

Aquatic Life Use Attainment Assessment update 2010-13 of Moon Brook Watershed

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Introduction

This document presents the results of biological assessments completed in Moon and Mussey brooks during 2010, 2012 and 2013. No sampling was conducted in 2011. A more detailed description of Moon and Mussey brooks and the biological assessments conducted prior to 2010 is presented in the 2010 ALU (Aquatic Life Use) Assessment (VTDEC 2010). Chemical data from these waters generated by the Department and La Rosa Program volunteers may be accessed through VTDEC (unpublished data).

Moon Brook is designated as impaired on the 2008 Vermont 303(d) List from its mouth at Otter Creek to a point upstream 2.9 miles due to non-support of aquatic life designated uses. The entire Moon Brook watershed is considered to contribute to its impairment, so all tributaries that enter within the listed reach are included in this designation. The source of the impairment comes from multiple impacts associated with excess stormwater runoff. Also contributing to current conditions are two on-stream ponds that have an effect of increasing summer water temperatures and blocking organism passage. Figure 1 shows sites of fish and macroinvertebrate assessments sampled since 1986. Table 1 gives site location, and a description of sites sampled between 2010 and 2013.

For macroinvertebrate and fish assessments, *Poor* and *Fair* ratings indicate an unacceptable level of degradation and therefore non-compliance with Class B Vermont Water Quality Standards (VWQS) – ALU. Appendix 1 provides biological metric abbreviations and relationships of biological measures to the VWQS ALUs.

Macroinvertebrate Community Assessments

Moon Brook: Five stream sites have been assessed for macroinvertebrate community health on Moon Brook. Four (RM 3.3, 1.5, 1.1 and 0.9) were considered riffle, small high gradient SHG habitat type and one (RM 0.1) a low gradient habitat.

The uppermost site on Moon Brook, at RM 3.3 above Combination Pond, was rated *Good* in both 2012 and 2013 (Table 2). Assessments here have consistently met Class B biocriteria with *Very Good-Good* ratings for 1988, 1991 and 2005, and *Good* for the 2001 assessment (Table 2). For the 2012 and 2013 samples, lower than expected total taxa and EPT richness or moderately elevated percent Oligochaeta accounted for the slightly lower rating. Order level and functional group composition for all sites are presented in Table 3.

RM 1.5 was the only site sampled for macroinvertebrates between Combination Pond and Route 7 during the period of 2010 to 2013. The previous assessments are *Very Good-Good*, in 2001 and *Fair* in 2004. The 2010 sample showed a recovery from *Fair* to *Good* with total and EPT richness numbers increasing. The Bio Index remained elevated and the functional group composition showed a moderate departure from the SHG stream type expectation, due in part, to the presence of the two on-stream ponds. In 2012 the community declined to a *Fair-Poor* condition with the lowest number of species and EPT taxa recorded since the reach was first sampled in 2001.

Between 2010 and 2013 all four assessments downstream of Route 7 conducted were rated *Fair-Poor* (Tables 2 and 4). RM 1.1 and 0.9 have, in past assessments, been consistently assessed as *Fair-Poor*. Very low EPT richness and high Bio Index values have been below expectations for each sample. In 2012 the macroinvertebrate community at RM 1.1 was also low in abundance. The low gradient RM 0.1 sample was assessed with “best professional judgment” (BPJ) by comparing eight community metrics to eight least-impaired reference-level low gradient streams of similar size and elevation (Table 4). The Moon Brook RM 0.1 community was clearly deficient in all eight metrics except density in 2008.

Table 1. Location description of sites sampled 2010 to 2013 in Moon and Mussey brooks. M- macroinvertebrate, F- fish.

Location	Site (RM)	Community	Gradient, Substrate	Description	Coordinates	Elevation (ft)	DA (Km ²)
Moon Brook	0.1	M, F	Low, Fines	At the mouth of Moon Brook, just above confluence with Otter Creek.	43.59351 72.98563	515	22.0
	0.9	M, F	Mod-High, Coarse	Above Porter Street bridge to Howe Center Industrial Park.	43.59777 72.97444	537	14.0
	1.1	M, F	Mod-High Coarse	Immediately upstream from Strong's Ave.	43.59972 72.97138	535	13.8
	1.5	M, F	Mod-High, Coarse	Below footbridge in recreation area off B street	43.60000 72.96777	540	13.0
	3.3	M, F	Mod-High, Coarse	Adjacent to old landfill, access from Charter Hill Drive.	43.61611 72.95138	659	3.5
Mussey Brook	0.1	F	Mod-High, Coarse	Upstream from Park St. bridge.	43.59388 72.97972	535	6.3
	0.2	M,F	Low, Fines	Behind & upstream of Children's Achievement Center.	43.59402 72.9765	540	6.2

Figure 1. Location of bioassessment reaches on Moon and Mussey brooks. Sites sampled during 2010-2013 update are marked in orange color in the figure and are asterisked in the table.

