

Aquatic Life Use Attainment Assessment of Fayville Branch January 2010

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Description of water body and sampling sites:

Fayville Branch has a drainage area of just over 36 km² and an elevation of 700 ft. at its outlet to Warm Brook in Arlington. The vast majority of Fayville Branch drains from the Green Mountain National Forest in Arlington, Sunderland, Shaftsbury and Glastenbury. The upper headwaters include both Fayville Branch and Black Brook in Glastenbury, at elevations of 3200' and 2100' respectively. Fayville continues down a fairly high gradient path to the sampling station at river mile (RM) 3.7, just upstream of the crossing with Route 7 at an elevation of 1094 ft. and a drainage area of 23.5 km². From the Route 7 crossing the stream flows north, following a more moderate gradient to its outlet to Warm Brook in the residential area of East Arlington, just downstream of a new sampling station at RM 0.2 (Figure 1).

RM 3.7

Fish assemblages were sampled at this location during 1984, 2008 and 2009. Macroinvertebrate samples were collected in 1992, 2008 and 2009. The historic sampling site at RM 3.7 has a 90% closed canopy, and is completely dominated by a 98% forested watershed, including deciduous (62%), evergreen (22%) and mixed (14%) stands. From the sampling site, the stream runs approximately 4.75 miles to its source. Black Brook splits from Fayville Branch about 1.7 miles upstream of RM 3.7, and is itself approximately 1.0 miles long.

The substrate at this sampling site is largely dominated by a combination of boulder (~50%) and cobble (~35%), and the substrate has historically been characterized by thick moss growth. A broad suite of water chemistry measurements characterizing this site was collected at this site in 2008 and 2009, as well as some key field chemistry measurements from early sampling efforts in 1984 and 1992 (Tables 1 and 2).

RM 0.2

Only the macroinvertebrate assemblage was sampled at this site, newly established during the 2009 sampling season. While the overall drainage area is still dominated by forest, the sampling reach lies within a residential area and drains some open land immediately upstream. The reach has partially open canopy (~50%) and the riffle area sampled does not have the significant moss cover associated with the RM 3.7 site. The riffle substrate at RM 0.2 is dominated by cobble (46%) and coarse gravel (32%). Some field water chemistry information was also collected (Table 1).

Biological Assessment:

Fish community

The fish assemblage was sampled at RM 3.7 during the standard index period in 1984, 2008 and 2009. At each of these sampling dates, brook trout were the only species captured. A Cold Water Index of Biotic Integrity (CWIBI) was calculated based on these trout populations (Table 3). The CWIBI assessed the fish community as *good* in 1984 and 2008, a borderline condition for meeting the criteria for Class B waters. The CWIBI rated the 2009 assemblage as *very good*, with the increase in scoring due to the presence of young-of-the-year brook trout as well as adult age classes. The density of brook trout in Fayville Branch was below the threshold criteria for Class B waters in each sampling year.

The extreme high scoring of three CWIBI metrics (proportion of coldwater species, % generalist feeders, % top carnivores) was unusually driven by the absence of species other than brook trout. A stream of this size should typically contain other native species, particularly the intolerant slimy sculpin and possibly the more tolerant blacknose dace. Both of these species are susceptible to acidified waters. The water chemistry of this stream shows moderately low pH values (6.14-6.56 on all sampling dates) and high concentrations of aluminum (222-250 ug/l), coupled with very low alkalinity. These water chemistry values are indicative of acidification, which is likely amplified during runoff events.

Macroinvertebrate community

RM 3.7. The physical characteristics of Fayville Branch draining to RM 3.7 fit the criteria for a small high gradient (SHG) stream type for macroinvertebrate assessment. The macroinvertebrate community at this site was assessed as *good* in 1992, *good-fair* in 2008, and *fair* in 2009. None of the assemblages passed all the metrics needed to indicate full support of Class B aquatic life uses. Though overall density, richness, and EPT metrics passed (or were indeterminate with a tendency to pass) the criteria for Class B waters in all years, these values were very low compared to what would be expected in a forested stream with favorable habitat. Chloroperlid and leuctrid stoneflies were dominant in these samples, indicating a potential acidification impairment. The decrease in relative abundance of collector taxa due to the dominance of predators and shredder-detritivores (eg. Chloroperlidae and Leuctridae) drove the Pinkham-Pearson Coefficient of Functional Group Similarity metric into the indeterminate range in both 1992 and 2009. No Coleoptera were found at this stream in 2008 or 2009, a group that would normally be a common occurrence. Excluding aluminum, other metal and nutrient concentrations were low at RM 3.7 and the site has favorable substrate habitat and embeddedness. These conditions were reinforced by excellent values of other macroinvertebrate metrics (i.e. Biotic Index, Percent Oligochaeta, EPT/EPT&C).

