STATE OF CONNECTICUT
DEPARTMENT OF ENVIRONMENTAL PROTECTION

4 September 2009

Dr. Thomas Armitage
EPA Science Advisory Board (1400F)
U.S. Environmental Protection Agency
1200 Pennsylvania Ave., NW
Washington, DC 20460

Dear Dr. Armitage,

Attached is a statement regarding the SAB Ecological Processes and Effects Committee review of the Draft "Empirical Approaches for Nutrient Criteria Derivation" dated 17 August 2009 for consideration by the Committee.

I thank you for this opportunity to comment.

Sincerely,

Paul E. Stacey
Director of Planning and Standards
Bureau of Water Protection and Land Reuse

Encl. Statement to the SAB EPEC

STATEMENT TO THE EPA SCIENCE ADVISORY BOARD
ECOLOGICAL PROCESSES AND EFFECTS COMMITTEE
Regarding
REVIEW OF EPA DRAFT GUIDANCE DOCUMENT
"EMPIRICAL APPROACHES FOR NUTRIENT CRITERIA DERIVATION"
For consideration at the 9-11 September 2009 Committee Meeting
Washington, DC

Submitted by
Paul E. Stacey, Director
Planning and Standards Division
Bureau of Water Protection and Land Reuse
Connecticut Department of Environmental Protection

I appreciate the opportunity that the EPA Science Advisory Board (SAB) and Ecological Processes and Effects Committee (EPEC) has provided for public input on the review of EPA's draft document "Empirical Approaches for Nutrient Criteria Derivation" ("draft report" henceforth). For over a decade the states have been required to work towards the development of numeric nutrient criteria, which has proven to be a difficult process. A recent EPA Office of Inspector General report (Report No. 09-P-0223, 26 August 2009) has indicated that progress towards that goal has been slow and recommends stronger state accountability to EPA "…for meeting milestones for adopting numeric nutrient water quality standards…" as a primary solution to the lack of progress.

It is my opinion that a rigorous schedule is not the solution to the problem. The solution is a strong and viable scientific underpinning that is currently lacking in both the EPA strategy and guidance. The present approach largely ignores how natural and altered ecosystems relate to nutrient enrichment, failing to distinguish between the natural diversity of condition and acceptable/unacceptable levels of human effect. While EPA's draft report presents an excellent overview of statistical applications that relate nutrient concentrations to selected biological responses, its application to the development of regulatory criteria is misdirected. As such, it creates a scenario where even seemingly good science would lead to ineffective policy upon application.

Therefore, I encourage the EPEC in their peer review process to look beyond the academic acuity of the statistical methodologies presented in the report. The relationship to environmental science and, ultimately, the policy implications of application under the Clean Water Act are of primary importance. The draft report simply does not provide a plausible pathway to criteria development that will lead to effective nutrient management upon implementation. In particular, I raise the following concerns, which I believe have been the primary obstacles towards the development of scientifically credible, and managerially useful, numeric nutrient criteria.

Nutrients are not "threshold" pollutants: Aquatic system responses to nutrients fall along a gradient of effects, commonly referred to as a biocondition gradient (BCG). There is no distinct

point at which a system can be defined as impaired based on a nutrient concentration that makes environmental sense. There is, in fact, a range of nutrient concentrations that occur, even under pristine conditions, which reflect variation in nutrient loading and biological community response. This distribution of condition can be seen in reference waters data EPA used to generate their guidance and is clearly not related to a single nutrient concentration. Attempts at establishing single number criteria for broad geographic areas or water types suggest a commonality of response, assimilative capacity, human effect and biological status that would be futile to replicate throughout a bioregion, state or even a watershed.

Nutrients should not be regulated like toxic chemicals: Although the draft report states that the "…criteria derivation process for the toxic effect of chemical pollutants is not applicable for nutrients…" (p. 1), the outcome of the proposed empirical approaches is essentially the same. Assuming concentrations of nutrients exhibit threshold endpoints for chlorophyll or transparency, even using field data, is no different than relating concentrations of toxic chemicals towards endpoints of fish mortality or growth impairment. In application, it only serves to diminish the diversity of ecosystems, creating a truncated distribution of conditions below an artificial and arbitrary criterion.

