

Biological Use Support Attainment Of the Rock River 2009



Prepared by

Vermont Department of Environmental Conservation
Water Quality Division
Biomonitoring and Aquatic Studies Section
RA La Rosa Environmental Laboratory
103 South Main Street
Waterbury, VT

Description of water body:

The Rock River drains a low elevation, primarily agricultural watershed of 93 km². The river begins at an elevation approximately 460 ft. in Highgate Vermont, flowing briefly north then turns westward where it winds through Franklin before returning to Highgate eventually flowing north into Quebec. It then turns south and reenters Highgate for 3.6 miles until it empties in Missisquoi Bay, Lake Champlain. The Rock River from its mouth to the Quebec border are designated as warm water fish habitat by the Vermont Water Quality Standards (WQS). The remaining waters are designated cold water fish habitat. The entire reach of the Rock River is classified as Class B waters.

From its mouth to the Quebec border (3.6 miles) the river is designated as impaired on the 2008 Vermont 303(d) list due to non support of Class B aesthetic standards. From the Quebec border upstream to the source the rivers is listed for impairment of Aquatic Life Use Standards. Though specific stressors are “undefined”, nutrient runoff from agricultural land use is suspected as the cause of the impairments.

Fish and or Macroinvertebrates were sampled upstream of where the river flows to the Quebec border at river miles (RM) 5.9, 7.9, 9.4, 14.8, 14.9 and 19.0 (Table 1 and Figure 1).

Table 1. Rock River sample site location information.

River mile from mouth (RM)	Town	Site Lat./Long.	Community sampled	Drainage area (km ²)	Elevation (ft.)
5.9	Highgate	45.00111 / 73.02472	Macroinvertebrate, Fish	58	180
7.9	Highgate	44.98000 / 73.02583	Macroinvertebrate, Fish	50	205
9.4	Highgate	44.96833 / 73.01389	Macroinvertebrate	45	220
14.8	Franklin	44.97306 / 72.96806	Macroinvertebrate	15	256
14.9	Franklin	44.97205 / 72.96698	Macroinvertebrate, Fish	15	266
19.0	Franklin	44.97361 / 72.93083	Macroinvertebrate	4	358

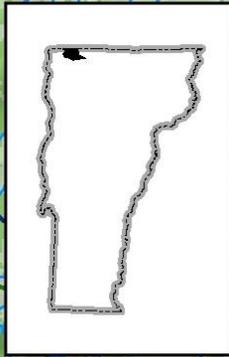
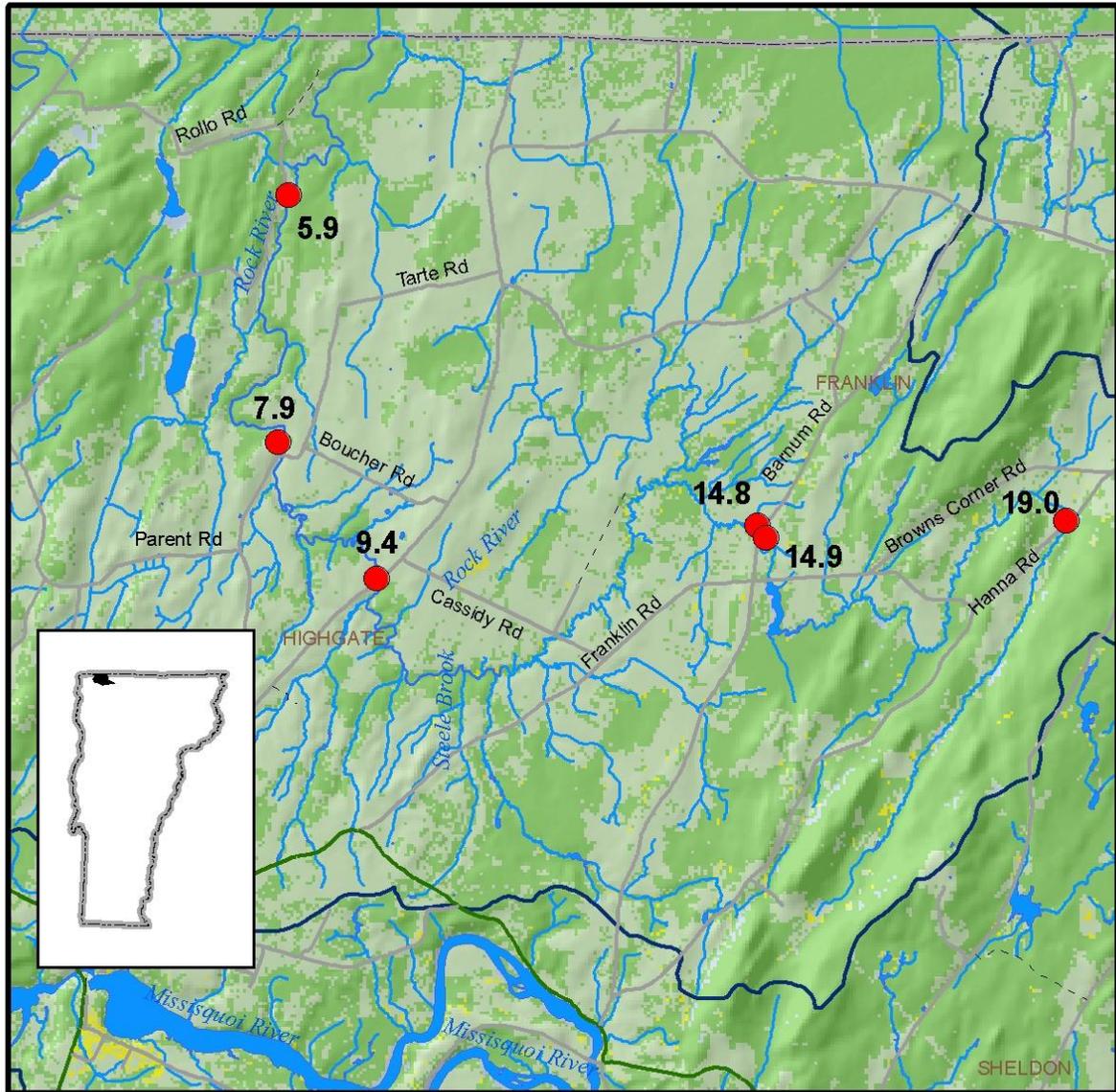
Biological Assessment