RM 0.2. The sampling site at RM 0.2 is characteristic of a moderate high gradient (MHG) stream, and was assessed as *very good-good* in 2009 using these criteria. All macroinvertebrate metrics passed the criteria for Class B waters. Density, overall richness and EPT richness were all significantly elevated at this downstream sampling site when compared to RM 3.7. The Biotic Index and EPT/EPT&C show no compositional changes related to enrichment stress. The community at RM 0.2 is dominated by *Polydora aviceps*, a relatively intolerant collector-gatherer midge larva. In fact the 10 most dominant taxa at this site were all collector-gatherers or collector-filterers, including several EPT taxa. This is in stark contrast to the community at RM 3.7. Oligochaeta are slightly

elevated, indicating some potential stress from sand or silt, however only a small amount of sand (~5%) was observed and the embeddedness was found to be low.

Summary of Stressors and Recommendations:

Elevated acid deposition in the Fayville Branch watershed coupled with low bedrock and soil buffering capacity is likely leading to low pHs and high concentrations of aluminum at RM 3.7 during the spring snowmelt period. Combined with low alkalinity, acidification has led to an impaired biological condition in this stream site. Acidification is probably limiting stream productivity to a level that can not fully support either fish or macroinvertebrate diversity, and is leading to the exclusion of some functional feeding groups. The reduction of density, richness and EPT metrics in the macroinvertebrate assessment are also indicative of both low productivity and pH stress. The absence of acid intolerant slimy sculpin and blacknose dace may also reflect acidic conditions. Aluminum concentrations found at RM 3.7 are probably toxic to the biological community as well. The more toxic inorganic fraction of aluminum likely dominates the total aluminum concentrations measured here. Low color measurements at this site indicate low amounts of dissolved organic carbon which would otherwise bind with aluminum to form the less toxic organic fraction.

In contrast to the upstream site, the macroinvertebrate community at RM 0.2 is significantly more dense and diverse and is dominated by collector taxa. There was also a substantial increase in pH to 7.8. Between sites RM 3.7 and RM 0.2 Fayville Branch flows through dolomite bedrock region (Figure 2). The calcium in this bedrock may be buffering the acidification seen upstream and allowing the biological community to return to a more natural condition. Functional and compositional changes in the community may be caused by increased productivity due to decreased acidification, decrease in slope between the sites (slower flow) and the more open canopy of RM 0.2.

