Section 5-4
Hart Brook (City of Lewiston)

Hart Brook

Hart Brook is a small urban stream located in Lewiston, Maine. The brook originates in the area of Pond Road, meanders through the Valley section neighborhoods, the Industrial Park, the Goff Brook neighborhoods, crosses under I-95, and then follows River Road to where it discharges to the Androscoggin River. The brook is approximately 3.7 miles long and its watershed encompasses approximately 2200 acres. It is highly developed and includes residential, commercial, industrial and undeveloped land uses.

Hart Brook (aka Dill Brook) is listed by DEP as an impaired stream. It is impaired for aquatic life (macroinvertebrates and algae), habitat, dissolved oxygen and E. coli. A Watershed Management Plan was completed in October 2008 which provides a plan for restoring the brook. The Clean Water Act requires that a TMDL, which is an assessment of impairments and pollutant loading reductions needed to meet water quality standards be developed for impaired waters. Therefore, a total maximum load (TMDL) report ("Maine Impervious Cover Total Maximum Daily Load Assessment (TMDL) for Impaired Streams" September 2012) has also been completed for this brook.

Monitoring History

• The Maine DEP Biological Monitoring Program has been monitoring the brook since 2003. This data is available on DEP's website.

• Limited monitoring was done as part of the TMDL and Watershed Management Plan development.

• The City of Lewiston joined the Volunteer River Monitoring Program in 2011. Due to staff changes, the City dropped out of the program in 2012, but rejoined in 2013.

• The City of Lewiston hired a consulting firm in 2016 to assist with more intensive monitoring and dropped out of the VRMP.

• In July 2014, the City reported to DEP that a sanitary sewer interceptor pipe issue was causing overflow to Hart Brook. The problem was caused by a hole in the pipe which was later addressed by lining the pipe.

Methods and Sampling Sites

City staff and interns monitor Hart Brook at six sites on the mainstem and two tributary sites. All of the sites are VRMP approved.

Monitoring is conducted biweekly from June to August. The monitors take measurements of water temperature and dissolved oxygen using a YSI meter. Conductivity is measured with either a YSI meter or an Oakton EC 11+/11 Testr conductivity pen. Grab samples for *E. coli* are collected and transported to the Lewiston-Auburn Water Pollution Control Authority.

Table 5-4-1: City of Lewiston sampling sites on Hart Brook.

VRMP Site ID	Organization Site Code	Sample Location	Class
Hart Brook-ADL04-VRMP	HB-1	Pike Industries	B
Hart Brook-ADL14-VRMP	HB-2	Goddard Road	B
Hart Brook-ADL19-VRMP	HB-3	Olive Street	B
Hart Brook-ADL28-VRMP	HB-4	Westminster Street	B
Hart Brook-ADLUA04-VRMP	HB-5	Trib - Morningside Street	B
Hart Brook-ADL23-VRMP	HB-6	Foch Street & Route 196	B
Hart Brook-ADLUB02-VRMP	HB-7	Trib - Mitchell Street & Swale Lane	B
Hart Brook-ADL30-VRMP	HB-8	Saratoga Street & Enterprise Street	B

