STREAM	CAMP STREAM - NBGCS08 - VRMP	7/25/2012	11:30 PM	N	STORM FLOW	LOW	20	WADING	PARTLY CLOUDY	BREEZE	MOSTLY CLOUDY	RUN		DARKLY STAINED	STREAM VERY LOW AND DARK-NO RECENT RAIN. NON-WADEABLE/MID-DEPTH
CAMP STREAM	CAMP STREAM - NBGCS08 - VRMP	8/1/2012	2:45 PM	N	BASE FLOW	MED	25	WADING	CLEAR	CALM	SHOWERS	RUN		DARKLY STAINED	1" RAIN LAST 24 HOURS; STREAM HIGHER THAN BEFORE AND RUNNING MORE. NON-WADEABLE/MID-DEPTH
CAMP STREAM	CAMP STREAM - NBGCS08 - VRMP	8/18/2012	2:50 PM	N	STORM FLOW	MED	21	WADING	CLOUDY	CALM	SHOWERS	RUN		DARKLY STAINED	2 DAYS PRIOR-HEAVY RAIN; LAST 24 HOURS 0.25" RAIN. NON-WADEABLE/MID-DEPTH
CAMP STREAM	CAMP STREAM - NBGCS08 - VRMP	8/31/2012	2:55 PM	N	BASE FLOW	LOW	19.5	WADING	PARTLY CLOUDY	CALM	CLEAR	RUN		DARKLY STAINED	STREAM VERY LOW-NOT MUCH RAIN. NON-WADEABLE/MID-DEPTH
CAMP STREAM	CAMP STREAM - NBGCS08 - VRMP	9/26/2012	1:20 PM	N	BASE FLOW	LOW	15	WADING	PARTLY CLOUDY	BREEZE	PARTLY CLOUDY	RUN		DARKLY STAINED	STREAM LOW-NO FLOW. NON-WADEABLE/MID-DEPTH
MILL STREAM	MILL STREAM - NBGMS02 - VRMP	5/31/2012	6:30 AM	N	BASE FLOW	MED	15	WADING	CLOUDY, FOGGY	CALM	CLOUDY, FOGGY, LIGHT RAIN, PARTLY CLOUDY	RUN		CLEAR	WADEABLE/MID-DEPTH
MILL STREAM	MILL STREAM - NBGMS02 - VRMP	6/23/2012	7:45 AM	N	BASE FLOW	MED	19	WADING	CLOUDY, FOGGY	CALM	PARTLY CLOUDY, SHOWERS	RUN		CLEAR	WADEABLE/MID-DEPTH
MILL STREAM	MILL STREAM - NBGMS02 - VRMP	7/11/2012	6:15 AM	N	BASE FLOW	LOW	16.5	WADING	CLEAR	CALM	PARTLY CLOUDY	RUN		CLEAR	NO SAMPLING DONE IN AUGUST-DROUGHT CONDITIONS, VIRTUALLY NO FLOW-STREAM ALMOST DRIED UP. WADEABLE/MID-DEPTH
SITE #2	WINSLOW STREAM - NBGWS32 - VRMP	6/5/2012	9:00 AM	N	STORM FLOW	HIGH	10	WADING	CLOUDY, SHOWERS	CALM	CLOUDY, HEAVY RAIN, LIGHT RAIN, SHOWERS	RUN		MED STAINED	HIGHEST WATER SEEN IN LAST 9 YEARS. 2.6" RAIN LAST 24 HOURS. WADEABLE/MID-DEPTH
SITE #2	WINSLOW STREAM - NBGWS32 - VRMP	6/25/2012	9:00 AM	N	BASE FLOW	MED	19.44	WADING	MOSTLY CLOUDY	CALM	CLOUDY, HEAVY RAIN, LIGHT RAIN, SHOWERS	RIFFLE		CLEAR	1" RAIN IN LAST 24 HOURS. WADEABLE/MID-DEPTH
SITE #2	WINSLOW STREAM - NBGWS32 - VRMP	7/23/2012	9:30 AM	N	BASE FLOW	LOW	23.33	WADING	CLEAR, PARTLY CLOUDY		CLEAR, PARTLY CLOUDY	RIFFLE		CLEAR	NO RAIN FOR SEVERAL WEEKS. WATER LEVEL LOOKS TO BE DOWN APPROX. 18-24". WADEABLE/MID-DEPTH
