UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
Region 1
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September 15, 2015

Alyssa Schuren, Commissioner
Vermont Department of Environmental Conservation
1 National Life Drive, Main 2
Montpelier, VT 05620-3520

Re: Review and Action on Vermont Water Quality Standards 2014 Triennial Review

Dear Ms. Schuren:

By letter of October 27, 2014, the Vermont Department of Environmental Conservation ("VTDEC") submitted revisions to its Water Quality Standards ("WQS") to Region 1 of the Environmental Protection Agency ("Region" or "EPA") for review. The revisions were certified by the Vermont Attorney General on December 16, 2014 as having been duly adopted pursuant to state law. On April 23, 2015 EPA approved most of the revisions to the human health criteria enumerated in Appendix C of the Vermont Water Quality Standards. The Region has completed its review of the remainder of the revisions to the Water Quality Standards and the results of that review are described below.

We commend VTDEC for adopting many revisions to its water quality standards that strengthen the ability to protect Vermont's waters, such as revisions to the *E. coli* criteria to protect swimming designated uses; the adoption of new chloride criteria and many revisions to toxics criteria; and numeric phosphorus and response variable criteria to protect the designated uses of aquatic life in wadeable streams[1] and aesthetics in lakes and reservoirs[2]. We would also like to thank VTDEC scientists for providing high quality and timely analytical work as questions arose during our review process.

EPA's review of VTDEC's WQS submission was limited to the provisions that are new or revised compared to the 2011 WQS, consistent with the authority provided in Section 303(c)(3) of the Clean Water Act ("CWA"). Pursuant to Section 303(c) (3) of the Clean Water Act and 40 C.F.R. Part 131, I hereby approve the following revisions:

Criteria (40 C.F.R. § 131.11)

- Revisions to the language contained in Vermont's WQS that now reflects the correct rulemaking authority for WQS in Vermont. Previous language that referred to the

[1] Specifically, the criteria apply to three of four wadeable stream types in Vermont (small high-gradient streams, medium high-gradient streams, and warm-water medium-gradient streams).
[2] Specifically, the criteria apply to lakes and reservoirs greater than 20 acres in surface area with a drainage area to surface area ratio less than 500:1, excluding Lake Champlain and Lake Memphremagog.

Natural Resources Board has been replaced by language that references the Agency of Natural Resources as the correct authority.

- Update of the *E. coli* criteria to protect the primary contact recreation designated use of swimming in fresh waters. Vermont's revised bacteria criteria are protective of the designated use and largely reflect EPA's guidance under Section 304(a) of the federal Clean Water Act.
- Adoption of new chloride criteria and revisions to the many toxic substances criteria for the protection of aquatic life. These criteria are located in Appendix C of the WQS and are now consistent with EPA's guidance under Section 304 (a) of the federal Clean Water Act and protective of the uses.
- New numeric criteria for phosphorus in combination with appropriate response variables to protect the designated uses of aesthetics in lakes and reservoirs and aquatic life in medium and high-gradient wadeable streams.

Supporting Discussion of Approvals

Criteria (40 C.F.R. § 131.11)

Revisions to Recreational Bacteria Criteria to Protect Human Health

Vermont's new recreational bacteria criteria consist of a geometric mean ("GM") of samples over a representative period and a statistical threshold value ("STV") not to be exceeded in more than 10 % of the same set of samples. Vermont's geometric mean values are set at EPA's nationally recommended Recreational Water Quality Criteria[3] ("RWQC") levels, and Vermont's STVs are lower (more protective) than EPA's recommendations. Vermont's representative period (duration) for Class B waters that are combined sewer overflow ("CSO")-impacted is set at the EPA- recommended 30 day level, while the duration for all other waters is set at 60 days.[4]

The duration component of the Agency's recommended criterion represents a critical exposure period during which the distribution of fecal indicator bacteria values should provide adequate protection for a population of recreational water users. During this critical exposure period, there should not be numerous events or lengthy periods of time where very high levels of fecal indicator bacteria occur, as this could lead to unacceptably high risk of illnesses. In recommending a 30 day duration the Agency expressed its concern that a very long critical exposure period could allow an excessive number of high exposure events over a shorter term to be "averaged out" over the long-term. EPA considers 30 days, which Vermont has adopted for