Nutrient criteria should not be established based on non-threshold response criteria: As noted, criteria for response parameters such as chlorophyll or invertebrate indices used in the draft report present a situation of creating a threshold response where one does not exist. Setting a stressor threshold in an attempt to effect an arbitrary response threshold simply compounds the arbitrary nature of the relationship.

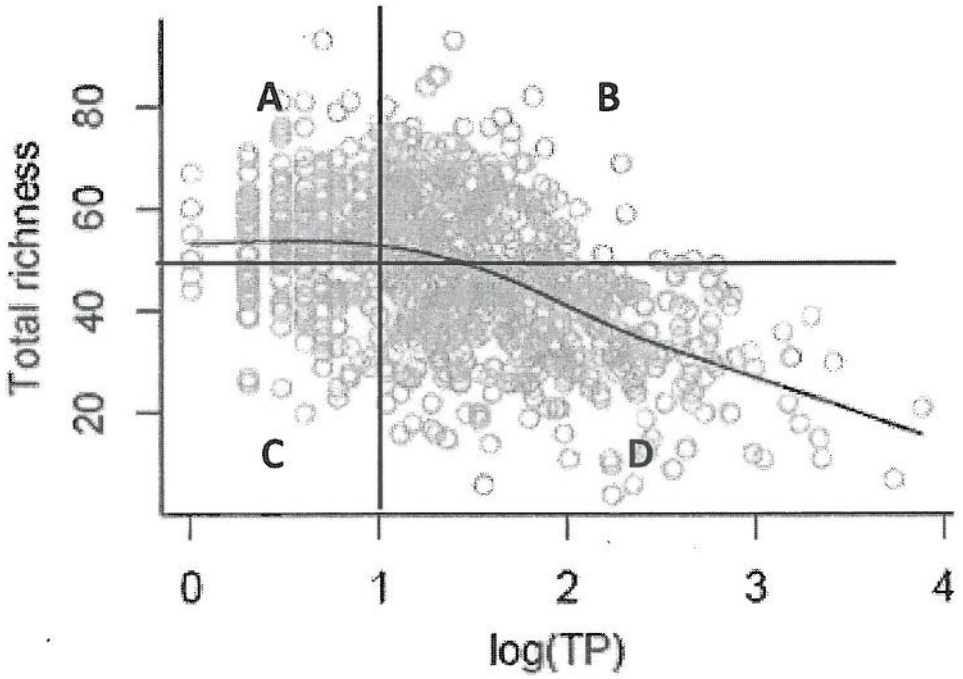
Use of nutrient concentrations as the stressors ignores ecosystem response dynamics: There is an assumption in the draft report analyses that nutrient *concentrations* are a primary driver of biological impairment. Significant interpretive error enters into the process since the dynamic nature of nutrients in living ecosystems is ignored. Instead, static, instantaneous relationships are used to define stressor-response relationship. Consequently, the relationships, as seen in the analyses presented in the draft report, are clearly not sufficient for developing single number criteria. Nutrients cycle and move in and out of biological and physical compartments, rendering the use of total nutrient concentration misleading at best. For example, nutrients may be sequestered in rooted aquatic macrophytes, benthic algae, sediments, or periphyton resulting in underestimates of nutrient dose in whole water samples; they may be sequestered in phytoplankton, which does contribute to whole water nutrient concentrations. Time of year and even time of day can make large differences in nutrient availability, as is reflected in water quality data. Biomass, as represented by chlorophyll-*a* or turbidity levels, reflect both an integration of nutrients over a time period and only a portion of the generated biomass. This use of empirical data confounds any clear stressor-response relationships in the discrete sample arrangements used in the analysis, and the consequent definition of "impairment". It is unlikely that the assumption that time-space substitutions proposed in the draft report do much to ameliorate this problem. It is not surprising that for any given nutrient concentration there is a wide range of response conditions evident in the data in the draft report. In section 5, for example, the discussion and Figures 29, 30 and 31 demonstrate the dilemma this creates since single number criteria attainment cannot ensure attainment of established response goals or designated uses.