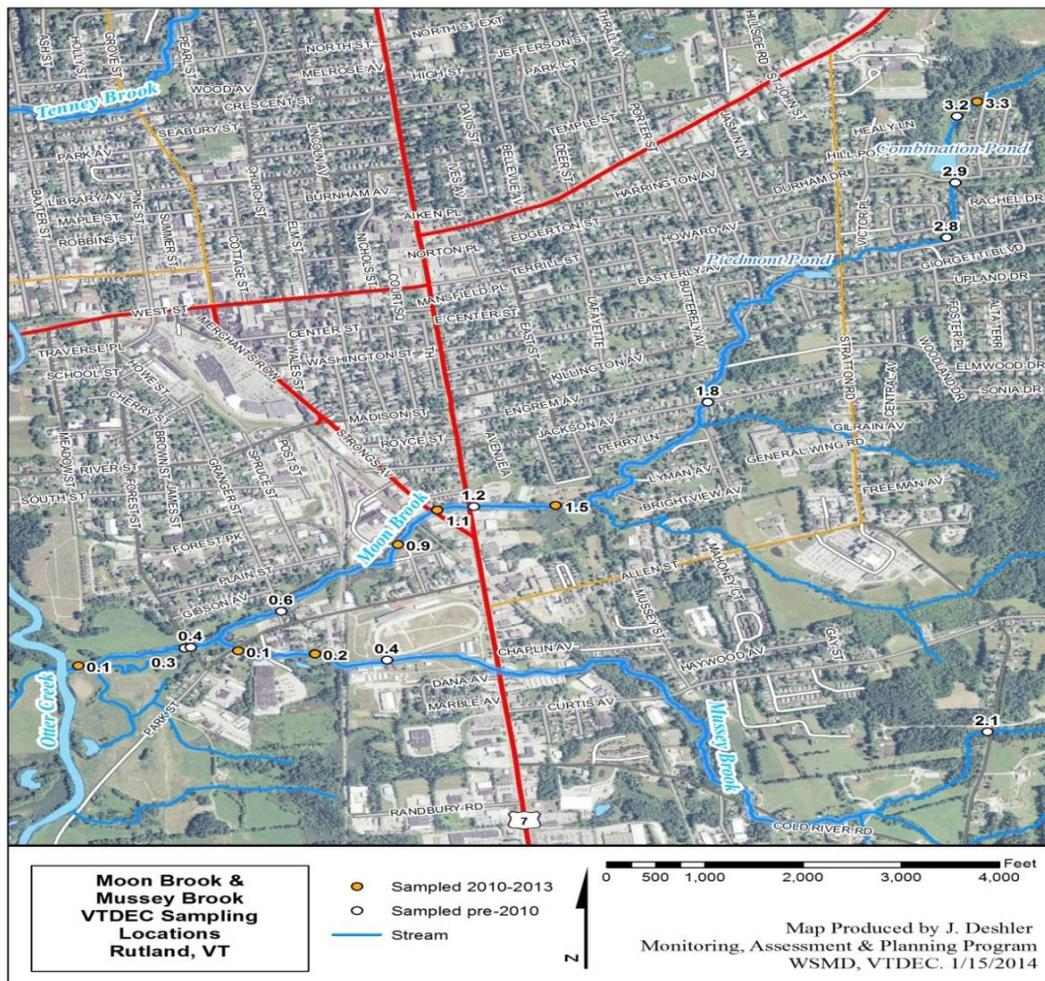


Table 2. Macroinvertebrate Community Metrics from Moon and Mussey Brooks from moderate to high gradient – course bottom stream reaches assessed 1988-2013 using VTDEC SHG stream type biocriteria. Assessments in bold do not meet Class B WQS (ALU).

