



## State of Vermont

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Department of Environmental Conservation

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September 13, 2005

Mr. Alan Shelvey  
City Engineer  
City of Rutland  
P.O. Box 969  
Rutland, Vermont 05702

Dear Mr. Shelvey,

Please find attached a letter prepared by Steve Fiske and Rich Langdon of my staff in response to your concerns related to the listing of Moon Brook as an impaired stream. Believe me when I say that we are fully cognizant of the ramifications associated with listing streams as impaired. We would not list a stream unless we were confident in our findings. I hope that the rationale provided here is helpful. Above all, it is our intent to move forward with this process in a reasonable manner and to respond to new information in an appropriate way. I hope that our disagreements will not dissuade you from continuing to work with us toward an equitable resolution to the highly complex issues surrounding stormwater management. I hope that you do not feel that we have ignored the information that you have provided – that is far from the case. While not dissuading us from our conclusions, it has given us much to think about as we continue to refine the tools we use to assess biological condition in streams and rivers.

Again, thank-you for your efforts. Please let me know if you have any questions. I can be reached at 802-241-3784 or [doug.burnham@state.vt.us](mailto:doug.burnham@state.vt.us).

Sincerely,

A handwritten signature in black ink, appearing to read "Doug Burnham".

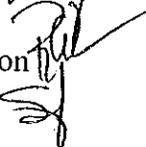
Doug Burnham  
Aquatic Biologist Supervisor



Agency of Natural Resources  
Department of Environmental Conservation

Water Quality Division  
Building 10 North  
802-241-3777

MEMORANDUM

To: Alan Shelvey  
From: Rich Langdon   
Steve Fiske   
Date: September 13, 2005  
Subject: Moon Brook Biologic Condition

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Jim Pease referred your August 2, 2005 letter to us for a response. In that letter you request that the DEC reconsider the current placement of Moon Brook in Rutland on the State 2004 303d list of "impaired waters." We found your request to be well prepared and thoughtful. We appreciate your familiarity with our documentation and your kind words in regards to our efforts. You have correctly identified some very important issues related to the assessment of biological condition in streams and rivers. We would like to present the following discussion for your consideration. In this discussion we hope to address your rationale for the request that Moon Brook be de-listed, as well as to clarify our process of recommending sites for listing under Section 303d. We would specifically like to address your concern that there is no appropriate reference condition describing Moon Brook and consequently no biological standard existing for implementing numeric biological metrics.

Generation of a reference condition

In order to implement numeric biological criteria, the DEC has established biological reference conditions for certain types of streams where adequate biological data were available. As you know, these reference conditions serve as the standard of comparison for streams and rivers of similar type. The type-specific biological reference condition is driven primarily by physical attributes of a stream segment. These are watershed size, substrate type (dictated in large part by gradient), elevation and zoogeographic factors. Numeric biocriteria for the macroinvertebrate community have been developed for three wadeable stream types based on the above for riffle habitat. DEC has identified a fourth stream type, the low-gradient soft bottom stream, but has not yet developed biological criteria. For the fish community, two indexes have been developed for all wadeable stream sections containing a significant portion of hard substrate.

For each stream type, the reference condition of biota is characterized by a range of values of common biological metrics such as species richness, number of intolerant

species, niche function, density, etc. Stream types are biologically differentiated by a characteristic range of values for some metrics. For example, for macroinvertebrates, the criteria for species richness for Class B waters for a *small high gradient stream*, a *medium high gradient stream* and a *warm water medium gradient stream* are: greater than 27, greater than 30, and greater than 30 respectively.

The term "stream type" can be misleading, since many streams can, as they change in gradient and drainage size, have reaches that represent more than one habitat type. Biological composition changes in response to changes in stream habitat. Macroinvertebrates from riffle habitat or hard-bottomed sections of higher gradient will require one reference type while a slower section of different habitat type, located upstream or downstream, requires another.

Numeric biocriteria for *naturally* soft bottomed (sand-silt) low gradient reaches have not yet been developed. For evaluations of communities of low gradient soft-bottomed sections DEC uses "weight-of-evidence" combined with "best professional judgment" in determining compliance with class-specific biological criteria (2004 Vermont Surface Water Assessment Methodology including Vermont Listing Methodology, 5/12/2004). The Methodology states the following: "In the absence of applicable biocriteria, all available information and data are used to make scientifically defensible weight-of-evidence findings that designated aquatic life uses are fully supported." We gather as much information as we have available, put it all together, and try to derive a reasonable conclusion about the biological condition of the site and the causal factors that drive that condition. We rely on our experience of 20 years of biological collections, our knowledge of biological condition gradients as they relate to human disturbance, universal concepts of aquatic biology, and the disturbance tolerance of all aquatic species in order to make these evaluations.