Hart Brook Sampling Sites
City of Lewiston

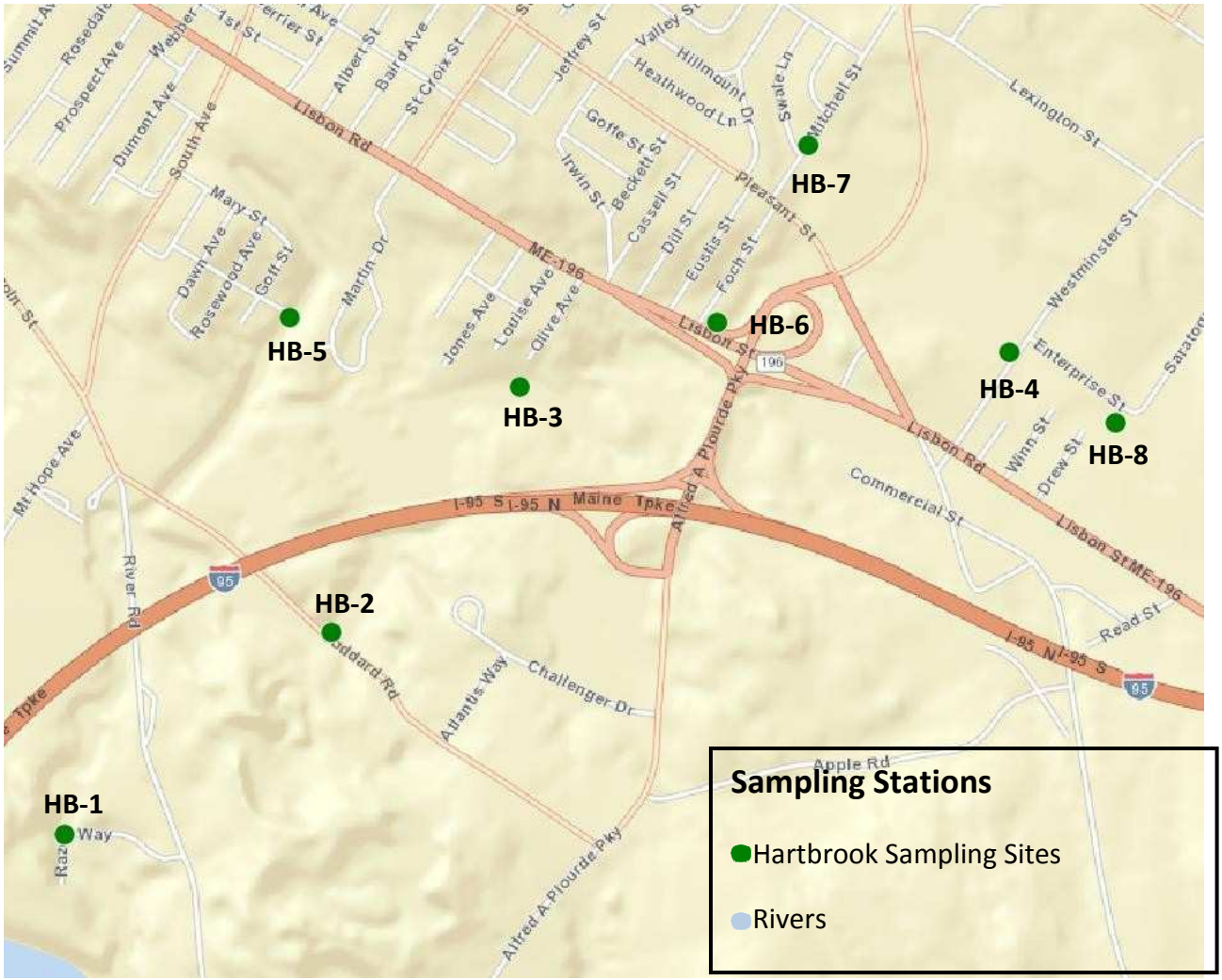


Figure 5-4-1: Map of Hart Brook sampling sites.

Results

Refer to Appendix A for discussion of individual site data and trends at the end of this report.

Dissolved Oxygen

Dissolved oxygen levels are generally lowest early in the morning and then increase during the day, peaking mid to late afternoon. Monitors should try to collect some samples early in the morning. Dissolved oxygen is also affected by flow conditions and temperature. During high flow conditions, more oxygen is added to the river from the atmosphere as the water is more turbulent and there is more opportunity for mixing. If flow during the summer months is higher or lower than normal, this will affect the dissolved oxygen.
Class B criteria for dissolved oxygen are a minimum of 7 mg/l (milligrams/liter) or 75% saturation. To meet water quality criteria, both concentration and saturation standards must be met.

2015 Results:
Dissolved oxygen was measured 3-6 times on the Hart Brook main stem and tributaries. For the sampling sites HB-2, HB-4, HB-5 and HB-6; there were 1-2 measurements that did not meet the Class B concentration criterion of 7 mg/L. Sample sites HB-2, HB-4 and HB-5 did not meet the percent saturation criterion of 75% saturation for 1-2 sample points. The lowest dissolved oxygen was at Site HB-4 (Westminster Street) where values were 4.7 and 5.4 mg/L in late May and early July. Sites HB-2, HB-5 and HB-6 each had one sample point just below 7 mg/L. Sampling sites HB-1, HB-3, HB-7 and HB-8 met Class B criterion for DO concentration and percent saturation on all sampling dates. Dissolved oxygen in the Hart Brook sites was overall good with the exception of one site. However, sampling did not occur beyond July and the last July sample date was not included due to QA/QC reasons (no calibration value). Overall, dissolved oxygen at Sites HB-2, HB-4, HB-5 and HB-6 was good for the short sample season. Dissolved oxygen at sites HB-1, HB-3, HB-7 and HB-8 was excellent for the short sample season.

Table 5-4-2: A summary of minimum, maximum, and mean dissolved oxygen concentration (mg/l) values at Hart Brook monitoring stations.

Site	Class	# Sample Points	Mean	Minimum	Maximum	Criterion	# Not Meeting Criterion
HB-1	B	5	9.6	8.5	10.5	7	0
HB-2	B	5	9.1	6.5	10.7	7	1
HB-3	B	6	9.6	8.4	10.9	7	0
HB-4	B	3	6.3	4.7	8.8	7	2
HB-5	B	5	8.6	6.5	9.6	7	1
HB-6	B	6	8.8	6.8	10.7	7	1
HB-7	B	6	9.8	9.3	10.2	7	0
HB-8	B	4	8.7	7.9	10.5	7	0

Table 5-4-3: A summary of minimum, maximum, and mean dissolved oxygen saturation (%) values at Hart Brook monitoring sites.

Site	Class	# Sample Points	Mean	Minimum	Maximum	Criterion	# Not Meeting Criterio
HB-1	B	5	98.0	84.9	110.1	75	0
HB-2	B	5	92.8	65.1	108.1	75	1
HB-3	B	6	96.4	87.9	110.0	75	0
HB-4	B	3	65.5	51.5	83.4	75	2
HB-5	B	5	87.4	69.4	96.7	75	1
HB-6	B	6	92.2	75.1	109.9	75	0
HB-7	B	6	98.3	94.5	101.3	75	0
HB-8	B	4	88.4	80.6	105.7	75	0

Figure 5-4-2: Graph of dissolved oxygen concentrations for main stem sites.