Stream	Site (River Mile)	Date	Community Assessment	Density	Total Richness	EPT Richness	Percent Model Affinity-Order	Biotic Index	% Oligochaeta	EPT/EPT+ Chironomidae	Pinkham Pearson Coefficient of Similarity-Function	
Moon Brook	0.9	9/1991	Poor	550	35.0	5.0	43	6.00	6.2	0.30	0.48	
		10/2008	Fair-Poor	2412	28.0	11.0	43	6.19	0.3	0.98	0.21	
		10/2013	Fair-Poor	742	40.0	11.0	63	3.87	0.7	0.78	0.29	
	1.1	10/2006	Fair-Poor	1143	33.0	8.0	53	6.40	6.8	0.87	0.62	
		9/2010	Fair-Poor	1864	24.0	10.0	42	5.44	0.0	0.97	0.28	
		10/2012	Fair-Poor	218	26.0	7.0	53	5.14	0.0	0.94	0.39	
	Route 7											
	1.5	10/2001	Very Good-Good	3552	48.0	19.0	62	4.84	0.3	0.79	0.66	
		10/2004	Fair	2608	37.0	10.0	63	4.69	0.5	0.77	0.63	
		9/2010	Good	4932	52.0	20.0	56	4.28	0.2	0.88	0.29	
		10/2012	Fair-Poor	1167	27.0	9.0	54	4.57	0.0	0.85	0.29	
	Combination Pond											
	3.3	10/1988	Very Good-Good	299	42.5	18.0	78	2.55	2.2	0.84	0.59	
		9/1991	Very Good-Good	902	49.5	19.5	65	3.29	1.1	0.62	0.67	
		10/2001	Good	691	38.5	16.5	57	2.14	1.3	0.90	0.45	
9/2005		Very Good-Good	1077	40.0	19.0	58	2.40	5.7	0.95	0.56		
10/2012		Good	592	29.5	16.5	57	2.69	0.2	0.96	0.42		
10/2013		Good	1984	43.0	20.5	52	2.65	7.8	0.94	.047		
Mussey Brook	0.1	10/2012	Poor	711	18.5	3.0	40	5.92	0.0	0.95	0.24	
10/2013		Fair-Poor	1688	32.0	10.0	59	5.29	0.5	0.86	0.28		

Table 3. Percent composition of the macroinvertebrate orders and functional feeding groups from all reaches on Moon and Mussey Brooks.

Stream	Site (RM)	Date	Coleop	Diptera	Ephem	Plecop	Trichop	Oligo	Other	Collector Gatherer %	Collector Filterer %	Predator	Shredder Detrivore	Shredder Herbivore %	Scraper%	
Moon Brook	0.1	10/2008	11	25	29	0	2	6	27	75	7	14	1	1	2	
		10/2012	24	39	<1	0	8	<1	28	21	3	60	6	2	7	
	Low gradient reaches below this point															
	0.9	9/1991	7	56	1	0	20	6	9	45	21	12	5	9	7	
		10/2008	6	4	1	0	88	0	1	2	89	2	0	0	6	
		10/2013	23	28	4	3	37	1	4	11	50	5	2	6	26	
	1.1	10/2006	6	15	1	1	70	7	1	11	69	8	2	3	7	
		9/2010	16	4	<1	1	78	0	<1	2	78	2	<1	2	16	
		10/2012	25	13	<1	<1	56	0	4	3	59	7	3	1	27	
Route 7																
Moon Brook	1.5	10/2001	25	22	3	2	46	0	2	14	43	9	0	3	27	
		10/2004	9	43	0	10	35	0	2	25	41	7	0	15	11	
		9/2010	28	15	3	1	51	<1	2	10	51	5	<1	3	29	
		10/2012	40	14	2	2	41	0	1	8	44	4	2	3	40	
Combination Pond																
Moon Brook	3.3	10/1988	21	23	15	11	26	2	2	26	19	19	5	6	25	
		9/1991	29	32	15	4	18	1	1	30	14	13	4	1	30	
		10/2001	40	10	4	6	37	1	2	8	18	25	5	0	41	
		9/2005	42	5	10	6	29	6	2	16	12	22	5	2	42	
		10/2012	20	7	6	8	57	<1	<1	11	43	14	<1	5	26	
		10/2013	35	6	6	4	39	8	2	18	26	14	1	3	38	
Mussey Brook																
Mussey Brook	0.1	10/2012	5	7	0	0	84	0	4	2	84	1	1	3	9	
		10/2013	4	16	10	1	67	1	1	6	67	4	1.2	6	16	
	0.2	10/2013	4	30	18	0	13	9	26	35	10	37	7	1	9	

Table 4. Macroinvertebrate biometrics from eight least-disturbed sites and Moon and Mussey brooks used to make BPJ assessment of fine bottom sites in Moon and Mussey Brooks. COTE=taxa from orders Coleoptera, Odonata, Trichoptera, and Ephemeroptera. % Tolerant = percent of taxa with Bioindex values ≥ 7 , and # INTOL= taxa with Biotic Index values of less than or equal to 3.0.

