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October 24, 2016

Mr. Andrew Edwards
Bureau of Water
South Carolina Department of Health and Environmental Control
2600 Bull Street
Columbia, South Carolina 29201

Dear Mr. Edwards:

This letter and associated attachments are submitted in response to the Department's proposed updates of water quality criteria that are being considered for revision as part of the triennial review process. NCASI has been an active participant in the technical and scientific aspects of water quality criteria development for many decades. NCASI is offering technical comments on this proposal on behalf of its member companies in the forest products industry. These companies represent more than 90% of the pulp and paper and two-thirds of the wood panels produced nationwide and include the majority of forest products facilities operating in South Carolina.

These comments relate specifically to three aspects of the triennial review: proposed changes to Human Health-based Water Quality Criteria (HHWQC); consideration of stream flow levels that may be treated as water quality criteria; and recreational water quality criteria. NCASI provides scientific and technical information on these topics below and hopes that the Department will give due consideration to this material as it moves forward with the triennial review process. With regard to HHWQC, we recognize that some of the decisions embodied in selection of these criteria are policy choices. However, it is also the case that these choices, and all other aspects of the process used for deriving HHWQC, should be considered in the context of the vast amount of scientific information available that reflects on the contrast between these criteria, their implied health protection targets, and the societal consequences associated with obligations to ensure compliance with these criteria.

Human Health Water Quality Criteria

As you are no doubt aware, recent changes in EPA recommendations concerning the adoption of HHWQC have been quite controversial in a number of states (i.e., Oregon, Washington, Idaho, Maine, and Florida). Many of the matters of scientific debate in these states are relevant in South Carolina. Further, to our knowledge all states that have considered EPA's 2015 national

recommended water quality criteria have chosen or are considering departing from those recommendations in one or more ways. These departures reflect significant efforts on the part of states to carefully consider the basis for the derivation of the criteria recommendations that were updated by EPA in 2015. Such consideration is important because the scientific underpinnings for some parameters used to derive the updated criteria are suspect to a degree that caused some states to reject them and, instead, employ alternative approaches.

Because of the large quantity of scientific and technical information that has been prepared in conjunction with activities related to updating HHWQC, the comments below are arranged by providing summary information on a number of relevant topics followed by references to more complete discussions of these topics contained in documents submitted along with these comments or easily obtainable elsewhere. The topics discussed include:

1. "explicit" and "implicit" parameters in EPA's deterministic equation for deriving HHWQC;
2. the problem of compounded conservatism;
3. whether the level of protectiveness in EPA's HHWQC recommendations is misrepresented by EPA and/or consistent with health protection targets established by South Carolina;
4. using probabilistic methods to mitigate compounded conservatism and develop HHWQC that more specifically match health protection targets established by South Carolina;
5. science considerations for Relative Source Contributions (RSC);
6. science considerations for Bioaccumulation Factors and Bioconcentration Factors (BAFs and BCFs);
7. science considerations for drinking water intake rates;
8. science consideration of the assumption that waters will exist at the HHWQC value 100% of the time; and
9. science considerations for EPA's fish consumption rate value.

HHWQC Comment 1

> **SCDHEC should carefully consider all values for explicit and implicit parameters used to derive HHWQC and report on the appropriateness of these for use in South Carolina.**

EPA's HHWQC are derived using a deterministic equation with parameters that represent (a) substance toxicity; (b) health risk; and (c) an exposure scenario. The exposure scenario embodied in the derivation includes several "explicit" parameters (i.e., for which there are variables in the derivation equation) and several "implicit" parameters which are part of the exposure scenario but which EPA does not include as variables. Explicit and implicit parameters are listed in Table 1.

Table 1. Explicit and Implicit Parameters used by EPA in the Exposure Scenario for Deriving HHWQC

Explicit Parameters	Implicit Parameters
body weight of a person	cooking loss
drinking water intake	duration of exposure
fish ingestion/consumption rate	exposure concentration
substance exposure from other sources	relative bioavailability
bioaccumulation/concentration	

Matters related to the selection of values for each parameter are discussed in detail in a NCASI paper titled *A review of methods for deriving human health-based water quality criteria with consideration of protectiveness* (NCASI 2012). Rather than merely accepting EPA's default values for each parameter, SCDHEC should carefully consider each and make an independent science-based assessment regarding appropriate values for South Carolina. Other states such as Washington and Florida have prepared detailed technical support documents that describe the rationale for decisions related to each of these parameters (FDEP 2016; WDOE 2016).