SITE #2	WINSLOW STREAM - NBGWS32 - VRMP	8/9/2012	9:10 AM	N	BASE FLOW	LOW	21.67	WADING	FOGGY	CALM	FOGGY, PARTLY CLOUDY	RIFFLE		CLEAR	NO RAIN IN PAST WEEK- TOTAL 0.5" FOR LAST 4 WEEKS. VERY LOW WATER LEVEL AND HIGH TEMP. WADEABLE/MID-DEPTH
SITE #2	WINSLOW STREAM - NBGWS32 - VRMP	8/30/2012	10:00 AM	N	BASE FLOW	LOW	21.67	WADING	CLEAR		CLEAR, PARTLY CLOUDY	RIFFLE		CLEAR	LOW WATER LEVEL. 0.2" RAIN IN LAST WEEK-EVERYTHING PRETTY DRY. WADEABLE/MID-DEPTH

Organization Site Code	VRMP Site ID	Date	Time	** Sample Type Qualifier	Flow	Stage	Air Temp (°C)	Sample Location	Current Weather	Air Condition	Past 24HR Weather	Habitat	Tide Stage	Water Appearance	Comments
SITE #2	WINSLOW STREAM - NBGWS32 - VRMP	9/20/2012	9:35 AM	N	STORM FLOW	LOW	12.22	WADING	CLEAR	BREEZE	CLEAR, HEAVY RAIN, MOSTLY CLOUDY, SHOWERS	RIFFLE		CLEAR	0.6" RAIN LAST 24 HOURS. WATER LEVEL AND FLOW HIGHER THAN 2 WEEKS AGO. WADEABLE/MID-DEPTH
SITE #3	MILL BROOK - NBGMB07 - VRMP	5/17/2012	9:05 AM	N	STORM FLOW	HIGH	16	WADING	CLEAR	BREEZE	CLOUDY, HEAVY RAIN	RIFFLE		CLEAR	1.2" OF RAIN IN LAST 24 HOURS. NON-WADEABLE/MID-DEPTH
SITE #3	MILL BROOK - NBGMB07 - VRMP	6/5/2012	8:30 AM	N	STORM FLOW	HIGH	10	WADING	CLOUDY, SHOWERS	CALM	CLOUDY, HEAVY RAIN, LIGHT RAIN, SHOWERS	RIFFLE		CLEAR	VERY HIGH/FAST WATER. 2.6" OF RAIN IN PAST 24 HOURS. WADEABLE/MID-DEPTH
SITE #3	MILL BROOK - NBGMB07 - VRMP	6/25/2012	8:35 AM	N	BASE FLOW	MED	19.44	WADING	MOSTLY CLOUDY	CALM	CLOUDY, HEAVY RAIN, LIGHT RAIN, SHOWERS	RIFFLE		CLEAR	1" RAIN IN LAST 24 HOURS. WADEABLE/MID-DEPTH
SITE #3	MILL BROOK - NBGMB07 - VRMP	7/23/2012	9:05 AM	N	BASE FLOW	LOW	23.33	WADING	CLEAR, PARTLY CLOUDY	BREEZE	CLEAR, PARTLY CLOUDY	RIFFLE		CLEAR	NO RAIN FOR SEVERAL WEEKS. WATER LEVEL QUITE LOW FOR JULY-STREAM WATER TEMP BEING RAISED BY WATER FROM PIERCE POND? WADEABLE/MID-DEPTH
SITE #3	MILL BROOK - NBGMB07 - VRMP	8/9/2012	8:45 AM	N	BASE FLOW	LOW	21.67	WADING	FOGGY	CALM	FOGGY, PARTLY CLOUDY	RIFFLE		CLEAR	NO RAIN LAST WEEK-TOTAL 0.5" FOR LAST 4 WEEKS. VERY LOW WATER LEVEL AND HIGH TEMP. WADEABLE/MID-DEPTH
SITE #3	MILL BROOK - NBGMB07 - VRMP	8/30/2012	9:30 AM	N	BASE FLOW	LOW	21.67	WADING	CLEAR	CALM	CLEAR, PARTLY CLOUDY	RUN		CLEAR	WATER LOWER THAN LAST SAMPLE DATE. 0.2" OF RAIN IN LAST WEEK. WADEABLE/MID-DEPTH