Fish Community. The fish assemblages of the Rock River were assessed using the mixed water index of Biological Integrity which was developed for streams that naturally support five or more native species. The fish community of the Rock River as assessed at four locations during 2002-2008 does not meet the Class B biological criterion for fish assemblages over much of its length. Only the RM 14.9 site in Franklin met standards with a rating of *good* in 2007 (Table 2). Fish densities were high at RM 7.9 and 14.9 sites indicating possible nutrient enrichment. No intolerant species were recorded at any site. The tolerant species blacknose dace and creek chub were dominant at RM 19.0. Sites downstream were dominated by tolerant species including the former two species in addition to white sucker and Bluntnose minnow (Table 3). The species composition at RM 5.9 indicated good conditions but the anomaly metric was descored because of several tessellated darters that were infested with yellow grub. Environmental stress can often reduce resistance to disease and parasites.

The RM 19.0 site was sampled twice with very similar results - IBI values of 27 for both years, which would normally result in a *fair* rating. No evaluations were made from these samples however, because they were judged not to be fully representative of the habitat for the reach of this stream. This small site drained a very small area (4km²) and supported only four species-one less than is required to apply the MWIBI. The available reference condition necessary for calibrating the MWIBI may not accurately reflect conditions for streams this small. The DEC will continue to refine the reference ideal for small warmwater sites. This site will also be re-sampled in 2009 to include a different mix of habitats in an attempt to record any additional species that may have been missed during the first two samples. If additional species are recorded the IBI may be reapplied and an evaluation provided at that time.

Figure 1: Biological sampling locations for the Rock River.

Rock River 2008 Sites



0 0.25 0.5 1 1.5 Miles

Map Produced by Katie Chang
 Biomonitoring and Aquatic Studies Section
 WQD, VT DEC
 2/19/09

Legend

- | | | |
|--|------------------|----------------------|
| ● Rock River 2008 Sites | Landcover | Major Roads |
| VT State Boundary | Non Classified | VT State Highway |
| Lakes and Ponds | Open Water | Class 1 Town Highway |
| Rivers | Urban | |
| Watershed Boundary | Open | |
| | Wooded | |

Table 2. Fish community metrics from the Rock River sites, evaluated using the Mixed Water Index of Biotic Integrity.

River Mile	Date	IBI and Assessment	Number of Native Species	Number of Intolerant Species	No. of Benthic Insectivore Species	% White Sucker and Creek Chub	% Generalist Feeders	% Insectivores	% Top Carnivores	% Anomalies	Density ¹ (#/100m ²)
5.9	5-May-2002	27 - Fair	9	0	2	13	48	52	0	4.1	76
7.9	17-Oct-2008	25 - Poor	7	0	2	23	66	34	0	1.0	308
14.9	25-Sept-2007	37 - Good	8	0	2	20	37	63	0	0	258
19.0 ²	25-Sept-2007	27	5	0	0	43	54	45	0	0	160
	17-Oct-2008	27	4	0	0	45	58	42	0	0	76

1 as measured by raw numbers of fish collected on first electrofishing run/100m²

2. both assessments were indeterminate

Table 3. Fish abundance expressed as numbers/100 m² collected from one electrofishing run and per cent of total fish species collected at each site in the Rock River by date.

Species	5.9 (2002)	7.9 (2008)	14.9 (2007)	19.0 (2007)	19.0 (2008)
Blacknose dace	5.9 (8)	69.4 (22)	97.1 (38)	72.6 (45)	34.6 (42)
Creek chub	7.6 (10)	33.1 (11)	52.4 (20)	68.3 (43)	32.2 (45)
Common shiner	19.0 (25)	95.7 (31)	42.4 (16)	17.3 (11)	9.4 (9)
Longnose dace	6.1 (8)	32.4 (11)	40.6 (16)	-	-
Tessellated darter	27.5 (36)	0.9 (1)	14.1 (6)	-	-
White sucker	2.2 (3)	36.4 (12)	-	-	-
Redbelly dace	-	-	-	1.6 (1)	2.4 (3)
Bluntnose minnow	5.4 (7)	38.2 (12)	-	-	-
Fathead minnow	2.4 (3)	-	0.6 (<1)	-	-
Mudminnow	-	-	0.6 (<1)	-	-
Banded killifish	-	-	10.6 (4)	-	-
Pearl dace	-	-	-	0.4 (<1)	-
Brook stickleback	0.3 (<1)	-	-	-	-