[3] http://water.epa.gov/scitech/swguidance/standards/criteria/health/recreation/

[4] Class B waters: *Escherichia coli*- In all Class B waters - Not to exceed a geometric mean of 126 organisms /100ml obtained over a representative period of 60 days, and no more than 10% of samples above 235 organisms/100 ml. In waters receiving combined sewer overflows, the representative period shall be 30 days. The Secretary may, by permit condition, waive compliance with this criterion during all or any portion of the period between October 31 and April 1, provided that a health hazard is not created. The Secretary shall provide written notice to the Vermont Department of Health prior to issuing a permit waiving compliance with the Escherichia coli criterion. Class A waters: Class A(1) as well as A(2) waters: *Escherichia coli* not to exceed a geometric mean of 126 organisms/100ml obtained over a representative period of 60 days, and no more than 10% of samples above 235 organisms/100ml. None attributable to the discharge of wastes.

CSO-impacted waters, to be an optimal duration period to capture both short-term and long-term variability of exposure conditions to protect recreational uses.

Additionally, EPA considers Vermont's adoption of a 60 day duration for those waters not impacted by CSOs to represent an acceptable critical exposure period to protect recreational uses for the following reasons. Field studies used to develop criteria recommendations were conducted over exposure periods of up to 90 days, and a shorter 60 day duration is thus scientifically defensible. Analysis of data from waters that experience short-term variability, or "transient fluctuations," from periodic high concentration releases exhibit very similar criteria attainment assessment outcomes using a 30 day or 90 day assessment period, when both the GM and STV criteria components are evaluated. The small percentage of outcomes where only a 30 day assessment period indicate non-attainment are predominantly the result of a single monthly measurement that lies between the GM and STV over the period of record, and may thus have a low probability of reflecting excessive risk of illness. It is the combination of field study duration and subsequent data analysis that makes 60 days an acceptable duration period in Vermont.

EPA's review of Vermont's revised recreational bacteria criteria is based on whether the criteria are protective of recreational uses including consideration of EPA's nationally recommended RWQC. EPA finds that the revised recreational criteria are scientifically defensible and protective of recreational uses for the reasons explained above and in EPA's 2012 RWQC document.[5]

Revisions to Criteria for Protection of Aquatic Life

Vermont has updated the State's aquatic biota criteria in Appendix C of the Vermont WQS for arsenic, selenium, pentachlorophenol, endrin, benzene hexachloride gamma (lindane), PCBs[6], ammonia and chloride to be consistent with EPA's current nationally recommended water quality criteria ("NRWQC") and has adopted EPA's recently recommended aquatic life criteria for acrolein, aldrin, carbaryl, diazinon, and nonylphenol. In addition, Vermont has updated the equations used for setting hardness-dependent metals criteria (resulting in new aquatic life criteria for cadmium, chromium (III), copper, mercury, nickel, silver, and zinc) and adopted EPA's recommended conversion factors for determining the dissolved fraction from the total recoverable amount for metals.

EPA's review of Vermont's new and revised aquatic life criteria is based on whether the criteria protect aquatic life uses, including consideration of EPA's NRWQC published pursuant to Section 304(a) of the CWA. EPA finds that the revised criteria are scientifically defensible and are protective of designated uses for the reasons explained in the EPA criteria documents for those pollutants.

[5] EPA, *Recreational Water Quality Criteria,* Office of Water, 820-F-12-058.
[6] The revision for PCB criteria is a new Total PCB criterion to replace criteria for individual PCB congeners.

