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by electronic mail

Hello Toby,

Thank you for taking the time, along with Ellen, to meet with Eric Smeltzer and me in mid-June, to discuss the comments delivered on our most recent justifications supporting our nutrient criteria proposal, received May 28th. In the following, I am providing some information that Region 1 and Headquarters may find helpful to assist in approving what we feel is a strong nutrient criteria package. It is our hope that the information provided in the following, along with work that you are doing, should satisfy the technical concerns articulated by your colleagues.

I also wanted to inform you as to the current status of our Water Quality Standards revision process. As I have previously described, adoption of rules in Vermont require several phases:

1. Pre-rulemaking stakeholder outreach;
2. Filing of draft rule with Secretary of State for Interagency Review;
3. Filing of revised draft rule with Secretary of State for Public hearings and comment;
4. Filing of further revised draft rule with Secretary of State for legislative review;
5. Filing of final rule with Secretary of State for publication.

In addition to these steps, EPA will need to approve the package as well. At present, the rule has incurred pre-rulemaking outreach and interagency review, and is in public review presently (step 3). Three hearings are scheduled; 7/29, 8/5, and 8/8, and comment closes 8/15/2014.

Details on the rulemaking process are available at

<https://secure.vermont.gov/SOS/rules/index.php>. I would like to extend an invitation to you and Ellen to participate in any of these according to your interest and convenience. You would be welcome, and if desired, the floor is open for you to present EPA's usual prefacing remarks on the process of standards promulgation and implementation.

With regard to the comments filed 5/28, Vermont's responses are provided in the following, by numbered point:

1. *Is there a way to strengthen the documentation regarding the relationship between macroinvertebrates and primary production? Specifically we need to show the direct deleterious impacts of increased primary production on the macroinvertebrate community.*

VT does not have the data in place to accomplish this request empirically. We have provided literature citations, including very useful ones provided by EPA-OST. We understand and appreciate that Region 1 is conducting additional literature research to show the responsiveness of macroinvertebrate communities to nutrient stresses. We look forward to helping as we can, and will gladly review the results for their applicability to VT's surface water conditions.

2. *Are there other examples of how the macroinvertebrate index has been used to assess water quality impairments and subsequent recovery related to phosphorus (specifically is there an example where a point source was the main sources of phosphorus pollution)?*

There are. One very specific one regards a wastewater treatment facility in Northfield, VT. In EPA's report entitled: "A Primer on Using Biological Assessments to Support Water Quality Management," this specific location is written up in detail. Please reference: http://water.epa.gov/scitech/swguidance/standards/criteria/aqlife/biocriteria/upload/primer_update.pdf, page 50. Please note the listing of surface waters that have been listed or delisted in comment 3.

3. *Can the number of nutrient listings and delistings using the macroinvertebrate biocriteria for assessment purposes be quantified?*

Yes. We are preparing such a list presently, to be delivered under separate cover. The use of macroinvertebrate biocriteria is a foundational component of our assessment and listing process, and many surface waters have been identified as impaired, or removed from the impaired waters list, based upon the use of our biocriteria. These listings include numerous instances where nutrients are a primary or contributing pollutant.

4. *The data in Table 1 tell a nice story of how the macroinvertebrate index is used to assess impacts from phosphorus on aquatic life and water quality. Is it possible to add in chl a data or periphyton data to this table to show a link between primary productivity and the macroinvertebrate community?*