Macroinvertebrate Community. The macroinvertebrate community was assessed using the VTDEC Warm Water Moderate Gradient stream criteria. In general the integrity of the community is degraded in a downstream direction. The lowest site, RM 7.9 showed ratings of *fair* to *poor* from all six sampling events between 1999 and 2008 (Table 4). The abundance or density of macroinvertebrates was always high. Richness of the pollution intolerant Ephemeroptera Plecoptera Trichoptera (EPT) taxa was low, with Plecoptera absent five of six years sampled. The Biotic Index (BI), a measure of the community tolerance of organic enrichment was high for every assessment. High numbers of moderately tolerant Hydropsychid Trichoptera kept the EPT/EPTc ratio at moderate levels despite elevated numbers of moderately tolerant Chironimids. The only assessment with elevated numbers of Oligochaeta worms was in 1999. The water quality sensitive insect orders Ephemeroptera, and Plecoptera were extremely depressed or absent (Table 5). The resulting functional feeding group composition (Table 6) shows collector filterers, and shredder herbivores often elevated with all other functional groups depressed. This shift in functional group composition was at a moderate level for three of six years sampled. The above described metric fingerprint and functional group composition at RM 7.9 is indicative of nutrient enrichment and high temperature as the primary stressors with silt also contributing.

Table 4. Macroinvertebrate community assessments and metrics for the Rock River.

River mile	Date	Assessment	Density	Richness	EPT	PMA-O	BI	Oligo. %	EPT/EPTc	PPCS-F
7.9	27-Sep-99	Poor	4202	43.5	11.5	61	5.99	14.5	0.67	0.55
	11-Oct-00	Poor	4304	30.5	7.0	49	6.08	0.4	0.49	0.42
	24-Sep-04	F air-Poor	3440	36.0	10.5	54	6.28	1.7	0.79	0.35
	19-Sep-05	Poor	3636	41.0	14.0	53	5.96	4.6	0.85	0.42
	25-Sep-07	Fair	2580	44.0	15.0	59	5.89	2.6	0.71	0.49
	17-Oct-08	Fair	5160	45.0	14.5	51	5.68	0.2	0.47	0.56
9.4	29-Sep-99	Poor	5236	37.0	7.0	58	5.48	0.2	0.64	0.59
	24-Sep-04	Fair -Poor	1976	31.0	12.	61	6.04	0	0.46	0.47
14.8	29-Sep-99	Fair	1456	29.0	12.0	61	5.22	0.3	0.66	0.33
	11-Oct-00	Fair	419	28.5	9.0	49	4.56	1.3	0.43	0.52
	01-Oct-04	Good	6744	47.0	19.0	66	5.38	1.5	0.61	0.50
	25-Sep-07	Good	5428	49.0	20.0	63	4.86	0	0.85	0.39
14.9	25-Sep-07	Vg - Good	3932	50.0	21.0	75	4.97	0.1	0.83	0.53
	17-Oct-08	Vg - Good	4692	49.0	21.0	88	3.74	0.2	0.83	0.53
19.0*	29-Sep-99	Vg-Good	1496	44.5	19.5	85	2.88	0.3	0.90	0.65
	25-Sep-07	Ex - V.good	1866	46.0	23.5	87	3.40	0	0.94	0.80
	17-Oct-08	Ex - V.good	1820	43.0	22.0	78	2.36	0.2	0.95	0.59
Class B Criteria			>300	>30	>16	>45	<5.40	<12.0	>.45	>0.40

The community at site RM 9.4 showed a similar taxonomic makeup as RM 7.9. Two assessments were completed, the first in 1999 (poor) and the second in 2004 (*fair* to *poor*). For both years the community fingerprint at this site was the same as at site 7.9.

The community at RM 14.8 has showed a significant improvement over the four times it was assessed between 1999-2007. The community scored *fair* for the first two years and *good* for the last two years. The first two years both overall community richness and EPT taxa richness values were very low, BI values were consistently elevated to a moderate level for all four years (Table 4). As a result the community failed to meet Class B aquatic life criteria. The above metrics and structural and functional composition (Tables 5 and 6) of the macroinvertebrate community indicated similar stressors as at the lower two sites. Assessments in 2004 and 2008 show a significant increase in both richness and EPT taxa present. The order Plecoptera absent

from the site was found present in low numbers. The Bio Index showed some improvement especially in the last assessment 2007. As a result the overall community assessment was *good*, meeting Class B aquatic life use.

The macroinvertebrate communities at RM 14.9 and 19.0 have consistently met Class B criteria. RM 14.9 was sampled in 2007 and 2008, while RM 19.0 was sampled in 1999, 2007, and in 2008. Assessments at these two sites ranged from *very good* to *excellent-very good*. Compared to the two lower sites overall densities were lower, and BI values were far lower (2.36-4.97) than from the lower sites (5.48-6.28). EPT taxa from the 14.9 and 19.0 were far higher ranging from 19.5-23.5 while at the lower two sites, and at site 14.8 in early assessments values of EPT taxa ranged from 7 to 15. Some differences were still evident between these two sites.

Density was generally twice as high at the 14.9 site compared to the 19.0 site, and the orders Ephemeroptera and Plecoptera were more highly represented in both number of taxa and percent composition at the upper 19.0 site, while the Coleoptera were higher in composition at the lower 14.9 site. It is also of significant note that the number of dominate taxa shifts between the two sites point toward a greater temperature stress at the 14.9 site compared to the 19.0 site. At the upper site several cool water taxa are represented among the dominate taxa including *Dolophilodes sp*, *Glossosoma sp*, *Isoperla sp*, and *Symphitopsyche slossonae*. At the lower site, 14.9, these taxa are replaced with the warmer water taxa *Chimarra aterima*, *Cheumatopsyche sp*, *Hydropsyche betteni*, and *Isonychia sp*. These taxonomic shifts strongly indicate temperature differences between these two sites.