Nutrient Criteria (Phosphorus and Response Variables)[7]

Vermont's new nutrient criteria are based on the "bioconfirmation" or "combined criterion" approach for expressing numeric phosphorus and response criteria to protect the designated uses of aquatic life in medium and high-gradient wadeable streams ("wadeable streams") and aesthetics in lakes and reservoirs other than Lake Champlain and Lake Memphremagog[8]. Vermont's combined criterion approach is supported[9] by EPA guidance on using stressor-response relationships in developing numeric nutrient criteria[10] and the guiding principles that are applicable to water quality standards and are set forth in sections I and II of EPA's 2013 document for integrating causal (in this case phosphorus) and response parameters into a single nutrient criterion.[11] The combined criterion approach integrates both causal (phosphorus) and response (biological and chemical) variables into a single water quality criterion. The combined criteria can be satisfied either by meeting the applicable numeric nutrient concentration values or by meeting all of the applicable nutrient response conditions.

EPA's review of Vermont's nutrient criteria is based on whether they satisfy the major elements of applicability, protectiveness and sound science rationale outlined in the EPA guiding principles for developing combined criteria for nutrients, as explained in the following paragraphs.

Applicability: Vermont is well qualified to use a combined criterion approach, having relied heavily on biological assessments to monitor Vermont waters for more than 20 years. In 2011, Vermont's biological assessment program was rated 3+, with a score of 93.3%, just short of the 95% score required for the highest level of 4. The following statement summarized the Critical Elements Evaluation (CEE):

> The VT DEC bioassessment program is technically very strong resulting in a CEE score of Level 3+. The "+" designation indicates the score is within 3 points of the next higher level, which, in VT's case is Level 4, the highest CEE level. Because of the credibility and accuracy of the VT biological program the agency routinely utilizes environmental response indicators (of both physical and biological condition) in the assessment process.[12]

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[7] Proposed Nutrient Criteria for Vermont's Inland Lakes and Wadeable Streams. Vermont Department of Environmental Conservation, Watershed Management Division. February 21, 2014.

[8] The new criteria adoption does not apply to low-gradient wadeable streams or rivers, which continue to be protected by previously approved narrative criteria. Previously approved numeric total phosphorus criteria continue to apply to Lake Champlain and Lake Memphremagog.

[9] While Vermont does not have an explicit measure of primary productivity, it showed in paired analyses of macroinvertebrate, periphyton and nutrient data that its biotic index and algal index are strongly correlated meaning that the biotic index could serve as an appropriate surrogate measure of primary productivity (see footnotes 10 and 11)

[10] Using Stressor-response Relationships to Derive Numeric Nutrient Criteria. Office of Water, EPA-820-S-10-001. November 2010.

[11] Guiding Principles on an Optional Approach for Developing and Implementing a Numeric Nutrient Criterion that Integrates Causal and Response Parameters. Office of Water, EPA-820-F-13-039. September 2013.

[12] Region 1 Biological Assessment Programs Review: Critical Technical Elements Evaluation (2006-2010). Maine Department of Environmental Protection & Midwest Biodiversity Institute, March 10, 2011, page 28.

The criteria account for variability by including criteria for six different medium to high gradient stream types (combinations of small and medium size; high and medium gradient; and Classes A(1), A(2) and B)) and criteria for three types of lakes and reservoirs (Classes A(1), A(2) and B)).

Protectiveness: The new criteria include protective causal total phosphorus (TP) values for each waterbody class. Wadeable stream values range from 9-27µg/L, which are lower than the applicable EPA recommended Ecoregion VIII reference criteria concentrations of 31.25 µg/L for rivers and streams. The response variables for wadeable streams include pH, turbidity, dissolved oxygen, and aquatic biota, wildlife, and aquatic habitat. All response variable values must be met in order for the wadeable stream to be considered fully supporting of the aquatic life designated use.

Total Phosphorus ("TP") values for lakes and reservoirs range from 12-18 µg/L. The State has also selected appropriate and protective response variables for lakes that include chlorophyll-a values from 2.6-7.0 µg/L, secchi disk values from 2.6-5.0 meters, pH, turbidity, dissolved oxygen, and aquatic biota, wildlife, and aquatic habitat. Again, all response variables must be met in order for a lake or reservoir to be considered fully supporting the aesthetic designated use.