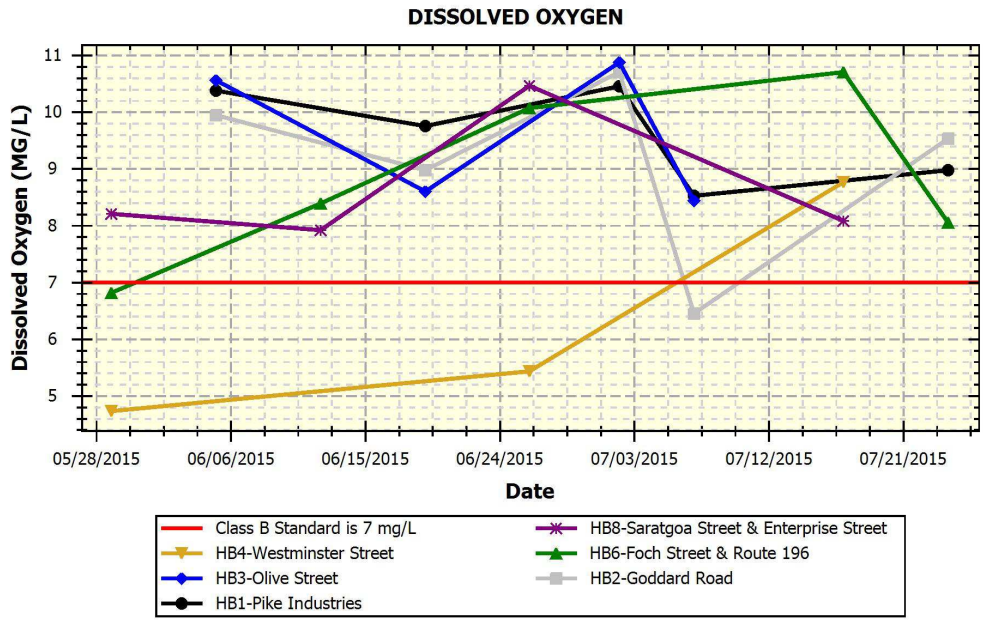


Figure 5-4-3: Graph of dissolved oxygen concentrations for tributaries.

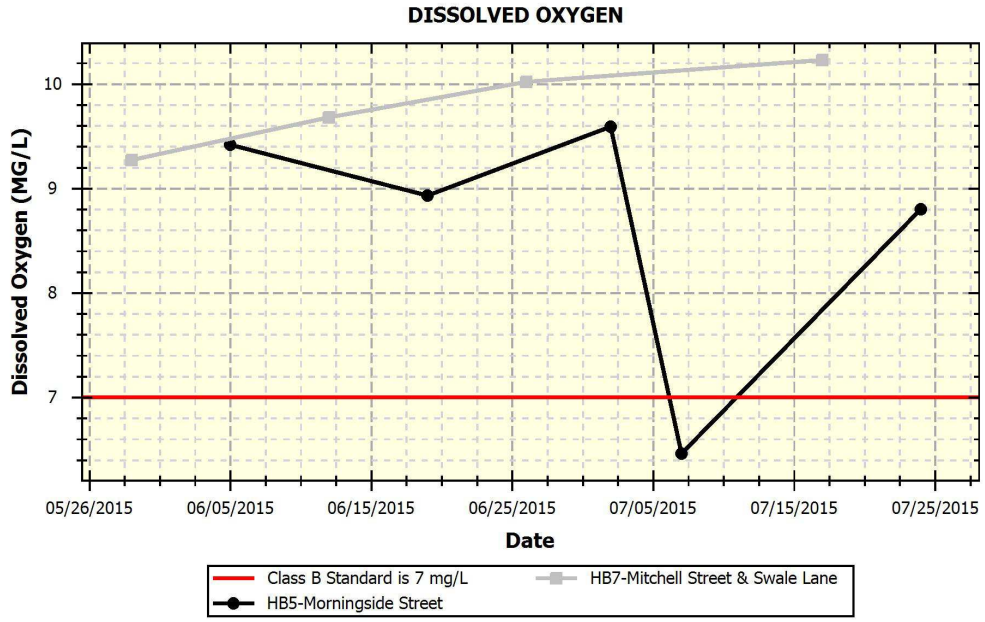


Figure 5-4-4: Graph of dissolved oxygen saturation for the main stem sites.