Table 5. Percent composition of the major macroinvertebrate orders by site on all sampling dates for the Rock River.

River Mile	Date	Oligochaeta	Coleoptera	Diptera	Ephemeroptera	Plecoptera	Trichoptera	Other
7.9	27-Sep-99	15	14	21	4	0	36	11
	11-Oct-00	<1	3	51	<1	0	44	1
	24-Sep-04	2	7	23	1	0	66	1
	19-Sep-05	5	3	16	4	0	67	6
	25-Sep-07	3	7	30	6	0	52	2
	17-Oct-08	<1	3	54	3	<1	38	1
9.4	29-Sep-99	<1	17	31	1	0	50	<1
	24-Sep-04	0	16	47	4	0	32	<1
	29-Sep-99	<1	32	22	8	0	35	2
14.8	11-Oct-00	1	39	34	6	0	18	2
	01-Oct-04	2	13	36	7	2	41	<1
	25-Sep-07	0	39	10	9	<1	42	<1
14.9	25-Sep-07	<1	17	15	18	1	49	1
	17-Oct-08	<1	19	15	31	<1	34	1
	29-Sep-99	<1	12	11	46	5	23	2
19.0	25-Sep-07	0	6	11	34	9	40	1
	17-Oct-08	<1	2	7	55	9	25	1
Model	WWMG	1.0	12.0	12.0	34.0	8.0	31.0	1.0

Table 6. Percent composition of macroinvertebrate functional groups for sampling dates for the Rock River.

River Mile	Date	Collector/ Gatherer	Collector/ Filterer	Predator	Shredder/ Detritivore	Shredder/ Herbivore	Scraper
7.9	27-Sep-99	33	42	2	<1	<1	19
	11-Oct-00	21	65	10	<1	1	3
	24-Sep-04	14	69	1	<1	10	7
	19-Sep-05	18	70	4	0	2	4
	25-Sep-07	21	53	1	1	14	11
	17-Oct-08	33	51	5	<1	5	6
9.4	29-Sep-99	24	52	1	1	2	17
	24-Sep-04	10	32	4	0	36	18
14.8	29-Sep-99	17	34	1	0	5	40
	11-Oct-00	26	18	12	0	2	40
	01-Oct-04	19	46	3	0	16	14
	25-Sep-07	8	43	4	0	<1	45
14.9	25-Sep-07	17	53	5	0	1	23
	17-Oct-08	33	36	3	<1	<1	27
	29-Sep-99	43	23	10	2	2	19
19.0	25-Sep-07	16	38	7	3	4	30
	17-Oct-08	52	18	8	4	3	15
Model	WWMG	22.0	36.0	7.0	2.0	5.0	22.0

Possible Stressors on Aquatic Life.

Physical habitat observations were collected at the time of macroinvertebrate sampling. The most significant of these measures presented in Table 7, include conditions of the substrate, canopy cover and a periphyton index.

The percent sand observed in riffles was low at the lower impaired sites and highest at the uppermost site - RM 19.0. Embeddedness followed a similar pattern rating very good most years at the lower sites, but only good or between 25-50% at the uppermost site RM 19.0, where the portion of sand in the substrate was also greater. This indicates that substrate habitat as measured by % sand and embeddedness is not a significant stressor at the lower degraded sites 7.9 thru 14.9. The silt rating however showed that the lower degraded sites RM 7.9 and 9.4 were considerably higher in silt rating than the upper sites 14.8/9 and 19.0. This indicates that finer silt particles are more prevalent at the downstream sites. Fine silts generally indicate nonpoint runoff or erosion of very fine materials such as clay or organic matter that often do not settle out except under very low flow conditions.

The periphyton assessments show moss cover with a thin layer of diatom micro algae dominating the uppermost site 19.0. Macro algae cover progressively increases (index range 0-10) in a downstream direction from none at site 19.0 to moderate levels at 14.8/9 (2.18-4.16), to high at site 7.9 (4.26-7.67). Micro algae thickness is moderate (1.17-2.88) at all sites below the uppermost reach 19.0. It is important to note that the canopy cover is highest at the upper most site 19.0, and lowest in the middle reaches 14.8/9. These observations show that periphyton algae cover for both macro and micro cover are greatest at the mid to lower sites strongly supporting the macroinvertebrate assessments that nutrients are causing increased primary in-stream productivity at these lower sites.

Table 7. Physical habitat and periphyton assessments at Rock River sites.