Least Disturbed Site	Date	Assessment	Density	Richness	COTE	Bio Index	% TOL	Number of INTOL Species	Oligo %	EPT
Burnt Meadow Brook		Very good	1584	54	30	5.86	31	13	1.0	19
Peach Brook		Excellent	439	50	24	3.11	7	13	4.7	15.5
Brighton Brook		Excellent	613	74	22	5.12	0	12	1.5	14
Seymour Brook		Very Good	3776	50	19	3.87	3	12	0.3	13
Willow Brook		Very Good	1752	41	17	2.56	0	15	0.0	11
Otter Creek Trib # 27		Very Good	1264	42	18	2.70	0	15	0.6	16
Button Brook		Excellent	2264	70	33	3.76	0	33	0.4	26
Sanford Brook		Very Good	2060	49	17	3.42	4	11	0.4	10
MEAN			1719	53.8	22.5	3.80	5.6	15.5	1.1	15.6
Moon Brook RM 0.1	10/2008	Fair	1334	35	14	5.16	27	4	5.8	6
	10/2012	Fair-Poor	281	40	19	4.60	21	3	0.4	5
Mussey Brook RM 0.2	10/2013	Fair-Poor	115	34	12	4.08	15	5	9.6	5

In 2012 the metrics of density, Bio Index, proportion of tolerant organisms, number of intolerant taxa, proportion of oligochaete worms and EPT richness all fell well outside the mean for the eight reference streams, also showing clear degradation. Physical habitat measures taken during biological sampling appears in Appendix 2.

Mussey Brook: The RM 0.1 site was sampled in 2012 and 2013 and assessed using the SHG stream type criteria. The ratings were *Poor* in 2012 and *Fair-Poor* in 2013. This stream section remains low in species richness and EPT richness, the Bio Index is elevated, and the PPCS-f is very low indicating an extreme departure from the expected in functional group composition. The low gradient RM 0.2 site has been sampled only once in 2013 and was assessed in *Fair-Poor* condition using metrics from the eight reference streams for comparison. The 2013 sample showed an extremely low density, COTE richness and number of intolerant taxa. The percent of sample made up of Oligochaete worms was also elevated.

Fish Community Assessments

Moon Brook: The upper-most section (RM 3.3), located immediately above Combination Pond, was evaluated using the Coldwater Index of Biotic Integrity (CWIBI). This index is normally applicable to coldwater stream reaches with small drainage areas with simple fish communities composed of two to four native species. The Mixed Water IBI (MWIBI) is responsive to impacts in both cold and warm running waters supporting five or more fish species. Because the lower hard bottom reaches of Moon Brook, from RM 0.9 to RM 2.9, support an unusually rich diversity of fish species, the (MWIBI) was used to evaluate the community in those reaches below Combination Pond. Both indexes score from 9 (*Very poor*) to 45 (*Excellent*). Neither IBI is normally applied to soft bottomed sites. For purposes of this evaluation the RM 0.1 site was designated as a soft-bottomed, slow flowing reach. As such, “best professional judgment” was employed to assess the fish community there.

The fish assemblage at RM 3.3 was assessed as *Very Good*, *Fair*, and *Excellent* for 2010, 2012, and 2013 respectively (Table 5). Earlier assessments from 2001 and 2005 were *Good* and *Excellent* respectively. The 2012 collection recorded an unusually high number of White Suckers and Creek Chubs which accounted for

the dramatic drop in the assessment to *Fair* in 2012 (Table 7). A breached upstream beaver dam may have accounted for this release of individuals of these two species into downstream sections. To a lesser extent, the same two species influx observed in 2001 followed by complete absence in the 2005 sample could have resulted from the same cause. Although the 2012 assessment was *Fair*, Brook Trout numbers were very high, implying that there was little or no site degradation of conditions during that year. Only a single White Sucker and no Creek Chubs were recorded at this site in 2013 which indicates that these pulses from upstream appear to alter the composition only temporarily. Overall the results of the five assessments of RM 3.3 conducted between 2001 and 2013 show a persistent and fairly healthy Brook Trout population which is intermittently supplemented with White Suckers and Creek Chubs from upstream. As long as Brook Trout remain dominant at that location however, and the other two species remain subdominant or absent, assessments will remain *Very good* to *Excellent*.