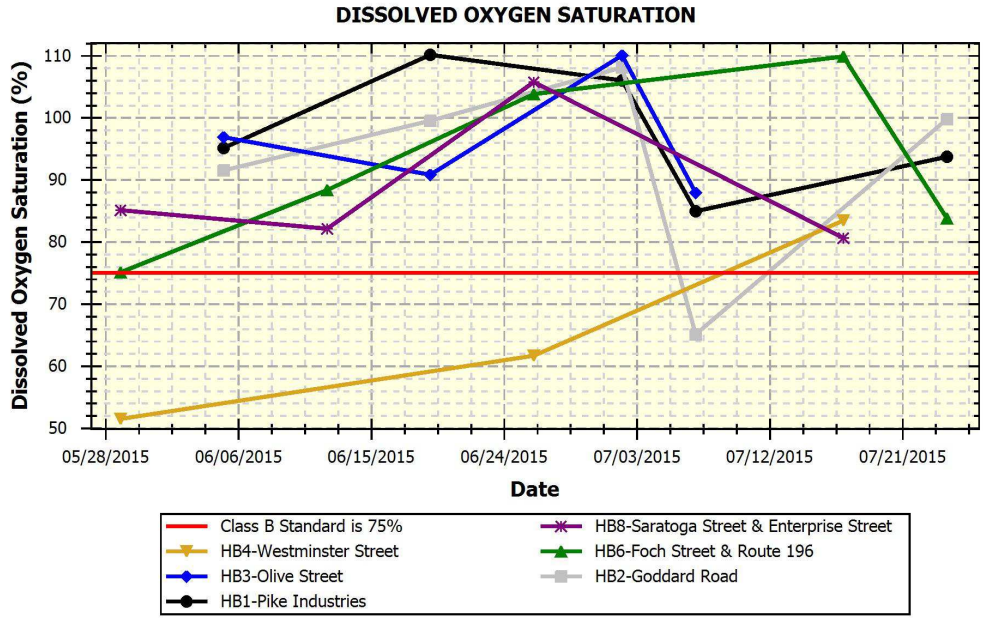
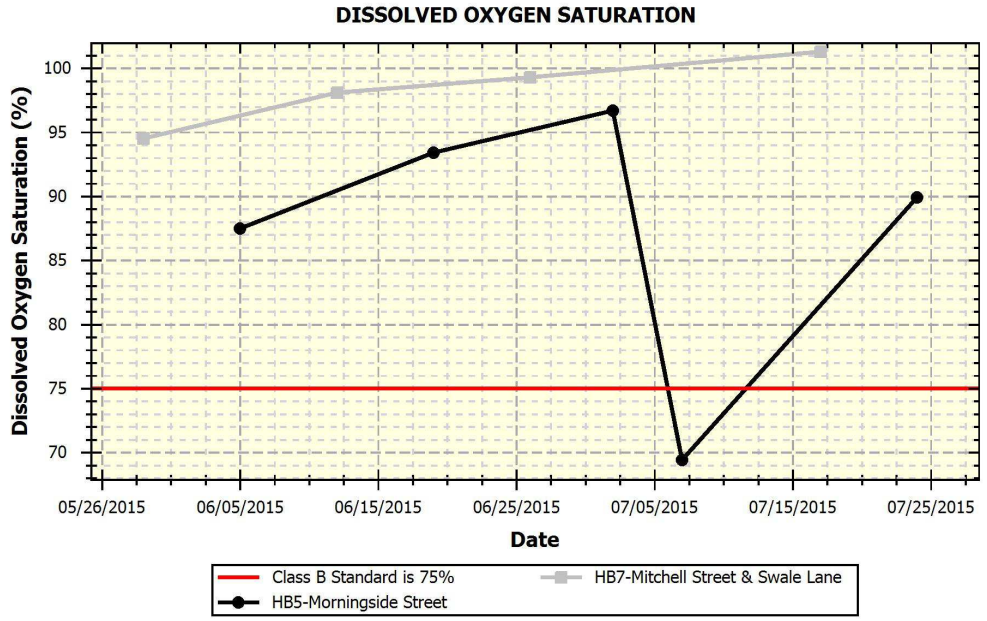


Figure 5-4-5: Graph of dissolved oxygen saturation for the tributaries.



Water Temperature

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.

2015 Results:

Temperature was measured 3-6 times on Hart Brook main stem and tributary sites. The main stem Sites HB-4, HB-6 and HB-8 were similar with temperatures ranging from 15.1-18.8°C for the sampling season through July. Main stem sites HB-1, HB-2 and HB-3 followed a similar pattern with temperatures starting out low and peaking in June. The highest temperature (20.5°C)was at Site HB-2. Temperature on the tributary sites (HB-5 and HB-7) ranged from 10.5-17.2°C for the sampling season through July. Overall temperture on the main stem sites were good to excellent and excellent on the tributary sites. The overall good to excellent temperatures may reflect the fact that monitoring did not continue through at least August.

Table 5-4-4: A summary of minimum, maximum, and mean water temperature (°C) values at Hart Brook monitoring sites.

Site	Class	# Sample Points	Mean	Minimum	Maximum	Criterion	# Exceeding Criterion
HB-1	B	5	16.2	11.5	19.2	n/a	n/a
HB-2	B	5	16.3	10.6	20.5	n/a	n/a
HB-3	B	6	15.7	11.4	17.9	n/a	n/a
HB-4	B	3	17.8	16.5	18.8	n/a	n/a
HB-5	B	5	15.2	10.5	17.2	n/a	n/a
HB-6	B	6	17.3	16.5	18.0	n/a	n/a
HB-7	B	6	15.8	15.1	16.2	n/a	n/a
HB-8	B	4	16.1	15.1	16.9	n/a	n/a

Figure 5-4-6: Graph of temperatures for the main stem sites.