HHWQC Comment 2

SCDHEC should recognize, carefully consider, and address the problem of "compounded conservatism" that occurs when EPA's deterministic method for criteria derivation is used.

For nearly all explicit and implicit parameters used for the exposure scenario in EPA's equation for deriving HHWQC the Agency selected values that represent upper-end or maximum possible conditions. This practice is known to lead to a condition of compounded conservatism wherein the actual degree of protectiveness in criteria can far exceed the target and stated level of protectiveness. While a greater degree of protectiveness is generally preferred, an excessive level of protectiveness has associated costs (for both government and the regulated community) related to attaining the criteria. Thus, the Department should carefully consider the degree of conservatism embodied in its recommended criteria, the relationship of that degree of conservatism to the health protection targets of the state, and the social and regulatory costs associated with implementation of final criteria.

Science and technical information relevant to the matter of compounded conservatism has been discussed in many venues, including by EPA's Risk Assessment Task Force that suggested that: "when several parameters are assessed, upper-end values and/or central tendency values are generally combined to generate a risk estimate that falls within the higher end of the population risk range" and "an exposure estimate that lies between the 90th percentile and the maximum exposure in the exposed population [should] be constructed by using maximum or near-maximum values for one or more of the most sensitive variables, leaving others at their mean values" (USEPA 2004). Similarly, in the 2005 Cancer Risk Assessment Guidelines (USEPA 2005), EPA stated:

> Overly conservative assumptions, when combined, can lead to unrealistic estimates of risk. This means that when constructing estimates from a series of factors (e.g., emissions, exposure, and unit risk estimates) not all factors should be set to values that maximize exposure, dose, or effect, since this will almost always lead to an estimate that is above the 99th-percentile confidence level and may be of limited use to decision makers.

Other treatments of this general topic have appeared in the peer-reviewed literature. Viscusi et al. (1997) provided a simple example to illustrate compounded conservatism in Superfund exposure assessments that showed that the use of just three conservative default variables (i.e., 95th percentile values) yields a reasonable worst case exposure in the 99.78th percentile. Adding a fourth default variable increases the estimate to the 99.95th percentile value. For comparison, EPA's deterministic method uses eight upper-end or maximum possible values and only two mean values (NCASI 2012).

In a report on the economics of health risk assessment, Lichtenberg (2010) noted that the use of conservative default parameters is intended to deliberately introduce an upward bias into estimates of risk, stating that "the numbers generated by such procedures can't really be thought of as estimates of risk, since they bear only a tenuous relationship to the probability that individuals will experience adverse health consequences or to the expected prevalence of adverse health consequences in the population." Additional treatment of this topic in the peer-reviewed literature can be found in Tatum et al. (2014).

HHWQC Comment 3

> **SCDHEC should consider whether the level of protectiveness in EPA's HHWQC recommendations is misrepresented by EPA and/or consistent with health protection targets established by South Carolina.**

While the selection of health protection targets is a policy choice, its application in the derivation of HHWQC is important to several science-based choices that influence the final criteria values. For example, identification and description of the population(s) associated with a specific health protection target(s) informs science choices related to selections of exposure values among a distribution of exposures. As such and with respect to HHWQC, SCDHEC should provide an explicit explanation of health protection targets and the populations to which these targets apply.

By way of example, the Florida Department of Environmental Protection (FDEP) describes its health protection targets for HHWQC as follows (FDEP 2016):

> The target risk for carcinogens was based on a no greater than one-in-a-million (10^{-6}) incremental excess risk of developing cancer over a life-time (assumed to be 70 years). . . Additionally, the resulting risks associated with calculated criteria were carefully assessed to ensure none of the criteria values produced risks exceeding 10^{-5} (1 in 100,000) at the 90^{th} percentile or 10^{-4} at the extreme upper end of the distribution (e.g., 95th, 99th percentiles).

Describing health risk targets in this way was needed in order to apply appropriate science in the selection of certain variables related to exposure (e.g., fish consumption rates, drinking water intake, body weights). SCDHEC should present a clear depiction of its health risk targets as a component of the HHWQC and should also conduct a quantitative comparison describing how the actual degree of protectiveness of final criteria compare with the health risk targets.