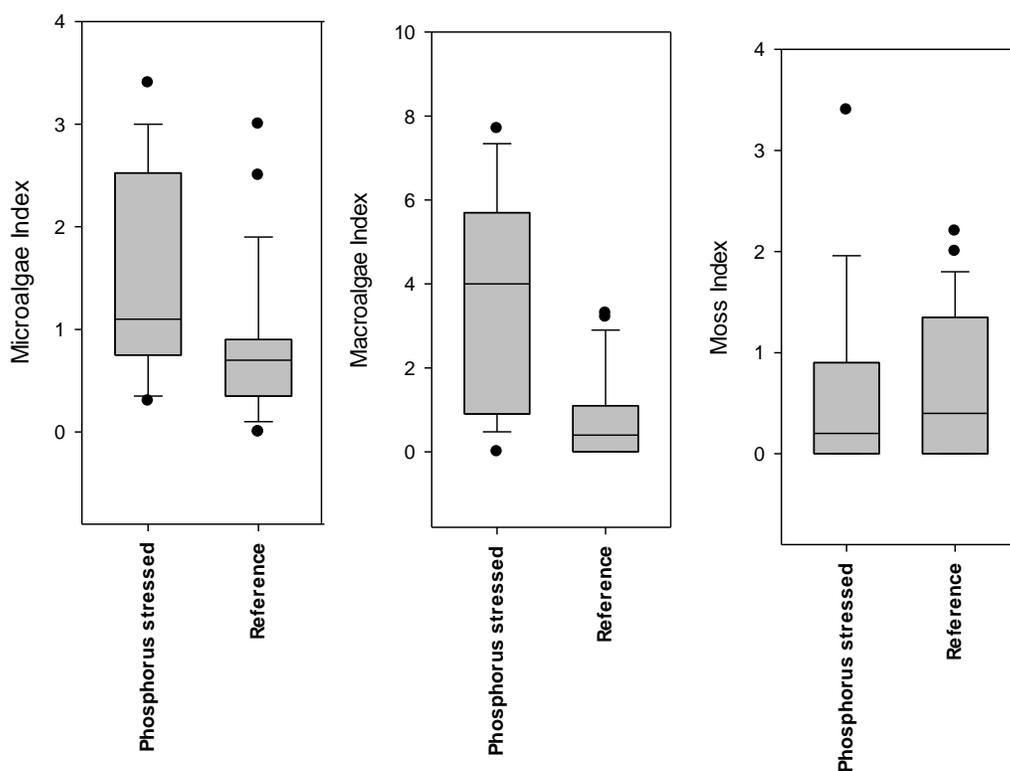
Unfortunately, there are only data available for periphyton biomass for this site from 2009 and 2010 sampling. No pre-sampling data are available, so it is impossible to show the pre-post change. In response to recent EPA guidance on the use of periphyton within nutrient criteria, DEC has begun developing methods for more systematic periphyton chl-a sampling this year, thanks to assistance from Headquarters, Region 1, and Tetra Tech. This is further discussed below.

5. *The plots in Figure 1 show some nice relationships. Is it possible to add chl a data or periphyton data to these plots?*

While no data on chlorophyll-a are available, the following figure presents three indices that summarize semi-quantitative estimates of microalgae, macroalgae, and moss, for a subset of the sites shown by Figure 1. The index values comprise a weighted average of the proportion of incidences of categories of incrementally denser algal cover, as described at the end of these comments. The intent of the index is to emphasize the occurrence of rocks with high percent cover of macroalgae, or thickness of microalgae.

The last pages of this document present the equations for each index and Figure 1 from the Vermont Nutrient Criteria Technical Support Document.

These results show no difference between the phosphorus stressed and reference sites for moss, but do show that the macroalgae and microalgae indices are indeed high when phosphorus and co-incident biometrics are high. This further substantiates the linkage between the occurrence of periphyton in streams, and detectable changes in the macroinvertebrate community. These measurements represent only a subset of $\leq 50\%$ of the sites from which all of the biometrics presented in Figure 1 are available. While this documents a positive response between nutrients and periphyton occurrence, and thus between periphyton and macroinvertebrates, the microalgae and macroalgae indices are weighted averages of semi-quantitative cover estimates, which are not the type of index Vermont would as criteria in Standards. Further, there is no objective basis yet for separating the algal scores themselves into “impaired” vs. “not impaired” sites.



6. *Even though the periphyton analyses that have been completed up to this date did not show a meaningful relationship between periphyton and alteration of the aquatic life designated use, are there any analyses (from VT or from the literature) that show impacts of periphyton growth on the macroinvertebrate community?*

VTDEC has to date been unable to document clear relationships of this type. Accordingly, we are grateful for Region 1's assistance in examining the literature to identify such analyses, and VT will assist in examining the findings for relevance to VT surface waters.

