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Review of Nitrogen & Co-Pollutants Draft Roadmap

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In general, this is a well-thought-out research plan, with enough specifics that make the intent and objectives relatively clear. Some specific comments:

- There is little mention of scientific uncertainty; this is a serious omission. Modeling and assessments of impacts of proposed management actions MUST be accompanied by a defensible quantitative statement of uncertainty. If stakeholders and/or decision makers are considering management actions based in part on modeling/assessment, they must be provided with some measure of the confidence (uncertainty) in the science. For too long and too often, EPA has failed to insist on this requirement for predictive models; as a consequence EPA ORD has tended to stress large elaborate models, such as that described in the section on integrated multimedia modeling, that appear to be motivated by the false assumption that models must be sufficiently detailed so the modelers can "get the processes right." This is an absurd goal that will likely never be achieved. The result of stressing the development of elaborate models is that these models are overparameterized. Among experienced hydrologic modelers, it is well-recognized that many ''sets'' of parameter values will fit large simulation models about equally well; similar predictions can be obtained by simultaneously manipulating several parameter values in concert. This is expected because all models are approximations of actual ecosystem processes, and because all parameters represent aggregate processes (spatially and temporally averaged at some implicit scale) and are unlikely to be represented by a fixed constant across scales. In addition, many mathematical structures impart extreme correlation among model parameters, even when the model is over-determined. This condition, called ''equifinality,'' is well-documented in the hydrologic sciences, but the concept rarely has been discussed in the water quality modeling research literature. I recommend that EPA ORD routinely require development and application of a second model to focus on what an overparameterized model cannot do – uncertainty analysis of model forecasts. This second model will be simpler than the overparameterized deterministic model; simplicity is necessary to facilitate uncertainty analysis. This multiple models approach has been recommended in other situations, such as in the Chesapeake Bay Program, to address the need for uncertainty analysis.
- It is good to see frequent referral to gap analysis; I would like to know how the gap analysis was/is conducted. I think that gap analysis should be considered a "value of information assessment" (VOIA). That is, new monitoring/research should be undertaken if the value (for informing decisions) of the new data/research justifies funding the effort. In general, proposed EPA ORD projects involve good science and good scientists, but that alone does not warrant funding. Funded projects should be restricted to those that provide the greatest information/knowledge gain, given ORD objectives. In many cases, a VOIA can be undertaken using sensitivity analysis.

- "Adequate" is a word that is frequently used in the Draft Roadmap to characterize expectations for new research (e.g., "to determine if approach is adequate"). How can "adequacy" of a research program be rigorously assessed without an uncertainty analysis?
- Research is needed to quantify the connection between a water quality criterion and a designated use; see Reckhow et al. (2005) for a discussion and example of this type of analysis. This will aid in the selection of nutrient criteria. The diagram below (NRC 2001) shows the linkages between a pollutant source and a designated use. We select a water quality criterion as an easily-measurable surrogate for the designated use. The closer the criterion is to the designated use (in the causal chain in the figure) the better the criterion is for assessing water quality standard compliance. The further the criterion from the designated use, the more hidden uncertainty that is present in determining compliance based on the criterion.

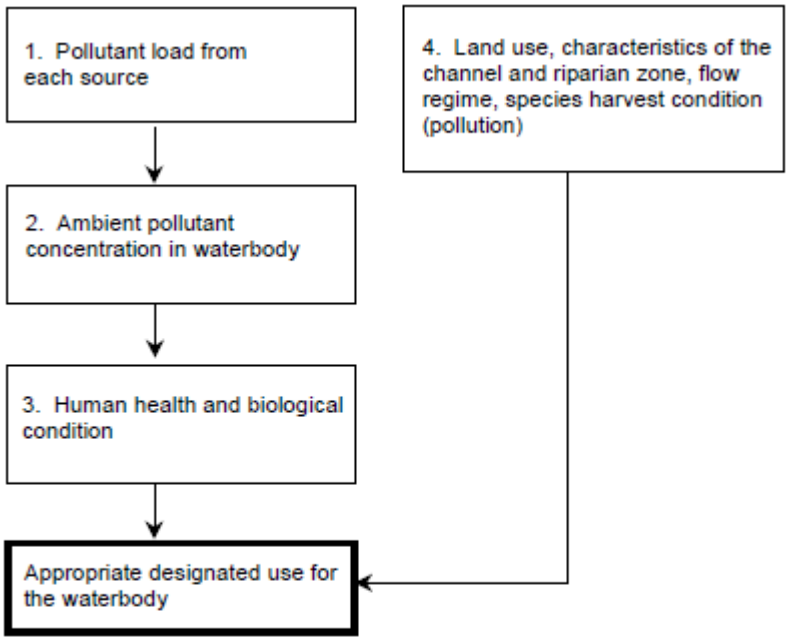

FIGURE 2-1 Types of water quality criteria and their position relative to designated uses.

NRC. 2001. Assessing the TMDL Approach to Water Quality Management. Committee to Assess the Scientific Basis of the Total Maximum Daily Load Approach to Water Pollution Reduction Water Science and Technology Board. Division on Earth and Life Studies. National Research Council.

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