River Mile	Date	Embeddedness Rating (1 poor-5 exc)	Silt Rating (1low-5 high)	Sand %	Gravel %	Coarse Gravel %	Cobble %	Boulder %	Canopy %	Macro Algae (Filamentous) Cover Index (0-10)	Moss Cover Index (0-10)	Micro Algae (Blue Green and Diatom) Thickness Index (0-10)
7.9	9/27/1999	4	5	5	10	30	45	10	35	-	-	-
	10/11/2000	3	5	2	0	25	30	35	50	-	-	-
	9/24/2004	4	5	1	3	39	41	9	50	7.8	5.4	1.8
	9/19/2005	4	4	0	4	26	60	3	40	4.3	1.7	2.2
	9/25/2007	4	4	3	13	31	49	3	65	5.1	3.1	1.2
	10/17/2008	4	5	0	15	15	68	2	50	7.1	2.5	0.7
9.4	9/29/1999	4	-	0	9	29	53	6	0	-	-	-
	9/24/2004	4	5	2	9	31	52	0	10	6.3	3.9	2.9
14.8	9/29/1999	4	1	5	20	35	40	1	0	-	-	-
	10/11/2000	3	2	2	19	39	30	13	20	-	-	-
	10/01/2004	3	1	3	13	31	51	2	5	2.2	0.0	2.9
	9/25-2007	4	4	1	9	21	62	7	10	3.1	0.3	2.5
14.9	9/25-2007	4	4	1	9	21	62	7	20	3.1	0.3	2.5
	10/17/2008	4	3	0	17	17	60	6	10	4.2	0.3	1.3
19.0	9/29/1999	3	2	10	25	30	15	15	80	-	-	-
	10/25-2007	3	4	15	17	11	42	15	90	0.0	4.2	0.3
	10/17/2008	3	2	12	33	15	24	16	95	0.0	4.5	0.1

Water quality data is presented in Table 8. The Rock River is moderate to high in alkalinity at all sites ranging from 42 to 140 mg/l. This level of alkalinity also results in high pH values, ranging generally 7.5-8.0. These measures indicate that pH is not a stressor. Nutrients - phosphorus and nitrogen- were sampled during both freshet and base flow conditions from 2004 thru 2008. Total phosphorus (TP) was low during both base and freshet flows at the upper most site 19.0, with TP only slightly higher than Dissolved P. At both the mid and lower sites TP and DP were elevated above levels found to likely cause aquatic life support impairment (>50ug/l TP). During base flows TP ranged from 58 to 86 ug/l. Dissolved phosphorus was often about half of the TP levels during base flows. Freshet flows showed even more elevated levels of both TP and DP. These were associated with elevated turbidity and total suspended solids (TSS) levels. Turbidity during freshet events ranged from 48-56 NTU at site 7.9. Turbidity was not elevated during freshet events at any of the mid or upper sites. It is interesting to note at RM 14.8 that even though turbidity was low during the Aug 9, 2007 freshet event, TP and DP were elevated above the likely to cause aquatic life impairment level.

Table 8: Water quality measures from all Rock River sites sampled in 1993-2008, collected at time of biological sampling. T=Total, D=dissolved (filtered).

River Mile	Date	Time	Water Temp. °C	Flow level	pH	Alk mg/L	Cond. umhos	Color Pt Co Units	DO mg/L	DO %
5.9	8/5/2002	1339	24.7	-	7.89	-	356	-	7.79	92.6
7.9	9/27/1999	-	17	-	7.35	73.8	282	110	-	-
	10/11/2000	-	6.5	-	7.78	129	344	70	-	-
	9/24/2004	1100	18.3	Base	7.91	140	354	50	-	-
	9/19/2005	1230	18	Freshet	7.9	89.8	296	-	-	-
	10/31/2005	1145	6	-	7.82	81.2	250	45	-	-
	8/9/2007	0900	20	Freshet	7.83	111	307	60	-	-
	9/25/2007	0900	17.5	Base	8.08	80.5	331	50	-	-
	10/17/2008	1000	10.3	Base	7.6	140	382	45	6.25	56.6
9.4	9/29/1999	-	17.5	-	-	76	273	100	-	-
	9/24/2004	1333	16.3	Base	7.87	135	326	50	-	-
12.0	8/9/2007	0900	-	Freshet	-	127	323	-	-	-
14.8	9/29/1999	-	20	-	-	68.5	196	80	-	-
	10/11/2000	-	7.5	-	7.39	114	263	60	-	-
	10/1/2004	1000	13.9	Base	7.8	110	329	35	9.69	93.9
	8/9/2007	0900	20	Freshet	7.32	116	249	55	-	-
	9/25/2007	0900	18.5	Base	8.12	99.6	241	50	-	-
14.9	10/17/2008	1200	10.5	Base	7.7	118	287	30	8.5	77
19.0	9/29/1999	-	17	-	-	66.1	165	55	-	-
	8/9/2007	0900	16	Freshet	7.81	72.2	160	65	-	-
	9/25/2007	0900	12	Base	7.9	42.4	180	50	-	-
	10/17/2008	1300	8.4	Base	7.88	107	224	20	8.3	71.5

Table 8. continued

River Mile	Date	Flow Type	Turb. NTU	TSS. mg/L	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
7.9	9/24/2004	Base	18	18.6	79	32	15.2	13.9	1.76	1.2
	9/19/2005	Freshet	48.4	35.6	187	87.8	16.1	30.7	1.70	0.57
	10/31/2005	Base	7.96	9.9	78.8	38.9	10.8	15.6	2.14	1.56
	8/9/2007	Freshet	56.8	-	226	115	15.3	14.5	1.95	0.78
	9/25/2007	Base	7.95	-	59	40.1	14.1	15	1.10	0.5
	10/17/2008	Base	7.29	-	86.6	40.1	20.8	18.5	1.25	0.44
9.4	9/24/2004	Base	32.6	24.2	79	26	13.5	12.3	1.17	0.65
12.0	8/9/2007	Freshet	56.5	-	270	178	10.0	14.4	1.57	0.39
14.8	10/1/2004	Base	1.69	2.4	58	44	7.3	4.81	0.70	0.15
	8/9/2007	Freshet	2.36	-	102	61.9	5.8	3.28	0.80	0.08
	9/25/2007	Base	3.06	-	70.2	58.4	8.4	6.17	0.76	0.16
14.9	10/17/2008	Base	1.16	-	62.1	55.9	12.7	7.58	0.63	0.08
19.0	8/9/2007	Freshet	1.89	-	27.2	20.1	< 2	3.42	0.63	0.13
	9/25/2007	Base	0.5	-	14.2	10.1	2.4	4.29	0.60	0.28
	10/17/2008	Base	1.94	-	13.6	10.2	4.5	4.66	0.69	0.13