Biological criteria for riffle and hard-bottomed stream reaches were developed by analysis of the VTDEC's extensive database. Ninety-three reference sites were selected from a total of over 1,000 stream sites sampled for macroinvertebrates. This analysis identified four unique stream types based on macroinvertebrate assemblage characteristics - three med-high gradient and one low gradient. Of 617 sites sampled for fish community health, 76 sites were selected to represent the fish reference conditions. This analysis identified two stream types based on fish assemblage characteristics - cold water and mixed water. Macroinvertebrate stream types differ somewhat from the fish stream types.

#### Moon Brook - Macroinvertebrates

All macroinvertebrate samples have been collected from riffle habitats in Moon Brook. The upper reaches of Moon Brook clearly should be assessed using the Small High Gradient macroinvertebrate stream type for a reference. The lower reaches of Moon Brook are difficult to cleanly place into either the Small High Gradient (SHG), or Warm Water Moderate gradient (WWMG) stream type. This is because it is difficult to say at exactly what point along Moon Brook the stream would naturally transition from a SHG type to a WWMG. As such, the assessment of the macroinvertebrate community incorporates a considerable amount of best professional judgment, using the threshold biocriteria for the Warm Water Moderate gradient (WWMG) stream type as guidance. Much of the best professional judgment in this case is based on a developing macroinvertebrate database of other small moderate gradient warm water streams of

moderate to low elevation. This database has advanced to the stage of development where the information is beginning to provide valuable insights into the interpretation of bioassessment data.

Many streams have sections of both high and low gradient. When sampling for macroinvertebrates, the length of stream with appropriate bottom substrate can be short, and influenced by human activity in the drainage. In the case of the Moon Brook assessment site below Forest Street Bridge, the cobble substrate, as you pointed out, is present due to the bridge location. It does, however, create a riffle habitat that should be inhabited by a reasonably diverse macroinvertebrate community. The reach is not isolated from upstream sections, including site RM 1.3 which has supported macroinvertebrate communities of good to very good biological integrity. The important thing is that appropriate substrate is present and water velocities over the substrate are also within an acceptable range (0.4-2.5 ft/sec). On a wider watershed/local level, the Moon Brook site is also capable of being recolonized by species from Otter Creek, Tenney Brook, and Cold River through aerial distribution of adult stages.

With the above in mind, the *EPT richness* (total number of taxa from the orders Ephemeroptera, Plecoptera and Trichoptera) at Moon Brook RM 0.3 is far below (often only 4-5 taxa) what we have seen for EPT richness in both *small high gradient*, and *warm water moderate gradient* stream types throughout Vermont, regardless of size and elevation. Some examples of local small streams in the database referred to above that are very similar to Moon Brook and have four to five times the number of EPT taxa are Smith Pond Brook in Pittsford and Breese Pond outlet in Hubbardton (**Table 1**). Others with similar characteristics (predominantly low-gradient streams in fine soil landscapes with riffle habitat separated by extensive pool habitat) that have met expectations include Thatcher Brook in Waterbury, Ayers Brook in Randolph, Allen and Muddy Brooks in South Burlington, Street Brook in Colchester and lower Tenney Brook in Rutland.

Moon Brook has demonstrated its potential to meet the biological criteria at site 1.3, where classification expectations have been met on at least one occasion. However during stressful years it has not been able to maintain a sufficiently diverse community to attain minimum levels of biological condition required for compliance with Class B criteria. Additional information and knowledge that DEC has factored into the listing of Moon Brook include: a) the dominant taxa present within the lower section of Moon Brook the last several samplings are the tolerant warm water generalists from the family Hydropsychidae - *Cheumatopsyche* sp. and *Hydropsyche betteni*; and b) the order Ephemeroptera, and Plecoptera have been completely absent during some years, including 2004.

The greatest change in the biological community in Moon Brook occurs after the brook passes through the uppermost on-stream pond. By mitigating for the effects of these ponds and implementing other stormwater control measures which the City of Rutland is actively pursuing DEC is confident that the macroinvertebrate community in Moon Brook will respond with numbers of sensitive EPT taxa increasing to an acceptable number.

## Moon Brook - Fish

The approach to assessing fish communities differs from macroinvertebrates. Two Indexes of Biotic Integrity (IBIs) cover all hard bottomed wadeable sites in the state. Each IBI is comprised of several individual metrics. The sum of the individual metric scores makes up the final IBI score. Scoring expectations for some IBI metrics are adjusted by stream segment attributes relating to watershed size and elevation.

While stream gradient determines velocity and to an extent, substrate type, it is the *substrate composition* that has a dominant effect on fish community composition. A predominantly rocky or hard bottom section is required to apply the IBIs currently used by DEC to assess fish assemblages. The main problem with evaluating fish communities is that soft-bottomed stream sections rarely support benthic insectivore species or intolerant species, even in an unimpaired condition. These species are, simply put, rock-loving and are generally not (or rarely) found over sand bottoms in Vermont. These are key IBI metrics in the Mixed Water IBI (MWIBI), and the natural absence of these species could cause an artificially low IBI score.