Draft report inadequately evaluates non-nutrient stressors and does not provide a viable process for their assessment: The draft report provides one example of a contributing stressor – sediment/substrate condition in streams that affect benthic community. There are dozens of attributes that contribute to upsets of trophic condition of water bodies, especially in flowing waters, that are difficult or impossible to account for using the empirical analytical tools EPA proposes in the draft report. Temperature, shading, extreme flow, toxic chemicals, community structure, stratification regime, watershed character, and land use history are just a few of the chemical, physical and biological attributes that can be reflected in trophic status and biological integrity of waters.

Draft report fails to consider inherent trophic tendencies of water bodies: It is likely that, in addition to the presence of non-nutrient stressors, there are natural attributes of surface waters that define eutrophic condition, assimilative capacity, "best attainable condition" (BAC) and other related response factors. The draft report does not consider the inherent trophic tendencies (ITT) of water bodies in its analysis. In addition to concerns that response criteria are inappropriately set, with subsequent fallout for the numeric nutrient criteria that are derived, it cannot be presumed that management efforts directed by misplaced criteria will have the benefits predicted by general ecoregional or water body type relationships. EPA needs to consider the ITT of lakes that may override the efficacy of nutrient controls. Not all lakes will, or should reflect, or be managed towards, a mesotrophic condition. No attention was paid towards natural succession of streams in the draft report. There is no realistic expectation in the natural world that fourth order streams should be identical to first order streams, even when undisturbed by human effect. If numeric criteria were to be successfully implemented in accordance with EPA guidance, the natural diversity of water bodies would be reduced and an ecological "sameness" imparted to lakes and streams that is statistically, but not ecologically reasonable. There also must be allowances for human presence that has irretrievably altered most ecosystems from effects of watershed uses and climate change to define endpoints in terms of a scientifically-defensible BAC rather than setting goals that may misdirect management efforts.

Numeric criteria based on concentration stressor-response relationships will lead to erroneous management decisions: Nutrients and nutrient-related response variables are not threshold relationships and are confounded by sampling error and unidentified stressors. Therefore, Type I and Type II errors in management application are unavoidable when numeric concentration criteria are used. For example, if the threshold criterion for total phosphorus (TP) of 10 ug/L were applied to Figure 6 (reproduced on the next page) and a vertical line drawn at that point, and a horizontal line at a total richness of 50, Quadrant C would represent the substantial subset of sites where management may be necessary, but not applied and Quadrant B would be those sites where management may not be necessary, but would be applied. Move the criteria lines, and the universe of error changes, but there is no position (criterion) that eliminates error. Even if the criterion represents a good approximation of a desired response, there will still be scatter and error. And this is assuming that TP is the only stressor affecting species richness, which is certainly not the case. While it might be argued that those sites would warrant further investigation, or may have other prevailing factors unrelated to TP, there is no flexibility in the application of nutrient criteria, which are required to be met regardless of cost and outcome. States would be required to implement costly phosphorus controls in Quadrant B situations, and

would be limited in their ability to control TP in Quadrant C situations. This raises concerns about conservative or liberal criteria that would misdirect state management actions at great cost to the environment and society.



Please consider: Misdirection has prevailed in the development of numeric nutrient criteria in the more than 10 years since identified as a priority in the Clean Water Action Plan because of the poor fit to practicable nutrient management efforts. The EPEC has an opportunity to move EPA in a workable direction. A sound, scientific foundation based on rational approaches would more certainly benefit the environment, which is the common goal of the states, EPA and the public. To do otherwise would be wasteful of increasingly scarce management resources and unduly delay environmental improvement. I suggest the EPEC consider:

1. The benefits of using a loading approach instead of the concentration approach that was proposed in the draft report. Loads are directly related to biological response; concentrations can be misleading, especially on a total nutrient basis.
2. How inherent trophic tendencies (ITT) could be incorporated within the analysis to ensure applicability of criteria, including consideration of best attainable conditions (BAC).
3. Use of response variables that are more directly related to nutrients, e.g, plant biomass or productivity responses reflective of ITT and BAC instead of invertebrate response and arbitrary stressor-response goals with unclear relationships.

4. How flexibility can be incorporated into loading criteria to reflect a reasonable range of conditions rather than the single number concentration approach. This will help avoid misdirection of management efforts and waste of scarce management dollars.
5. How to ensure criteria do not truncate natural distributions of trophic condition or impart an ecological homogeneity to waterbodies.

Thank you for the opportunity to comment on this very important matter.

4 Sept 2009

Paul E. Stacey

Date