Figure 1. Map of Fayville Branch and surrounding areas

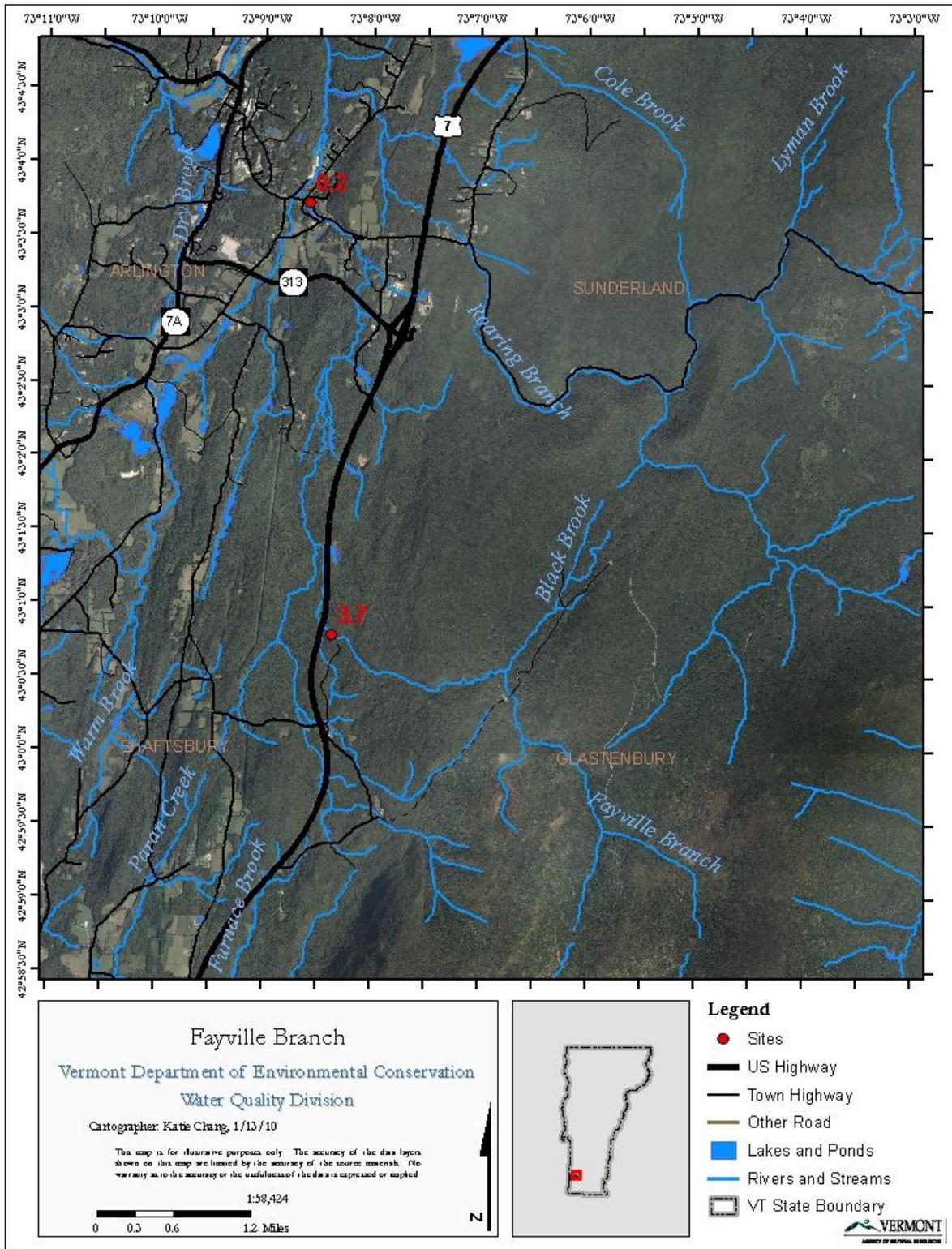


Figure 2. Bedrock geology of the Fayville Branch watershed and surrounding areas.