SITE #3	MILL BROOK - NBGMB07 - VRMP	9/20/2012	9:10 AM	N	BASE FLOW	LOW	12.22	WADING	CLEAR	BREEZE	CLEAR, HEAVY RAIN, MOSTLY CLOUDY, SHOWERS	RUN		CLEAR	0.6" RAIN IN LAST 24 HOURS. WATER LEVEL STILL EXTREMELY LOW-FLOW IS VERY SLOW. WADEABLE/MID-DEPTH

Bagaduce River, Bagaduce Watershed Association - Non-Approved Sites:

BRIDGES POINT	BAGADUCE RIVER - NBG - BWA	6/16/2012	10:20 AM	N	BASE FLOW	HIGH	15	WADING	CLOUDY	BREEZE	CLEAR, CLOUDY	RUN	HIGH	TURBID	WAS VERY WINDY YESTERDAY-WATER MAY STILL BE A BIT STIRRED UP. WADEABLE/1.5 FT BELOW SURFACE
BRIDGES POINT	BAGADUCE RIVER - NBG - BWA	7/5/2012	11:00 AM	N	BASE FLOW	MED	23.89	WADING	MOSTLY CLOUDY, PARTLY CLOUDY	BREEZE	CLOUDY, PARTLY CLOUDY, SHOWERS	RUN	LOW FLOOD	OPAQUE	0.1" RAIN OVERNIGHT. BREEZE MUDDYING THE WATER ON THE IN-COMING TIDE. WADEABLE/MID-DEPTH
BRIDGES POINT	BAGADUCE RIVER - NBG - BWA	7/31/2012	10:00 AM	N	BASE FLOW	HIGH	22.78	WADING	CLEAR	BREEZE	CLEAR, PARTLY CLOUDY	RUN	HIGH	MILKY	TIDE CAME IN WITH SILT-BEEN EXTREMELY DRY FOR LAST MONTH. WADEABLE/MID-DEPTH
BRIDGES POINT	BAGADUCE RIVER - NBG - BWA	8/22/2012	3:40 PM	N	BASE FLOW	HIGH	23.33	WADING	PARTLY CLOUDY	BREEZE	CLEAR, FOGGY, PARTLY CLOUDY	RUN	HIGH FLOOD	OPAQUE	TIDE HEIGHT ABOVE NORMAL. TURBIDITY <120 CM BECOMING THE NORM? OPAQUENESS LOOKS LIKE FINE MARINE CLAY SILT. IN 2010 USE TO BE ABLE TO SEE BOTTOM CLEARLY IN 4+ FEET OF WATER. WADEABLE/MID-DEPTH
BRIDGES POINT	BAGADUCE RIVER - NBG - BWA	9/27/2012	9:45 AM	N	BASE FLOW	HIGH	12.22	WADING	CLEAR	BREEZE	CLOUDY, FOGGY, MOSTLY CLOUDY, SHOWERS	RUN	HIGH	MILKY	TURBIDITY SCORE IS BETTER THAN AT MIDSUMMER. ONLY 0.2" RAIN YESTERDAY. WADEABLE/MID-DEPTH
JOHNSON POINT NARROWS	BAGADUCE RIVER - NBG153 - BWA	5/23/2012	1:50 PM	N		MED	24		PARTLY CLOUDY	BREEZE	LIGHT RAIN		LOW FLOOD	CLEAR	NON-WADEABLE/MID-DEPTH SAMPLE LOCATION FROM DOCK.

Organization Site Code	VRMP Site ID	Date	Time	** Sample Type Qualifier	Flow	Stage	Air Temp (°C)	Sample Location	Current Weather	Air Condition	Past 24HR Weather	Habitat	Tide Stage	Water Appearance	Comments
JOHNSON POINT NARROWS	BAGADUCE RIVER - NBG153 - BWA	6/12/2012	5:15 PM	N			18.89			BREEZE	CLEAR		HIGH EBB		WATER APPEARANCE MURKY. NON-WADEABLE/MID-DEPTH SAMPLE LOCATION FROM DOCK.