The biological integrity of the fish community can be accurately characterized in Moon Brook by the use of IBIs at all sites at, and upstream from, river mile (RM) 0.7 (the Porter St. bridge). The substrate composition at RM 0.7 was nearly 60% gravel, cobble, and boulder. Although gradient at that point was low, the bottom was hard. Sites RM 0.7, 1.0, 1.3 and 2.3 can be appropriately assessed using the Mixed Water IBI (for sites potentially supporting more than four native species). The cold water IBI was applied to the upstream-most site (RM 2.7) upstream of the pond at Sharon Drive. This index can be applied to cold water sites that support two to four native species (this site supports three native species).

At sites downstream from RM 0.7, best professional judgment would need to play a role in the ultimate determination of ecological health since it is unclear whether or not this segment is naturally soft bottomed. The possibility that a fairly low gradient naturally hard bottomed segment could have been transformed into a primarily soft bottomed segment by excessive sedimentation is a consideration. The data collected from 1993 for RM 0.3 showed an MWIBI value of 25, corresponding to *poor-fair* condition. Using best professional judgment, the evaluation results in a *fair* determination. Both evaluations (MWIBI and best professional judgment) conclude that the fish assemblages fails to meet the minimum fish-based Class B criteria of *good*. Since this data point is over 10 years old, re-sampling this site would provide an assessment of the current status.

Your assumption that "the stream natural conditions will never produce the required data", we believe, is incorrect. Current and future watershed improvement practices that you listed in your letter is likely to allow for a biological recovery resulting in full compliance with class standards. Efforts to reduce water temperature increases from on-stream ponds could go a long way improving the biological condition of Moon Brook. For example, brook trout could expand their numbers downstream, affecting a significant positive change in IBI scores.

In summary we cannot agree with your argument that there is no applicable reference condition for Moon Brook. In the lower segment (downstream from RM 0.7) a question does arise as to whether to apply biological metrics and indexes (hard bottomed vs. soft bottomed). The macroinvertebrate sample was taken from cobble at RM 0.3 thereby providing reasonable potential for colonization of invertebrates and thereby permitting use, with some best professional judgment, of the WWMG stream type criteria. The fish assemblage at RM 0.3 failed to meet the class B standard using an IBI as well as best professional judgment. This renders the reference condition issue there somewhat moot. Applicable reference conditions for fish and macroinvertebrates exist at all other upstream sites allowing the use of numeric metrics and indexes in assessing compliance with state WQS. Biological data from the adjacent Tenney Brook gives an additional indication of the potential for Moon Brook (Table 2). As we develop modifications to our expectations for small low elevation warm or mixed water streams we will adjust our expectations for lower Moon Brook as appropriate. In the future we will use sites 0.3 (with the application of best professional judgment as appropriate), 0.7 (fish only), 1.3, and 2.6 as primary compliance sites. We will also begin to sample the low gradient reach habitat to give a more complete picture of the biological condition within this more dominant habitat type in lower Moon Brook.

The supplementary analysis which you provided in your letter is of interest to us as we develop our data for very low gradient soft bottom streams. You have clearly put some thought into this and have made some interesting and valid observations. We have carefully considered the information that you provided in formulating this response. While we cannot completely agree with you in regards to Moon Brook, your thoughtful comments have been injected into our "best professional judgment" library for future considerations. We hope that we can continue a dialogue with you regarding these issues.

We hope this addresses your concerns regarding applicable reference condition. We want you to know that listing waters under 303d is a process taken seriously by our staff. Sufficient high quality data are required before we make a confident call of impairment. If we cannot be confident of the assessment of impairment, we do not recommend a site for listing. We are confident that Moon Brook is impaired from below the upper on-stream pond to its mouth. We are also confident that if the proposed mitigation activities are completed, Moon Brook's biological integrity will improve to acceptable levels. We will be glad to discuss any other concerns or questions you may have on Moon Brook.

**Table 1.** Comparison of EPT and total macroinvertebrate richness between Moon Brook RM 0.3 and two reference streams of similar type. "\*" denote clear departures from the reference condition.

Selected Metrics	Moon Brook RM 0.3 (mean of 2201 and 2004 data)	Smith Pond Bk.	Breese Pd. Outlet
EPT Richness	7 *	22.0	20.0
Total Richness	29 *	44.0	47.5
Bio-Index	5.40 *	2.79	2.62
% Oligochaeta	4.0	0.5	1.8
EPT/EPT Chiro.	0.80	0.93	0.84
Total Density	1088	1085	1502

**Table 2.** Comparison of selected metrics from of the fish assemblages between adjacent Moon and Teney Brooks in Rutland.

	Moon Brook RM 0.7	Moon Brook RM 1.3	Tenney Brook RM 1.0	Tenney Brook RM 2.6
Total Density (#s/100m <sup>2</sup> )	17.0	50.0	74.9	81.6
Trout Density (#s/100m <sup>2</sup> )	0	0.6	6.2	23.3
Slimy Sculpin Density (#s/100m <sup>2</sup> )	0	0	9.2	31.5
Total Species Richness	mean 6.5	10.0	7.0	5.0
MWIBI	(25) - Poor BPJ- Fair	23, 25 both poor	41, 35 very good, good	43, 39 Excellent, very good