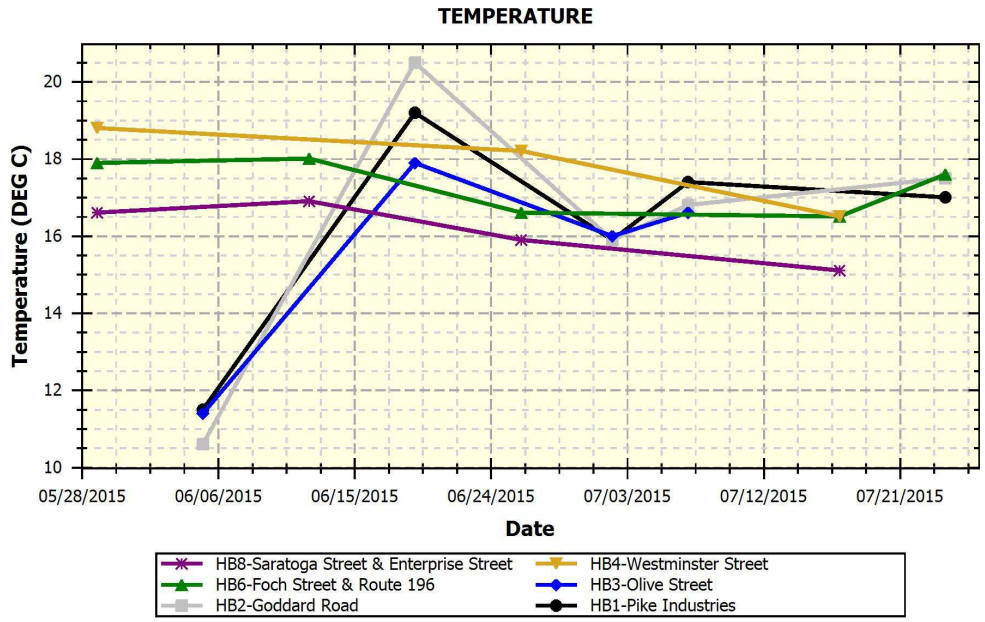
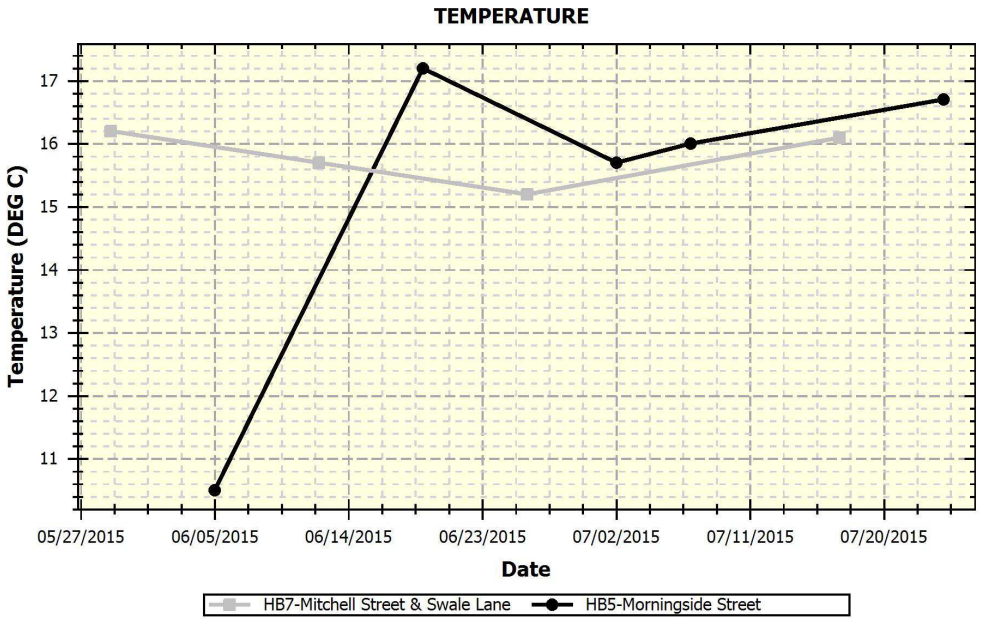


Figure 5-4-7: Graph of temperatures for the tributaries.



Specific Conductance

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. If enough samples of chloride and conductivity are taken, a regression may be developed. 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 in surface and groundwater from road maintenance practices.

2015 Results:

Specific conductance was measured 3-6 times at the Hart Brook main stem and tributary sampling sites. Highest values occurred in the main stem sites with means ranging from 543-988 µS/cm. Maximum values at the main stem sites ranged from 756-1390 µS/cm. All of the values for sites HB-4 and HB-8 were very high. The values at the other main stem sites were moderately high to very high. Values at the tributary sites were lower with means at these sites (HB-5 and HB-7) ranging from 291-408 µS/cm and maximum values were 404 and 600 µS/cm respectively. Overall, specific conductance is very high. Generally, urban streams have high specific conductance due to pollutants from stormwater runoff that includes road salt.

Table 5-4-5: A summary of minimum, maximum, and mean specific conductance (µS/cm) values at Hart Brook monitoring sites.

Site	Class	# Sample Points	Mean	Minimum	Maximum	Criterion	# Exceeding Criterion
HB-1	B	5	604	385	1100	n/a	n/a
HB-2	B	5.	543	275	757	n/a	n/a
HB-3	B	6	729	360	900	n/a	n/a
HB-4	B	3	958	718	1200	n/a	n/a
HB-5	B	5	291	243	404	n/a	n/a
HB-6	B	6	620	276	756	n/a	n/a
HB-7	B	6	408	260	600	n/a	n/a
HB-8	B	4	988	700	1390	n/a	n/a

Figure 5-4-8: Graph of specific conductivity for the main stem sites.