JOHNSON POINT NARROWS	BAGADUCE RIVER - NBG153 - BWA	10/18/2012	2:15 PM	N			16.11		CLEAR	BREEZE			HIGH EBB		NON-WADEABLE/MID-DEPTH SAMPLE LOCATION FROM DOCK. ASSUME VERTICAL DEPTH IS "MID-DEPTH"-RECORDED AS 7 FT. DID NOT RECORD TIME OF CALIBRATION- ASSUME IT WAS 15 MINUTES AS "TIME METER TURNED ON" WAS 2:00 PM AND "TIME SAMPLED" WAS 2:15 PM.
LORDS COVE	BAGADUCE RIVER - NBG - BWA2	5/28/2012	9:00 AM	N	BASE FLOW	LOW	15.56		MOSTLY CLOUDY	CALM	CLEAR, LIGHT RAIN		LOW FLOOD	OPAQUE	SAMPLE LOCATION FROM DOCK. NOT SURE ABOUT VERTICAL DEPTH-LOOKS LIKE SURFACE.
LORDS COVE	BAGADUCE RIVER - NBG - BWA2	6/12/2012	9:10 AM	N	BASE FLOW	MED	20		CLEAR	BREEZE	CLEAR		EBB	OPAQUE	SAMPLE LOCATION FROM DOCK. NOT SURE ABOUT VERTICAL DEPTH-LOOKS LIKE SURFACE.
LORDS COVE	BAGADUCE RIVER - NBG - BWA2	6/28/2012	8:30 AM	N	BASE FLOW	MED	18.89		PARTLY CLOUDY	CALM	HEAVY RAIN		HIGH EBB	OPAQUE	PLUS/MINUS 3 INCHES OF RAIN IN PAST 24 HOURS SAMPLE LOCATION FROM DOCK. NOT SURE ABOUT VERTICAL DEPTH-LOOKS LIKE SURFACE.
LORDS COVE	BAGADUCE RIVER - NBG - BWA2	7/12/2012	9:10 AM	N	BASE FLOW	MED	21.67		CLEAR	CALM	CLEAR		EBB	OPAQUE	SAMPLE LOCATION FROM DOCK. NOT SURE ABOUT VERTICAL DEPTH-LOOKS LIKE SURFACE.
LORDS COVE	BAGADUCE RIVER - NBG - BWA2	8/1/2012	8:30 AM	N	BASE FLOW	MED				CALM	PARTLY CLOUDY		EBB	CLEAR	SAMPLE LOCATION FROM DOCK. NO VERTICAL DEPTH RECORDED.
LORDS COVE	BAGADUCE RIVER - NBG - BWA2	10/10/2012	9:30 AM	N	BASE FLOW	MED	10		PARTLY CLOUDY	CALM	MOSTLY CLOUDY		HIGH EBB	CLEAR	SAMPLE LOCATION FROM DOCK. NO VERTICAL DEPTH RECORDED.
YOUNGS ISLAND	BAGADUCE RIVER - NBG133 - BWA	5/23/2012	11:20 AM	N			24	BOAT	PARTLY CLOUDY	CALM	LIGHT RAIN				NON-WADEABLE/MID-DEPTH
YOUNGS ISLAND	BAGADUCE RIVER - NBG133 - BWA	6/28/2012	7:30 PM	N			20	BOAT	CLEAR	CALM	HEAVY RAIN		HIGH EBB		HEAVY RAIN PAST 3 DAYS. NON-WADEABLE/MID-DEPTH
YOUNGS ISLAND	BAGADUCE RIVER - NBG133 - BWA	8/1/2012	4:20 PM	N			22	BOAT	CLEAR	CALM	CLEAR, HEAVY RAIN		LOW EBB		OVERNIGHT STEADY RAIN NON-WADEABLE/MID-DEPTH
YOUNGS ISLAND	BAGADUCE RIVER - NBG133 - BWA	9/9/2012	6:45 PM	N			19	BOAT	CLEAR	CALM	LIGHT RAIN, MOSTLY CLOUDY		HIGH EBB		NON-WADEABLE/MID-DEPTH
YOUNGS ISLAND	BAGADUCE RIVER - NBG133 - BWA	10/2/2012	9:00 AM	N			18	BOAT	CLEAR	CALM	CLEAR, CLOUDY, LIGHT RAIN, PARTLY CLOUDY		LOW FLOOD		NON-WADEABLE/MID-DEPTH