Sample site RM 1.5, located between Combination Pond and Route 7, was sampled in 2010 and 2012. The assessments showed improvement in MWIBI values from 29 (*Fair*) and 23 (*Poor*) in 2001 and 2002, to 35 and 31- (both *Good*) in 2010 and 2012 respectively. Increases in the proportion of more specialized feeder species to generalized feeders accounted for the increase in IBI values.

The fish assemblage at RM 0.1 and 0.9 continued to show degraded conditions. MWIBI values at RM 0.9 for 2010 and 2013 were 27 (*Poor*) and 25 (*Fair*) respectively. The four preceding samples taken at this site between 1991 and 2008 showed a similar range of 25-31 (*Poor* to *Fair*). While the number of species was relatively high for a stream of this drainage size and position in the drainage, the community assessed was dominated by tolerant and generalist feeders (represented primarily by Creek Chubs and Blacknose Dace). Cold water species have been very rarely taken at this site; a single Brown Trout in 2004 and two Brook Trout in 1991 were the only two recorded. The remaining species are classified as eurythermal, possessing a wide range of temperature tolerance.

The RM 0.1 site was rated *Fair* in 2012, compared to the only other sample: a *Poor* rating in 2008. Both were rated using BPJ. The relatively high species richness at this site can be explained by its close proximity and accessibility to Otter Creek which would support a wider variety of fish species owing to its larger size. As with RM 0.9, cold water species were very rare; a single longnose sucker was collected in 2012. All other fishes sampled there are classified as eurythermal or warm water. The 2012 community was hyper-dominated by the tolerant generalist feeder, Bluntnose Minnow making up over 60% of the total collected.

Mussey Brook: The RM 0.1 site was sampled in 2012 and for the first time since sampling at this site began, met (albeit narrowly) Class B Water Quality Standards ALU. Prior assessments conducted in 2002, 2004 and 2006 were all *poor*. The higher MWIBI was due to an increase in specialist feeder species and the presence of two coldwater species: slimy sculpin and brown trout. The community was still however deficient in the proportion as top carnivores and number of native intolerant species.

The low gradient soft bottom site at RM 0.2 was sampled only in 2013 and rated a *Fair* using BPJ. The sample was given a low rating despite the site physical habitat being regarded as very good. Total density was very low and the sample was dominated by generalist feeders all of whom are classified as tolerant. There were no cold water species observed at this site.

Table 5. Fish community Mixed Water Index of Biotic Integrity metrics from Moon Brook sites (1986-2013) at Sites RM 0.6, 0.9, 1.5 and 2.8. Cold Water IBI metrics for Site 3.3 and 3.2. Best professional judgment was used to evaluate Sites RM 0.1 and 0.3. Assessments in Bold do not meet Class B WQS (ALU).

Site (RM)	Date	MWIBI ¹ and Assessment	Number of Native Species	Number of Intolerant Species	Number of Benthic Insectivore Species	% White Sucker and Creek Chub	% Generalist Feeders	% Insectivores	% Top Carnivores	% Anomalies	Total Density ² (#/100m ²)
0.1	10/2008	Poor	8	0	1	25	54	46	0	4	4
	10/2012	Fair	15	1	4	10	80	20	0	0	132
0.9	9/1991	29 - Fair	9	1	2	46	58	41	1	0	74
	9/2002	25 - Poor	8	0	1	60	80	20	0	0	19
	10/2004	25 - Poor	7	0	2	46	61	37	2	4	22
	10/2008	31 - Fair	5	0	2	5	15	85	0	0	7
	9/2010	27 - Fair	6	0	2	46	48	52	0	0	21
	10/2013	25 - Poor	9	0	1	34	68	32	0	0	20
Route 7											
1.5	10/2001	29 - Fair	13	1	3	49	78	20	1	0.3	81
	9/2002	23 - Poor	7	1	1	65	78	19	3	0	12
	9/2010	35 - Good	11	1	3	9	24	72	4	0	72
	10/2012	31 - Good	12	1	3	29	57	41	2	0	40
Combination Pond											
		CWIBI ³ and Assessment	Number of Intolerant Species	Proportion of Coldwater Stenotherms	% Generalist Feeders	% Top Carnivores	Brook Trout Density	Brook Trout age classes			Total Density
3.3	10/2001	33 - Good	1	60	40	60	7	3			12
	9/2005	42 - Excellent	1	100	0	100	19	3			19
	9/2010	39 - Very good	1	94	6	94	9	3			10
	10/2012	24 - Fair	1	19	82	19	20	3			107
	10/2013	42 - Excellent	1	96	4	96	9	3			9