HHWQC Comment 4

SCDHEC should consider using probabilistic methods to derive HHWQC.

Recent advancements in exposure assessment modeling have included the use of probabilistic risk analysis rather than deterministic approaches. EPA's criteria are derived using the older deterministic procedure, and more recent guidance by EPA's Risk Assessment Forum (USEPA 2016) discusses the advantages of probabilistic vs. deterministic analysis. Further, Florida used a probabilistic approach in deriving its HHWQC (FDEP 2016). A whitepaper describing the use of a probabilistic approach for deriving HHWQC is provided with these comments (Anderson and Buonanduci 2014), and it is noteworthy that such a tool to assist in the process of deriving criteria using this methodology is freely available.

The Department should consult these documents and consider the advantages of deriving HHWQC using a probabilistic approach.

HHWQC Comment 5

SCDHEC should consider the science behind the choice of values representing Relative Source Contributions (RSC).

An explicit parameter in EPA's derivation of HHWQC is the relative source contribution, or RSC. The RSC describes the contribution of a contaminant from one or more sources relative to a total exposure from all sources. The Agency's justification for including RSCs in criteria for drinking water and HHWQC is provided in several documents. Related statements from some of these are as follows:

> "To determine the RMCL [Recommended Maximum Contaminant Level], the contribution from other sources of exposure, including air and food, should be taken into account." (USEPA 1985)
>
> "The 1980 AWQC National Guidelines recommended that contributions from non-water sources, namely air and non-fish dietary intake, be subtracted from the Acceptable Daily Intake (ADI), thus reducing the amount of the ADI 'available' for water-related sources of intake." (USEPA 2000)
>
> "EPA emphasizes that the purpose of the RSC is to ensure that the level of a chemical allowed by a criterion or multiple criteria, when combined with other identified sources

> of exposure common to the population of concern, will not result in exposures that exceed the RfD or the POD/UF." (USEPA 2000)
>
> ". . . to ensure that the level of a contaminant in drinking water, when combined with other sources of exposure (e.g. food and air) will not result in a total exposure for an individual that exceeds the reference dose." (USGAO 2011)

Consistent with the above statements, the RSC is a factor multiplied by the reference dose (RfD) for the purpose of apportioning only part of the RfD to, in the case of HHWQC, exposure through consumption of drinking water and fish. This parameter has been discussed as part of HHWQC derivation since 2000 (USEPA 2000), although between 2000 and 2015 a value of 1.0 (i.e., 100% and effectively negating the RSC) was most commonly used when calculating EPA's recommended HHWQC criteria (USEPA 2002). EPA only recently incorporated the RSC for most of the relevant criteria (USEPA 2015) and also applied upper- and lower-bound limits on the RSC, 80% and 20%, respectively.

In a document included with these comments (NCASI 2016a), NCASI provided an analysis of technical matters related to use of RSCs and, especially, the methodology for calculating RSC values. The document describes the relative merit of two approaches for calculating RSC values. The Department should review this document and consider whether and how the RSC value should be employed in criteria derivation. It is noteworthy that Washington considered use of RSC in deriving its HHWQC and elected to apply a value of 1.0 to criteria for which the RSC parameter is used (non-carcinogens) (WDOE 2016).

HHWQC Comment 6

> **SCDHEC should consider the science behind Bioaccumulation Factors and Bioconcentration Factors (BAFs and BCFs).**

An important change in the process used by EPA in updating its recommended HHWQC in 2015 was adopting the use of measured or estimated bioaccumulation factors (BAFs) in lieu of using bioconcentration factors (BCFs) for this purpose.

EPA's process for deriving BAFs for the regulated chemicals is not transparent, and the scientific merit of the BAFs used in the proposal cannot be evaluated based on EPA's supporting documentation. As part of the process of updating HHWQC in 2014, EPA proposed to alter its prior convention of using BCFs to represent bioaccumulation in the criteria derivation equation and instead used modeled BAFs calculated via the EPI Suite software package. In finalizing the HHWQC guidance in 2015, however, EPA apparently departed from strict reliance on the EPI Suite model and chose to select a value representing bioaccumulation (a BAF or a BCF) for each substance using a decision tree published in a 2003 technical document (i.e., USEPA 2003, Figure 3-1). That decision tree and information in the chemical-specific criteria support documents suggest that EPA selected BAFs or BCFs for criteria derivation from either measured or predicted BAFs or BCFs from laboratory or field studies. Numerous science and technical issues with EPA's choices in this regard have been raised since that time. At least one state

(WDOE 2016) has chosen to rely instead on the previously used BCFs for purposes of HHWQC derivation, and another state made adjustments to the BAFs to better reflect state-specific conditions (FDEP 2016).