Table 8. Continued

River Mile	Date	Diss. Ca mg/L	Total Ca mg/L	Diss. Mg mg/L	Total Mg mg/L	Diss. Na mg/L	Total Na mg/L	Diss. K mg/L	Total K mg/L	Total Al ug/L	Diss. Al ug/L	Total Hardness	Total Hardness from totals
7.9	9/24/2004	49.3	--	8.98	--	9.1	--	4.75	--	--	14.1	167	--
	9/19/2005	38.1	--	6.71	--	7.43	--	7.91	--	--	--	123	--
	10/31/2005	29.4	--	5.64	--	5.49	--	3.88	--	--	15.2	96.2	--
	8/9/2007	39.8	--	7.95	--	8.64	--	7	--	--	25	132	--
	9/25/2007	42.2	--	8.68	--	8.94	--	5.58	--	--	25	141	--
	10/17/2008	--	45.7	--	9.95	--	11.2	--	8.43	127	--	--	155
9.4	9/24/2004	47.3	--	8.76	--	8.59	--	4.27	--	--	18.5	154	--
12.0	8/8/2007	45.1	--	8.52	--	6.6	--	6.72	--	--	30	148	--
14.8	10/1/2004	38.2	--	7.29	--	4.16	--	2.75	--	--	< 10	125	--
	8/9/2007	38	--	7.6	--	4.11	--	2.76	--	--	< 10	126	--
	9/25/2007	31.8	--	6.7	--	4.69	--	4	--	--	< 10	107	--
14.9	10/17/2008	--	37.2	--	8.13	--	5.96	--	5.25	12	--	--	126
19.0	8/9/2007	26	--	5.29	--	1.67	--	0.88	--	--	11	86.6	--
	9/25/2007	26.1	--	5.06	--	1.92	--	0.94	--	--	< 10	86.1	--
	10/17/2008	--	32.2	--	6.2	--	2.65	--	2	23	--	--	106

Table 8. Continued

River Mile	Date	Diss. As ug/L	Total As ug/L	Diss. Cd ug/L	Total Cd ug/L	Diss. Cr ug/L	Total Cr ug/L	Diss. Cu ug/L	Total Cu ug/L	Diss. Fe ug/L	Total Fe ug/L	Diss. Pb ug/L	Total Pb ug/L	Diss. Mn ug/L	Total Mn ug/L	Diss. Ni ug/L	Total Ni ug/L	Diss. Se ug/L	Total Se ug/L	Diss. Zn ug/L	Total Zn ug/L
7.9	9/24/2004	< 1	-	< 1	-	< 5	-	< 10	-	234	-	< 5	-	85	-	-	-	-	-	< 10	-
	9/19/2005	1.04	-	< 1	-	< 5	-	< 10	-	78.6	-	< 5	-	76.4	-	< 5	-	-	-	123	-
	10/31/2005	< 1	-	< 1	-	< 5	-	< 10	-	< 50	-	< 5	-	40.7	-	< 5	-	-	-	< 10	-
	8/9/2007	1.29	-	< 1	-	< 5	-	< 10	-	< 50	-	< 1	-	-	-	-	-	< 5	-	< 50	-
	9/25/2007	1	-	< 1	-	< 5	-	< 10	-	66.1	-	1.89	-	-	-	-	-	< 5	-	< 50	-
	10/17/2008	-	1.4	-	< 1	-	< 5	-	< 10	-	539	-	< 1	-	114	-	< 5	-	< 5	-	< 50
9.4	9/24/2004	< 1	-	< 1	-	< 5	-	< 10	-	241	-	< 5	-	92.7	-	-	-	-	-	< 10	-
12.0	8/8/2007	1.25	-	< 1	-	< 5	-	< 10	-	109	-	2.57	-	-	-	-	-	< 5	-	< 50	-
14.8	10/1/2004	< 1	-	< 1	-	< 5	-	< 10	-	291	-	< 5	-	30	-	-	-	-	-	< 10	-
	8/9/2007	< 1	-	< 1	-	< 5	-	< 10	-	204	-	< 1	-	-	-	-	-	< 5	-	< 50	-
	9/25/2007	< 1	-	< 1	-	< 5	-	< 10	-	172	-	< 1	-	-	-	-	-	< 5	-	< 50	-
14.9	10/17/2008	-	< 1	-	< 1	-	< 5	-	< 10	-	174	-	< 1	-	22	-	< 5	-	< 5	-	< 50
19.0	8/9/2007	< 1	-	< 1	-	< 5	-	< 10	-	186	-	< 1	-	-	-	-	-	< 5	-	< 50	-
	9/25/2007	< 1	-	< 1	-	< 5	-	< 10	-	92.9	-	< 1	-	-	-	-	-	< 5	-	< 50	-
	10/17/2008	-	< 1	-	< 1	-	< 5	-	< 10	-	248	-	< 1	-	71.2	-	< 5	-	< 5	-	< 50