1. MWIBI Range: 9-25 (Poor), 27-29 (Fair), 33-35 (Good), 37 (Very Good), 41-45 (Excellent) 2. Calculated as numbers captured during first electrofishing run /100m² 3. CWIBI Range: 9-25 (Poor), 27 (Fair), 33 (Good), 36 (Very Good), 42-45 (Excellent) * No IBI was calculated due to lack of accurate reference for soft bottomed sites

Table 6. Fish community metrics from Mussey Brook site RM 0.1, evaluated using the Mixed Water Index of Biotic Integrity (MWIBI)¹ for RM 0.1 and best professional judgment for RM 0.2.

Site (river mile)	Date	MWIBI and Assessment	Number of Native Species	Number of Intolerant Species	Number of Benthic Insectivore Species	% White Sucker and Creek Chub	% Generalist Feeders	% Insectivores	% Top Carnivores	% Anomalies	Total Density (#/100m ²)
0.1	9/2002	25 - Poor	7	1	2	55	59.	41	0	0	285
	10/2004	27 - Fair	8	1	3	32	36	64	0	4	13
	10/2012	31 - Good	11	1	4	17	62	37	1	0	147
0.2	10/2013	29 - Fair	8	0	2	20	56	44	0	0	15

1. MWIBI Range: 9-25 (Poor), 27-29 (Fair), 33-35 (Good), 37 (Very Good), 41-45 (Excellent)

Table 7. Proportion of sample by fish species for Moon and Mussey brooks 2010-2013.

Site	Date	Brook Trout	Brown Trout	Allegany Pearl Dace	Blacknose Dace	Bluntnose Minnow	Common Shiner	Creek Chub	Fathead Minnow	Cutlips Minnow	Longnose Dace	Redbelly Dace	Longnose Sucker	White Sucker	Brown Bullhead	Banded Killifish	Pumpkin seed	Slimy Sculpin	Tessellated Darter
Moon Brook																			
0.1	10/2012			1	2	60	7	5	1	<1	1		<1	5	<1	1	2		13
0.9	9/2010				31	2		34		3				12					18
	10/2013				17		22	31	3			9		3		2	5		9
1.5	9/2010	4		<1	38		1	18		3	29	1		1					3
	10/2012	2	<1	<1	17		24	14	2	7	15	3		15			<1		<1
3.3	9/2010	94						6											
	10/2012	19						47						35					
	10/2013	96												4					
Mussey Brook																			
0.1	10/2012		<1		19	2	41	12	3	<1	2			4			1	2	12
0.2	10/2013				25	2	20	15	15					5					15

References

VTDEC Unpublished data. An Appendix of water chemistry data for Moon and Mussey brooks between 2010 and 2013. Vermont Department of Environmental Conservation, Watershed Management Division, Montpelier VT.

VTDEC 2010. Aquatic Life Use Attainment Assessment of Moon Brook 2010. Vermont Department of Environmental Conservation, Waterbury VT.

VTDEC 2010. Vermont 2010 303(d) List of Impaired Waters. Vermont Department of Environmental Conservation, Watershed Management Division, Montpelier VT.

Appendix 2. Biological Criteria in Vermont Water Quality Standards

Water quality types from VWQS and associated narrative biocriteria and biological ratings.

	Narrative Criteria for Aquatic Biota	Ratings for Macroinvertebrate and Fish Communities
A 1	Consistent with waters in their natural condition	Excellent
B 1	Minor changes in community from the reference condition	Very Good
B 2-3	Moderate changes in community from the reference condition	Good

Macroinvertebrate criteria for community types and associated water quality Management Types from VWQS.