Sound Science Rationale: Vermont used an analysis that is comparable to the EPA-recommended stressor-response approach to deriving nutrient criteria.[13] A statistical approach was used that balances the false positive and false negative sampling error rates in making impairment decisions to account for the inherent variability that is involved in sampling aquatic systems. This approach provides statistical probability that a site will not be determined to be impaired when it is not impaired and vice versa.

Wadeable Streams

For the purposes of deriving criteria to protect the aquatic life designated use in wadeable streams, VT DEC analyzed total phosphorus concentrations in conjunction with the eight disaggregated macroinvertebrate metrics discussed below.[14] The macroinvertebrate metrics also serve as a biological response variable within the combined criterion.

Vermont's expertise in biological sampling and assessment is highlighted by the use of its Macroinvertebrate Bioassessment protocol, which is unique in that each of the eight metrics that make up the Macroinvertebrate Bioassessment protocol must be considered "Full Support" for the assessment to be considered meeting the aquatic life designated use. The Macroinvertebrate Bioassessment protocol consists of the following disaggregated metrics, which are scored

[13] Using Stressor-response Relationships to Derive Numeric Nutrient Criteria. Office of Water, EPA-820-S-10-001. November 2010.

[14] VT DEC also analyzed TP and data on microalgal biofilm thickness as part of the State's pebble count methodology in an effort to develop a measure of primary productivity to support the aesthetics designated use in wadeable streams. VT DEC concluded, however, that the available data were insufficient to support the development of nutrient criteria to protect aesthetic uses in Vermont streams, because there had been no direct assessment (via user survey) of aesthetic impacts on stream users, and there was a relatively weak relationship between nutrients and microalgal biofilm thickness.

individually for assessment of nutrient impacts: density, richness, EPT Index[15], percent model affinity of orders, Hilsenhoff Biotic Index, percent Oligochaeta, EPT/EPT & Chironomidae[16], and the Pinkham-Pearson coefficient of similarity-functional groups. The macroinvertebrate metrics are compared directly to reference condition, which provides measurements of impacts to multiple macroinvertebrate assemblages. Vermont has a scientifically robust sampling program that is combined with valid statistical analyses of all appropriate data. Peer-reviewed scientific literature also provides additional support for the use of macroinvertebrates as a sensitive indicator of nutrient pollution.[17]

Vermont conducted three analyses, in addition to the analyses described in the technical support document for the criteria, using the State's macroinvertebrate, phosphorus, and algal measure data. These analyses demonstrate the effectiveness of the macroinvertebrate metrics in detecting responses to a gradient of phosphorus concentrations and provide the basis for concluding that one of Vermont's macroinvertebrate metrics, the Hilsenhoff Biotic Index metric, can serve as a surrogate for a measure of primary productivity. The first analysis,[18] which compared phosphorus impacted and reference condition sites against each of the individual macroinvertebrate metrics, demonstrated the sensitivity of the macroinvertebrate metrics to a gradient of phosphorus conditions. This analysis also included an example (Crystal Brook, Derby, VT) of how Vermont uses the macroinvertebrate metrics to assess streams and determine impairment or compliance with the aquatic life designated use.

The second analysis[19] focused on the relationship between periphyton and the macroinvertebrate metrics along a phosphorus gradient in Vermont streams from sites where periphyton, macroinvertebrates and phosphorus were all sampled concurrently. This analysis demonstrated that several of the Vermont macroinvertebrate metrics were more strongly associated with phosphorus than the periphyton index. The Hilsenhoff Biotic Index metric was particularly strongly associated with total phosphorus.

The third analysis[20] quantified the strength of the relationship between the periphyton index and the Hilsenhoff Biotic Index, while accounting for the sampling variability for each index. This analysis shows strong correlation between the periphyton index and the Hilsenhoff Biotic Index metric, demonstrating that the Hilsenhoff Biotic Index provides a surrogate measure for primary productivity in these types of Vermont streams.