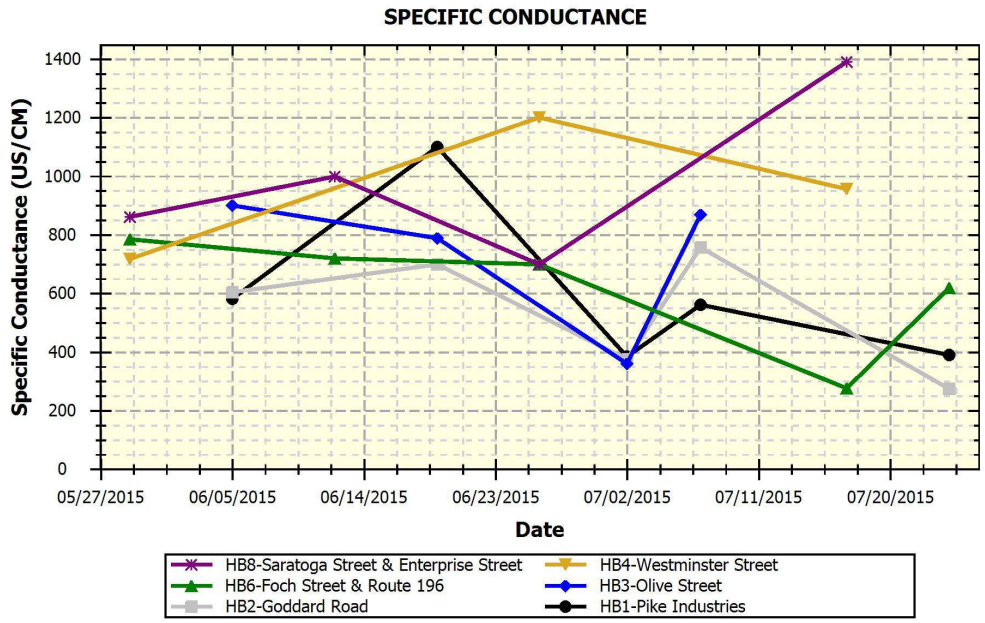
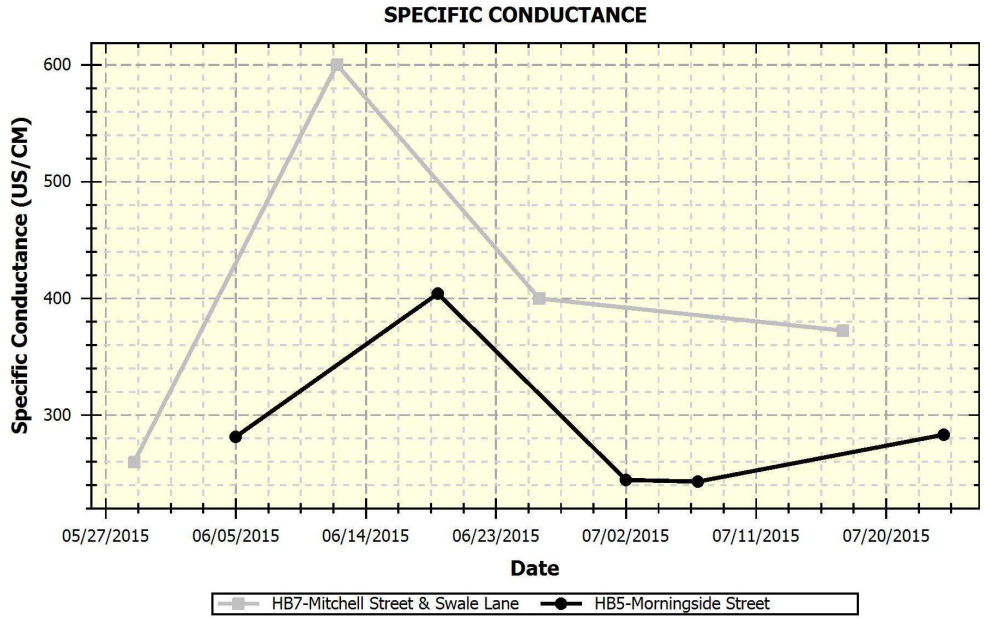


Figure 5-4-9: Graph of specific conductivity for the tributaries.



Bacteria

Enterococcus bacteria are used as the indicator organism for marine waters and *E. coli* bacteria are used for freshwaters. While these types of bacteria are not pathogens, their presence in the water may indicate the presence of other organisms including bacteria and viruses that can cause gastrointestinal illnesses. Monitoring should include at least 6 samples and include a mix of dry and storm event sampling.

Class B criteria for bacteria are as follows: "Between May 15th and Sept 30th, *E. coli* of human and domestic origin shall not exceed a geometric mean of 64/100 ml (milliliters) or an instantaneous level of 236/100 ml." Class SB criteria are as follows: "Between May 15th and September 30th, the numbers of enterococcus bacteria of human and domestic animal origin in these waters may not exceed a geometric mean of 8 per 100 milliliters or an instantaneous level of 54 per 100 milliliters." Geometric means are calculated instead of average because it is more appropriate to use this calculation for something like bacteria where there may be one or more very high or low values that can skew the mean

2015 Results:

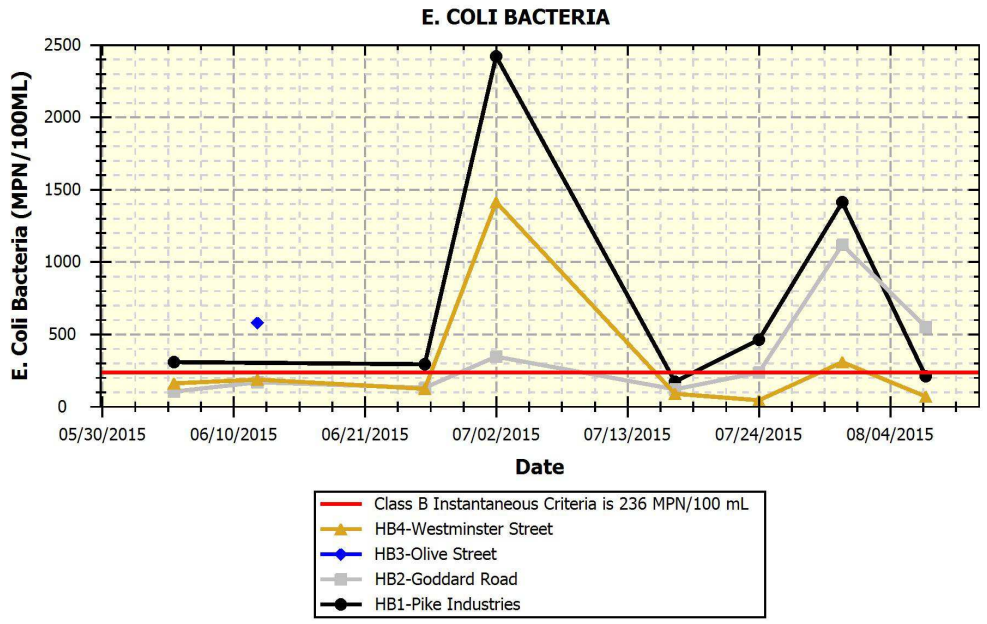
Escherichia coli bacteria were sampled 7-8 times at three sampling sites (HB-1, HB-2 and HB-4), Site HB-3 was sampled one time. At site HB-1, the instanteous criterion was exceeded 4 of 7 sample dates and the geo-mean criterion was exceeded. At site HB-2, the instanteous crierion was exceeded on 3 of 8 sample dates and the geo-mean criterion was exceeded. At site HB-4, the instanteous criterion was exceeded on 2 of 8 sample dates and the geo-mean criterion was not exceeded. The highest results occurred on July 2 and July 31-these do not appear to be associated with significant rainfall events. Bacteria results were overall fair to poor.