Metric, Metric Abbreviation and [Range of Values]	Direction of Scoring*	Small High Gradient (SHG)			Moderate High Gradient (MHG)			Warmwater Medium Gradient (WMG)		
		Vermont Water Quality Standards - Water Management Types								
		A1	B1	B, B2-3 A2	A1	B1	B, B2-3 A2	A1	B1	B, B2-3 A2
Richness -Total Taxa Richness [0-∞]	Positive	> 35	> 31	> 27	> 43	> 39	> 30	> 40	> 35	>30
EPT - Ephemeroptera + Plecoptera + Trichoptera Taxa Richness [0-∞]	Positive	> 21	>19	> 16	> 24	> 22	> 18	> 21	> 19	> 16
PMAO - Percent Model Affinity-Insect Orders compared to Reference [0-100]	Positive	>65	> 55	> 45	> 65	> 55	> 45	> 65	> 55	> 45
BI - Biotic Index [0-10]	Negative	< 3.0	< 3.5	< 4.5	< 3.5	< 4.0	<5.0	< 4.25	< 4.75	< 5.40
%Oligo - % of Sample that is Oligochaete Worms [0-100]	Negative	< 2	< 5	< 12	< 2	< 5	< 12	< 2	< 5	< 12
EPT/EPT+C Number of EPT/EPT+ Number of Chironomids [0-1]	Positive	> 0.65	> 0.55	> 0.45	> 0.65	> 0.55	> 0.45	> 0.65	> 0.55	> 0.45
PPCS - Pinkham Pearson Coefficient of Similarity [0-1]	Positive	> 0.50	> 0.45	> 0.40	> 0.50	> 0.45	> 0.40	> 0.50	> 0.45	> 0.40
Density -Numbers of Organisms/meter ²	Positive	>500	>400	>300	>500	>400	>300	>500	>400	>300

Fish community Mixed Water Index of Biotic Integrity (MWIBI) and Cold Water IBI (WIBI) metrics and scoring ranges for associated Water Management Types - VWQS.

9 MWIBI metrics and scoring direction*		6 CWIBI metrics and scoring direction*	
Total number of native fish species	Pos.		.
Number of native intolerant species	Pos.	Number of native intolerant species	Pos.
Number and identity of native benthic insectivores	Pos.		
Proportion of individuals as white suckers and creek chubs	Neg.		
Proportion of individuals as generalist feeders	Neg.	Proportion of individuals as generalist feeders	Neg.
Proportion of individuals as water column and benthic insectivores	Pos.	Proportion of individuals as coldwater stenotherms	Pos.
Proportion of individuals as top carnivores	Pos.	Proportion of individuals as top carnivores	Pos.
Proportion of individuals with deformities, fin erosion, lesions tumors	Neg.	Brook trout density (#s/100 m ² -1 pass)	Pos.
Abundance of Sample	Pos.	Brook trout age class structure	Pos.

Range = 45 (excellent) to 9 (very poor)	A1	B1	B 2-3, A2
IBI score (range 9-45)	41-45	37-39	31-35

* Positive scoring – the higher the value the more that metric is similar to the reference condition. Negative score – opposite.

Appendix 2: Physical Habitat observations from sites on Moon and Mussey brooks sampled 2010-2013.

Station	Date	Silt Rating (1 low-5 high)	% Silt	% Sand	% Gravel	% Coarse Gravel	% Cobble	% Canopy
Moon Brook								
0.9	9/1991		0*	15*	15*	15*	40*	80
	10/2008		0*	30*	25*	25*	15*	90
	10/2013	4	0	3	16	41	34	80
1.1	10/2006	4	0	2	13	8	46	90
	9/2010	3	0	2	13	11	47	80
	10/2012	3	0*	10*	15*	25*	35*	70
1.5	10/2001	3	0	2	19	48	31	50
	10/2004	2	0	2	15	50	31	40
	9/2010	3	0	8	15	27	49	60
	10/2012	3	0	10	11	34	44	80
3.3	10/1988		0*	40*	10*	10*	25*	99
	9/1991		0*	25*	15*	15*	20*	100
	10/2001	2	0	21	37	13	28	100
	9/2005		0*	13*	20*	30*	25*	100
	10/2012	2	0	3	18	55	19	90
	10/2013	1	0	9	22	9	49	60
Mussey Brook								
0.1	10/2006		0*	17*	22*	22*	34*	95
	10/2012	4	0	6	36	19	36	70
	10/2013		0	20	21	49	10	90
0.2	10/2013	4	50*	50*	0*	0*	0*	50