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[15] EPT Index: EPT Index is comprised of the three environmentally sensitive Orders of aquatic insects Ephemeroptera, Plecoptera and Tricoptera

[16] EPT/EPT & Chironomidaea:Index that compares the three environmentally sensitive Orders of aquatic insects Ephemeroptera, Plecoptera and Tricoptera with the environmentally tolerant family of Chironomidae.

[17] Appendix A. Supplemental documentation providing justification for the use of Vermont's existing macroinvertebrate biocriteria to provide a biological response variable for the application of VTDEC proposed nutrient criteria for Wadeable Streams. VTDEC, May 13, 2014.

[18] Appendix A. Supplemental documentation providing justification for the use of Vermont's existing macroinvertebrate biocriteria to provide a biological response variable for the application of VTDEC proposed nutrient criteria for Wadeable Streams. VT DEC, May 13, 2014.

[19] Memorandum: VTDEC additional analysis of the relationship between periphyton cover and macroinvertebrate metrics for the application of numeric nutrient criteria. VT DEC, April 13, 2015.

[20] Memorandum: VT DEC further additional analysis of the relationship between periphyton cover and macroinvertebrate metrics for the application of numeric criteria. VT DEC, June 5, 2015.

Based on these analyses, EPA finds that Vermont has demonstrated that the State's macroinvertebrate metrics include measures that are at least as sensitive as the algae index in identifying impairment of the aquatic life designated use and that the Hilsenhoff Biotic Index metric can serve as an appropriate surrogate measure for primary productivity in these types of Vermont streams.

Lakes and Reservoirs

For the purpose of deriving criteria to protect the aesthetics designated use in lakes and reservoirs, Vermont DEC used two methods. For Class A(1) waters, Vermont DEC calculated the TP concentrations that should exist in lakes with little or no development or agriculture in their watersheds. For Class A(2) and Class B lakes and reservoirs, Vermont examined the relationships between user perception survey responses and data on total phosphorus concentrations, chlorophyll-a concentrations, and Secchi disk depths, and set criteria values for Class A(2) lakes and reservoirs based on the "excellent or very good" aesthetics standard, and for Class B lakes and reservoirs based on the "good" standard.

EPA finds that the numeric phosphorous values and corresponding biological and chemical response variables are based on sound science and protect the designated uses of aquatic life protection in wadeable streams and aesthetics in lakes and ponds.

Technical and scientific bases for Vermont's new nutrient criteria were described in the State's October 30, 2014 *Nutrient Criteria for Vermont's Inland Lakes and Wadeable Stream Technical Support Document*. While EPA has relied on this document as well as other technical correspondence to support decision making regarding the scientific rationale for the new combined criteria, EPA, in this letter, is not approving or disapproving any element of the implementation approaches discussed in the document since they are not new or revised WQSs.[21] EPA expects that Vermont will implement the new combined criteria in a manner that is consistent with existing implementation requirements that ensure the protectiveness of the CWA, including those applicable to the National Pollutant Discharge Elimination System (NPDES) program in 40 C.F.R. Part 122. Section 122.44(d) of the permitting regulations, and guiding Principle III B[22], which applies to the NPDES program, state that NPDES permits must contain limits for any pollutants or pollutant parameters that are or may be discharged at levels that will cause, have the reasonable potential to cause, or contribute to an excursion above any WQS. (40 CFR 122.44(d) (1)) Under this approach, where reasonable potential exists, permit writers must include limits in permits to achieve the WQS and, in doing so, should develop water quality-based effluent limits based on the numeric nutrient causal parameters.

We look forward to continued cooperation with Vermont in the development, review, and approval of water quality standards pursuant to our responsibilities under the Clean Water Act.

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[21] See *What is a New or Revised Water Quality Standard Under CWA 303(c)(3)? - Frequently Asked Questions*, EPA Publication 820F12017, October 2012.

[22] Guiding Principles on an Optional Approach for Developing and Implementing a Numeric Nutrient Criterion that Integrates Causal and Response Parameters. Office of Water, EPA-820-F-13-039. September 2013.

Please contact Ralph Abele (617-918-1629) if you have any questions.

Sincerely,

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