Table 5-4-6: A summary of minimum, maximum, and geometric means for bacteria (MPN/100 mL) values at Hart Brook monitoring sites.

Site	Class	# Sample Points	Geometric Mean	Minimum	Maximum	Criterion Inst/Geo	# Exceeding Criterion
HB-1	B	7	471	172	2419	236/64	4
HB-2	B	8	246	104	1120	236/64	3
HB-3	B	1	*NA	579	579	236/64	1
HB-4	B	8	160	45	1413	236/64	2

*Not enough samples to calculate GeoMean

Figure 5-4-8: Graph of *E. Coli* for the main stem sites.



Discussion and Recommendations

There are numerous sources of pollution and other stresses to Hart Brook sites monitored by the City of Lewiston 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., septic systems, eroded soil, fertilizers, pesticides, heavy metals, petroleum residues, road salt, wildlife and pet feces) and polluted stormwater originating from urban impervious surfaces (e.g., streets, parking lots, driveways, rooftops), 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 have 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:

- **The interns genreally did a good job of getting out early in the morning. It is important to get some values early in the morning (before 8:00 am), particularly during the warmer summer months. 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 and during the day, plant life is photosynthesizing. It would be worthwhile to monitor 2x/day (early morning and mid-afternoon) at least a couple of times during July-August to determine if there are significant differences. Significant differences (at least 2 mg/l) may indicate nutrient loading issues.**
- **Ensure that monitoring includes the period through July and August which are generally the months when streams are most stressed. Flow tends to be lowest and temperature the highest in these months.**
- **It would be worthwhile to take water samples for chloride to determine if winter salt is a problem. Potential sources of the high conductivity may also be tracked by walking the stream and periodically measuring conductivity.**
- **Continue monitoring at all stations to develop a long term trend database.**

Appendix A-1. 2011 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/A" = 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 (NTU)	Total Diss. Solids (MG/L)	** TSS (MG/L)	E Coli Bacteria (MPN/ 100ML)	Entero-cocci (MPN/ 100ML)
Hartbrook-City of Lewiston: Approved Sites																
HB-6	HART BROOK - ADL23 - VRMP	5/29/2015	8:08 AM	NA			17.9	75.1	6.8	785.70						
HB-6	HART BROOK - ADL23 - VRMP	6/12/2015	7:50 AM	NA			18	88.4	8.4	719.00						
HB-6	HART BROOK - ADL23 - VRMP	6/26/2015	10:24 AM	NA			16.6	103.8	10.1	700.00						
HB-6	HART BROOK - ADL23 - VRMP	7/17/2015	9:20 AM	NA			16.5	109.9	10.7	276.00						
HB-6	HART BROOK - ADL23 - VRMP	7/24/2015	9:23 AM	NA			17.6	83.8	8.1	619.00						
HB-6	HART BROOK - ADL23 - VRMP	7/24/2015	9:23 AM	DUP			17.4	83.4	7.9	586.00						
HB-8	HART BROOK - ADL30 - VRMP	5/29/2015	8:32 AM	NA			16.6	85.1	8.2	862.00						
HB-8	HART BROOK - ADL30 - VRMP	6/12/2015	8:18 AM	NA			16.9	82.1	7.9	1000.00						
HB-8	HART BROOK - ADL30 - VRMP	6/26/2015	11:00 AM	NA			15.9	105.7	10.5	700.00						
HB-8	HART BROOK - ADL30 - VRMP	7/17/2015	8:45 AM	NA			15.1	80.6	8.1	1390.00						
HB-1	HART BROOK-ADL04-VRMP	6/5/2015	7:58 AM	NA			11.5	95.1	10.4	581.00					308	
HB-1	HART BROOK-ADL04-VRMP	6/19/2015	1:20 PM	NA			19.2	110.1	9.8	1100.00						
HB-1	HART BROOK-ADL04-VRMP	6/26/2015	11:22 AM	NA											290.9	
HB-1	HART BROOK-ADL04-VRMP	7/2/2015	8:23 AM	NA			15.9	106	10.5	385.00					2419.6	
HB-1	HART BROOK-ADL04-VRMP	7/7/2015	8:53 AM	NA			17.4	84.9	8.5	561.00						
HB-1	HART BROOK-ADL04-VRMP	7/17/2015	9:57 AM	NA											172	
HB-1	HART BROOK-ADL04-VRMP	7/24/2015	8:07 AM	NA			17	93.7	9	390.30					461.1	
HB-1	HART BROOK-ADL04-VRMP	7/31/2015	9:18 AM	NA											1414	
HB-1	HART BROOK-ADL04-VRMP	8/7/2015	9:02 AM	NA											210	
HB-2	HART BROOK-ADL14-VRMP	6/5/2015	8:11 AM	NA			10.6	91.5	10	605.00					104	
HB-2	HART BROOK-ADL14-VRMP	6/12/2015	9:00 AM	NA											166.4	
HB-2	HART BROOK-ADL14-VRMP	6/19/2015	1:32 PM	NA			20.5	99.5	9	700.00						
HB-2	HART BROOK-ADL14-VRMP	6/26/2015	11:15 AM	NA											129.1	
HB-2	HART BROOK-ADL14-VRMP	7/2/2015	8:43 AM	NA			15.9	108.1	10.7	375.00					344.8	
HB-2	HART BROOK-ADL14-VRMP	7/7/2015	8:38 AM	NA			16.8	65.1	6.5	757.00						
HB-2	HART BROOK-ADL14-VRMP	7/17/2015	9:49 AM	NA											119	
HB-2	HART BROOK-ADL14-VRMP	7/24/2015	8:34 AM	NA			17.5	99.8	9.5	275.30					235.9	
HB-2	HART BROOK-ADL14-VRMP	7/31/2015	9:30 AM	NA											1120	
HB-2	HART BROOK-ADL14-VRMP	8/7/2015	8:41 AM	NA											548	
HB-3	HART BROOK-ADL19-VRMP	6/5/2015	8:42 AM	NA			11.4	96.9	10.6	900.00						
HB-3	HART BROOK-ADL19-VRMP	6/12/2015	9:10 AM	NA											579.4	
HB-3	HART BROOK-ADL19-VRMP	6/19/2015	1:46 PM	NA			17.9	90.8	8.6	788.00						
HB-3	HART BROOK-ADL19-VRMP	7/2/2015	9:07 AM	NA			16	110	10.9	360.00						
HB-3	HART BROOK-ADL19-VRMP	7/7/2015	8:08 AM	NA			16.6	87.9	8.4	869.00						