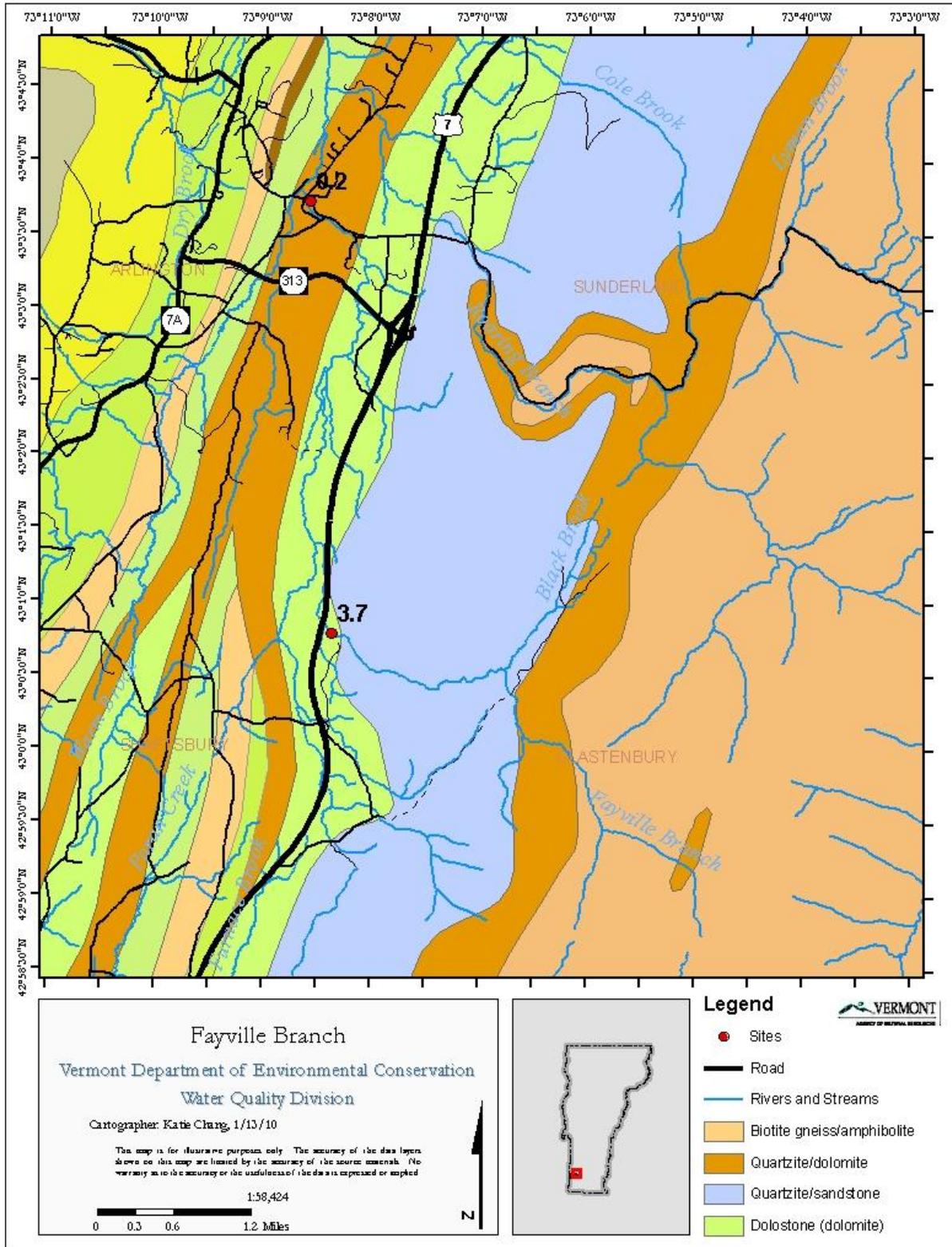


Table 1. General ambient chemical measurements collected at Fayville Branch sites from 1984-2009.

RM	Date	Water Temp (C)	Field pH	Alk (mg/L)	Field Cond (umhos)	Lab Cond (umhos)	Color (Pt-Co Units)	DO (mg/L)	DO%	Turb NTU
3.7	10/22/1984		6.56	2.07	25					
3.7	10/8/1992	7	6.5	0	27					
3.7	9/10/2008	11.68	6.14	1.4	22	18.7	15	10.76	100.4	0.31
3.7	7/29/2009	13	6.27	1.12		16.7	14.75			
3.7	9/30/2009	8.7	6.5	1.8	11.3	18.2	25	10.3	92	< 0.2
0.2	9/25/2009	12.4	7.8		81			10	94	

Table 2. Nutrient and metal chemical measurements collected at Fayville Branch RM 3.7 in 2008 and 2009. 2009 data represent the average of side-by-side field duplicates.

Date	Total P (ug/L)	Total Diss P (ug/g)	Total Cl (mg/L)	Total SO4 (mg/L)	Total N (mg/L)	Total NOX (mg/L)	Total Ca (mg/L)
9/10/2008	7.44	< 5	< 2	3.34	0.37	0.24	1.57
7/29/2009			0.38	3.38		0.28	1.06
9/30/2009	5.645	5.47	< 2	3.235	0.265	0.19	1.065

Date	Total Mg (mg/L)	Total Na (mg/L)	Total K (mg/L)	Total Al (ug/L)	Total As (ug/L)	Total Cd (ug/L)	Total Cr (ug/L)
9/10/2008	0.63	0.7	0.44	250	< 1	< 1	< 5
7/29/2009	0.37	0.68	0.44	129			
9/30/2009	0.385	0.77	0.605	222	< 1	< 1	< 5

Date	Total Cu (ug/L)	Total Fe (ug/L)	Total Pb (ug/L)	Total Mn (ug/L)	Total Ni (ug/L)	Total Se (ug/L)	Total Zn (ug/L)
9/10/2008	< 10	< 50	< 1	13.6	< 5	< 5	< 50
9/30/2009	< 10	< 50	< 1	9.575	< 5	< 5	< 50

Table 3. Fish community metrics for Fayville Branch RM 3.7. Two sampling runs were conducted in 1984.

Date	IBI and Assessment	Number of Intolerant Native Species	Proportion of Coldwater Species	% Generalist Feeders	% Top Carnivores	Brook Trout Density / 100m ²	Number of Brook Trout Year Classes
10/22/1984	30 - Good	1	100	0	100	0.6	1
9/10/2008	30 - Good	1	100	0	100	0.68	1
9/30/2009	36 - Very Good	1	100	0	100	1.88	3

Table 4. Macroinvertebrate metrics for Fayville Branch from 1992-2009. Macroinvertebrates at RM 0.2 were collected by a consultant using VT DEC methodology. All individual metrics pass for an SHG Class B stream, except those in bold (indeterminate).

Site	Date	Assessment	Density	Richness	EPT	PMA-O	BI	% Oligochaeta	EPT/ EPT&C	PPCS-F
3.7	10/8/1992	Good	368	30	19	69.4	0.91	1.4	0.96	0.37
3.7	9/10/2008	Good-Fair	679	33	16.5	78.6	2.36	1.4	0.82	0.71
3.7	9/30/2009	Fair	542	27	20	57.2	0.83	0.0	0.97	0.43
0.2	9/25/2009	VeryGd-Good	1344	41	24	69.6	3.32	6.8	0.63	0.48