Table 8. Continued

River Mile	Date	Diss Mn ug/L	Total Mn ug/L	Diss Ni ug/L	Total Ni ug/L	Diss Se ug/L	Total Se ug/L	Diss Zn ug/L	Total Zn ug/L
7.9	9/24/2004	85	-	-	-	-	-	< 10	-
	9/19/2005	76.4	-	< 5	-	-	-	123	-
	10/31/2005	40.7	-	< 5	-	-	-	< 10	-
	8/9/2007	-	-	-	-	< 5	-	< 50	-
	9/25/2007	-	-	-	-	< 5	-	< 50	-
	10/17/2008	-	114	-	< 5	-	< 5	-	< 50
9.4	9/24/2004	92.7	-	-	-	-	-	< 10	-
12.0	8/8/2007	-	-	-	-	< 5	-	< 50	-
14.8	10/1/2004	30	-	-	-	-	-	< 10	-
	8/9/2007	-	-	-	-	< 5	-	< 50	-
	9/25/2007	-	-	-	-	< 5	-	< 50	-
14.9	10/17/2008	-	22	-	< 5	-	< 5	-	< 50
19.0	8/9/2007	-	-	-	-	< 5	-	< 50	-
	9/25/2007	-	-	-	-	< 5	-	< 50	-
	10/17/2008	-	71.2	-	< 5	-	< 5	-	< 50

Total Nitrogen (TN) was also found to be elevated at all sites, reaching its highest levels (1.1 - 2.14 mgN/l) at the lowest 7.9 site. The mid and upper sites 14.8/9 and 19.0 were also approaching the guidance value of 0.75 mgN/l found to likely cause aquatic life use impairment. TN ranged from 0.60 to 0.80 at these two mid-upper sites. Nitrogen levels did not appear to be effected by freshet flow events.

Dissolved oxygen (D.O.) was measured only once at all sites. On Oct 17 2008 the D.O. was found to be low - 6.25mg/l (56.6% saturation) at site 7.9, failing to attain VTWQS for both Cold and Warm water fish habitat. Both the mid site 14.9 and upper site 19.0 were found to be supporting D.O. criteria on the same day. The low D.O. concentration measured at site 7.9 also supports the finding above that in-stream primary productivity is high a likely cause for the low D.O. High levels of silt also could indicate a significant amount of BOD draw within the silt-laden sediments.

No metals were found to be near or above toxic ALS criteria at any site on all occasions sampled from 2004 to 2008. These data are presented in Table 8. Most metals were below detection limits. Chloride was found to be slightly elevated at the lower and mid sites (6-21mg/l), well below ALS criteria, compared to the uppermost site 19.0 that measured close to background natural levels of 2-4 mg/l.

Stream temperature data-loggers were deployed in the summer of 2008 at the uppermost site - RM19.0 and a lower site- RM 7.9. Figures 2 and 3 show water temperature fluctuations during the months of August and September. While temperatures at RM 19.0 only exceeded 70 degrees F on a few occasions, values at RM 7.9 topped 70 degrees on almost all days, exceeding 80 on one occasion. A likely influence on elevated water temperatures at 7.9 are the on stream pond between RM 19.0 and 14.9. In addition, a lack of riparian vegetative canopy created by clearing fields for agricultural use may also be contributing to the higher stream temperatures.

Figure 2. Minimum, maximum and mean water temperatures at site RM 19.0 on the Rock River, 2007.