7. *There is some question as to whether it was clearly nutrients causing the impairment. Since the problem seemed to be a leak in a manure pond were there other constituents that were polluting like BOD, DOC, or particulates?*

This comment pre-supposes that nutrients exist in isolation, without co-occurring pollutants. In most real-world situations in Vermont, nutrients are coincident with the other pollutants noted, and others. VTDEC's [Surface Water Management Strategy](#) is founded on the concept of managing stressors that result in the release of mixtures of pollutants. While it is possible for a site to exhibit high BOD loading and low nutrients, that is a rare instance, and not the case at Crystal Brook. With regard to DOC, carbon is not considered a pollutant in VT, though it is regulated in WWTF discharge through effluent limitations on COD. In ambient situations, many waters, particularly the most remote and forested, have naturally high DOC, with accompanying elevated nutrient levels. Further, sediment and phosphorus are strongly linked in northeastern streams that are not effluent dominated, and only in the instance of wastewater or overfertilization do we see high nutrient, low particulate water. In the specific case of the Crystal Brook project, our data indicated a turbidity measurement of 5.3 NTU coincident with TP of 212 $\mu\text{g/L}$. Vermont's water quality criterion for turbidity in Crystal Brook is 10 NTU under low median monthly flow. While we do not have BOD data, the conditions in the stream are not consistent with hi BOD loading. Vermont continues to assert that the repair of the failing manure storage facility addressed a serious nutrient source. Major improvements in biological stream condition resulted from an order-of-magnitude reduction in ambient phosphorus concentration.

8. *This doesn't seem to make it clear that the bugs are reacting faster than a primary productivity indicator would. In the intro there is discussion of the pathways of nutrient response and there it even shows that macroinverts are last in line.*

VTDEC is not trying to prove that macroinvertebrates respond faster. Rather, we present evidence that macroinvertebrates are the most precise assemblage to indicate failure to attain ALUS at high nutrients, based on definitions and procedures specific to VT, as codified in rule based on our Water Quality Standards. In Appendix A of the Technical Support Document, Vermont explains why the temporal variability and inconsistency in periphyton make it a less precise indicator of biological impairment than macroinvertebrates.

An underlying theme VTDEC perceives in this comment is that a change in the periphyton community constitutes an impairment to ALUS. To be clear, determining the magnitude of change in ecological integrity which constitutes impairment for any assemblage is a matter of State policy. Vermont's Water Quality Standards presently define the departure from reference which constitutes impairment to ALUS, based on biological indices approved by the Secretary of ANR. Vermont simply does not yet have the data necessary to determine an allowable departure from reference for periphyton. The bottom line is that even while Vermont's proposed nutrient criteria do not have measures of primary productivity for streams, they are still highly protective of ALUS due to robust macroinvertebrate biocriteria.

Lastly, Vermont is very appreciative of the support being provided by Headquarters to conduct studies of periphyton abundance relative to aesthetic quality in streams. This work sets the stage for Vermont to promulgate additional, periphyton-based metrics within the nutrient criteria during subsequent triennial review cycles.

Periphyton index cover computations:

Moss % Cover
0 (none)
1 < 5%
2 5 to 25%
3 > 25%
Macro Algae % Cover
0 (none)
1 < 5%
2 5 to 25%
3 > 25%
Micro Algae Thickness
0 (none) %
1 (slimy) %
2 (draw line) %
3 (0.5 to 1mm) %
4 (1 to 5mm) %
5 (5 to 20mm) %

The index is calculated as:

Moss Index:

$$\text{ROUND}(\frac{([\text{SubMoss0}\%] * 0 + [\text{SubMoss1}\%] * 2) + [\text{SubMoss2}\%] * 6 + [\text{SubMoss3}\%] * 10}{100}, 1)$$

Macroalgae Index:

$$\text{ROUND}(\frac{([\text{SubMacroAlgae0}\%] * 0 + [\text{SubMacroAlgae1}\%] * 2) + [\text{SubMacroAlgae2}\%] * 6 + [\text{SubMacroAlgae3}\%] * 10}{100}, 1)$$

Microalgae Index:

$$\text{ROUND}(\frac{([\text{SubMicroAlgae0}\%] * 0 + [\text{SubMicroAlgae1}\%] * 0.5) + [\text{SubMicroAlgae2}\%] * 2 + [\text{SubMicroAlgae3}\%] * 4 + [\text{SubMicroAlgae4}\%] * 7 + [\text{SubMicroAlgae5}\%] * 10}{100}, 1)$$

Figure 1 from Appendix A of Vermont's Nutrient Criteria Technical Support Document