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 (NTU)	Total Diss. Solids (MG/L)	** TSS (MG/L)	E Coli Bacteria (MPN/ 100ML)	Entero-cocci (MPN/ 100ML)
HB-3	HART BROOK-ADL19-VRMP	7/7/2015	8:08 AM	DUP			16.6	85.7	8.4	870.00						
HB-4	HART BROOK-ADL28-VRMP	5/29/2015	8:39 AM	NA			18.8	51.5	4.7	718.00						
HB-4	HART BROOK-ADL28-VRMP	6/5/2015	8:55 AM	NA											161	
HB-4	HART BROOK-ADL28-VRMP	6/12/2015	8:45 AM	NA											186	
HB-4	HART BROOK-ADL28-VRMP	6/26/2015	10:51 AM	NA			18.2	61.7	5.4	1200.00					123.4	
HB-4	HART BROOK-ADL28-VRMP	7/2/2015	9:36 AM	NA											1413.6	
HB-4	HART BROOK-ADL28-VRMP	7/17/2015	8:30 AM	NA			16.5	83.4	8.8	956.00					88	
HB-4	HART BROOK-ADL28-VRMP	7/24/2015	8:55 AM	NA											45	
HB-4	HART BROOK-ADL28-VRMP	7/31/2015	9:00 AM	NA											308	
HB-4	HART BROOK-ADL28-VRMP	8/7/2015	9:10 AM	NA											68	
HB-5	UNNAMED TRIBUTARY-ADLUA04-VRMP	6/5/2015	8:26 AM	NA			10.5	87.5	9.4	281.00						
HB-5	UNNAMED TRIBUTARY-ADLUA04-VRMP	6/19/2015	1:55 PM	NA			17.2	93.4	8.9	404.00						
HB-5	UNNAMED TRIBUTARY-ADLUA04-VRMP	7/2/2015	9:23 AM	NA			15.7	96.7	9.6	244.00						
HB-5	UNNAMED TRIBUTARY-ADLUA04-VRMP	7/7/2015	7:50 AM	NA			16	69.4	6.5	243.00						
HB-5	UNNAMED TRIBUTARY-ADLUA04-VRMP	7/24/2015	9:42 AM	NA			16.7	89.9	8.8	283.20						
HB-7	UNNAMED TRIBUTARY-ADLUB02-VRMP	5/29/2015	8:19 AM	NA			16.2	94.5	9.3	259.80						
HB-7	UNNAMED TRIBUTARY-ADLUB02-VRMP	6/12/2015	7:58 AM	NA			15.7	98.1	9.7	600.00						
HB-7	UNNAMED TRIBUTARY-ADLUB02-VRMP	6/12/2015	7:58 AM	DUP			15.7	98.2	9.8	500.00						
HB-7	UNNAMED TRIBUTARY-ADLUB02-VRMP	6/26/2015	10:35 AM	NA			15.2	99.3	10	400.00						
HB-7	UNNAMED TRIBUTARY-ADLUB02-VRMP	6/26/2015	10:35 AM	DUP			15.1	100.6	10.1	400.00						
HB-7	UNNAMED TRIBUTARY-ADLUB02-VRMP	7/17/2015	8:59 AM	NA			16.1	101.3	10.2	372.00						