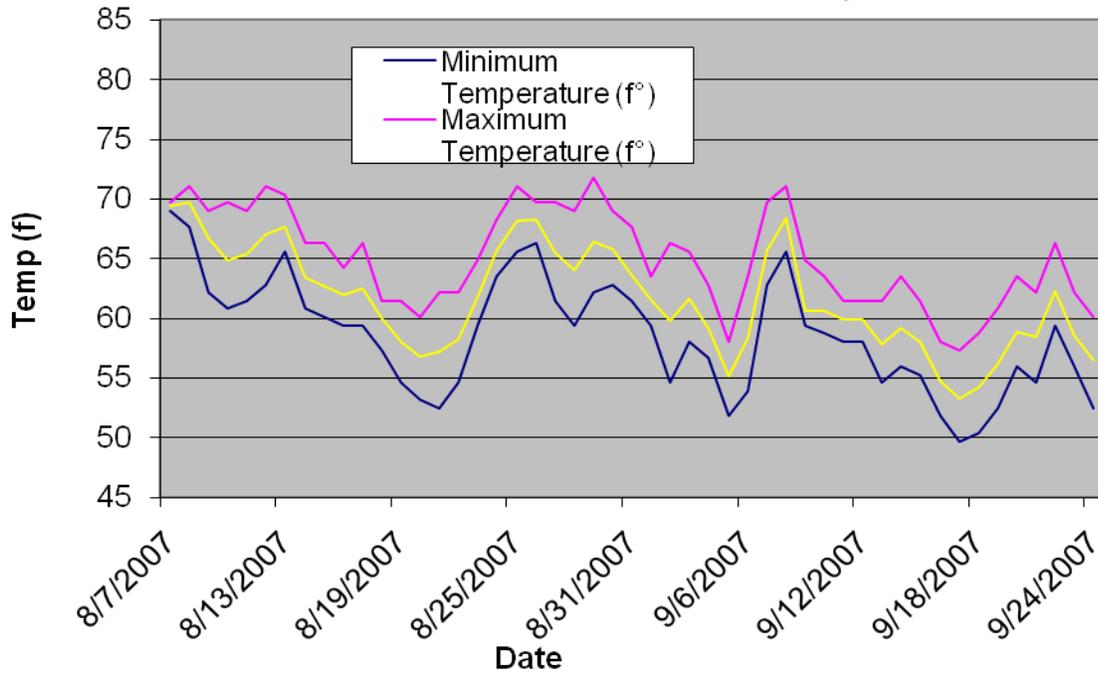
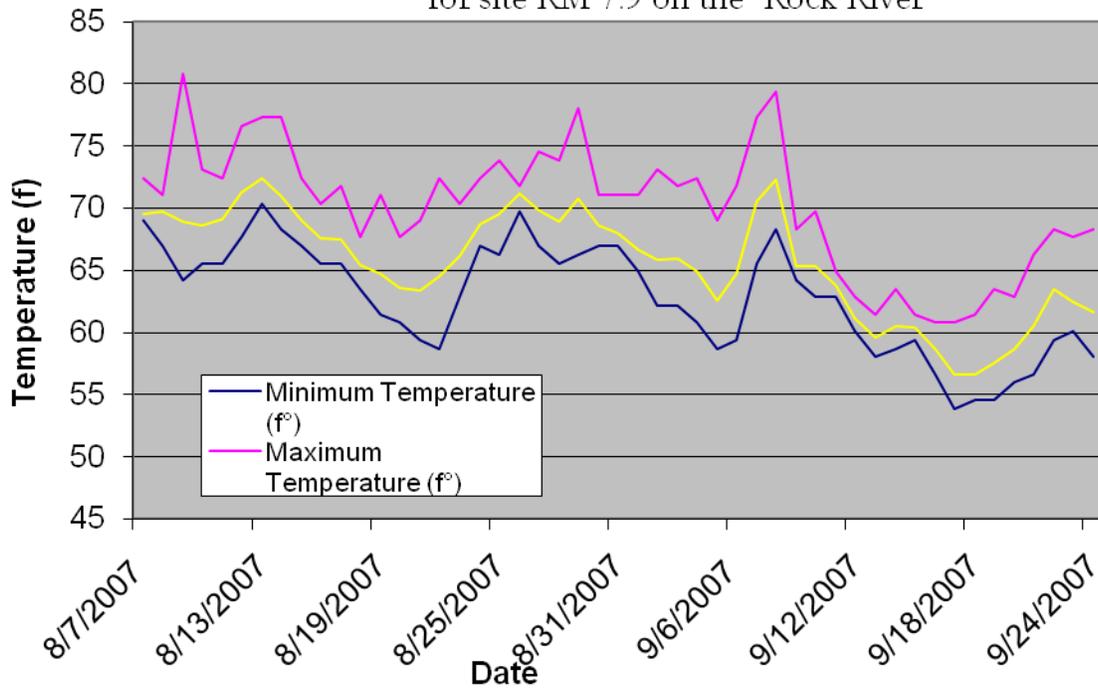


Figure 3. Minimum, Maximum, and mean water temperatures for site RM 7.9 on the Rock River



The above water quality and habitat measures strongly implicate nutrients and temperature as the two primary stressors on the Rock River aquatic life. The percent land use cover within the upper Rock River watershed is presented in table 9. The lower sites found to be most impaired, having the most elevated levels of nutrients, silt, and highest temperatures, are those most dominated by agricultural land use (>50%). The mid and upper sites have progressively less agricultural land use (26-9%) and greater percentages of forested land (66-84%). This suggests that the source of nutrients, silt and to some extent, temperature increases, is likely due to non point agricultural land use.

Table: 9. Land cover watershed percentages are presented below for four stations along the Rock River.

River Mile	Developed	Agriculture	Forest	Wetland	Bare Land	Water	Totals
5.9	4	56	36	5	0	0	100
7.9	4	57	35	4	0	0	100
14.8	2	26	66	6	0	0	100
19	0	9	84	6	0	0	100

Data was calculated using USGS Vermont StreamStats and NOAA C-CAP Great Lakes Land Cover Project (2006)

Biological Assessment – Summary

Biological data from the Rock River indicate that the lower reaches - downstream from river mile 14.9 - are failing to meet Class B WQS. The fish and macroinvertebrate assemblages failed to meet Class B criteria for ALS at site 7.9 for all six assessments from 1999 to 2008. The Fish assessment at RM 5.9, and the macroinvertebrate assessments at RM 9.4 also failed. At site 14.8 and 14.9 the early assessments in 1999 and 2000 also failed to meet Class B WQS for aquatic life use. The last three macroinvertebrate assessments from 2004 to 2008, and fish assessment in 2007 show this reach is supporting Class B WQS for aquatic life use. The upper most reach 19.0 has consistently met Class B aquatic life use for all three macroinvertebrate assessments 1999 to 2008. The fish community assessments at this upper site are inconclusive.

The taxonomic and functional structure of both fish and macroinvertebrates indicated excessive nutrient enrichment. Temperature stress was evident for the macroinvertebrate community at the impaired lower reaches sites 5.9 to 9.4. At site 14.8 and 14.9 these same stressors were evident in the community structure and function through the year 2000. The latter assessments from 2004-2008 show a lessening of nutrient enrichment stress, while a moderate temperature stress is still indicated at this mid stream sites.