A considerable body of science exists concerning the accumulation of substances in fish tissue. Notably, it is widely recognized that BAFs and BCFs are influenced by multiple local environmental factors (e.g., food web structure, water temperature, dissolved carbon). Therefore, it is important to understand the basis for EPA's selection of a specific BCF or BAF so that states, the public, and the regulated community may consider the appropriateness of the choice for a particular situation and to allow states to modify the national BCF or BAF such that it better represents state-specific conditions.

Unfortunately, the technical documentation issued with EPA's updated 2015 criteria is wholly insufficient to allow comprehensive technical comment on EPA's selection of BAFs or BCFs, and whether those are appropriate for South Carolina or any other state. This is because EPA has not provided sufficient detail about the origin of the BAF or BCF data upon which the selected value is based, nor has EPA provided the specific procedures and choices it used to derive the BAF or BCF that was ultimately selected for criteria derivation. This lack of transparency in describing the origin of the BAFs and BCFs effectively prohibits substantive comment on the technical merits of EPA's choice of a national recommended value and on the appropriateness of that value in specific states or waterbodies, such as those in South Carolina.

Additional scientific analysis regarding the adequacy of EPA's choice of BAF values used for some of the updated, 2015 recommended HHWQC has been prepared by Anderson et al. (2016) and is included with these comments. The authors also found significant and critical flaws with EPA's approach to assigning BAF values for purposes of HHWQC derivation.

The choice of a BAF or BCF can have a large influence on calculated criteria values. We respectfully suggest that SCDHEC ask EPA to produce a technical document that clearly identifies the specific procedures used to select each BAF or BCF value and that presents the data in a manner such that interested and affected parties can both reproduce EPA's calculations and evaluate them for applicability in state-specific applications.

HHWQC Comment 7

> **SCDHEC should consider the science related to the drinking water intake value used to derive HHWQC.**

Among the parameters used in the exposure scenario embodied in derivation of HHWQC is the amount of water people drink each day. The value used by EPA is 2.4 L/person/day. The Department should recognize that the inherently conservative assumption embodied in this value is that all of this water comes from untreated surface water supplies and is contaminated at the criteria concentrations. Virtually all of the water consumed in the US is sourced either from groundwater or surface water that undergoes some degree of treatment prior to consumption. Such treatment would be expected to remove at least some and probably significant fractions of

many substances for which HHWQC are established. Indeed, public water supplies must meet strict quality limits established by the Safe Drinking Water Act. Given this situation, SCDHEC should evaluate whether the drinking water intake value used by EPA is appropriate for South Carolina and consider whether another value is better suited to the situation in the state.

HHWQC Comment 8

> **SCDHEC should consider the assumption that waters will exist at the HHWQC value 100% of the time.**

An implicit assumption embodied in EPA's recommended HHWQC is that substances for which criteria are derived will exist in streams, rivers, and estuaries at a concentration equal to the criteria 100% of the time for 70 years. The likelihood of this actually occurring for all substances is remote and thus it represents an extreme scenario that contributes to the compounding of conservatism in the derived criteria. Approaches exist to moderate this conservatism, and one such approach has been explored by NCASI. Submitted with these comments is a document titled *Estimation of the degree of conservatism implicit in human health water quality criteria due to not considering fish exposure and oceanic dilution* (NCASI 2016b). The Department should consider the appropriateness of the implicit assumption regarding water column concentrations and the utility of approaches for making a more reasoned decision about these concentrations.

HHWQC Comment 9

> **SCDHEC should conduct its own evaluation of fish consumption patterns in South Carolina rather than relying on EPA's national default value.**

When EPA updated HHWQC in 2015, it revised its approach to estimating fish consumption rates. The revised approach was described in a document titled *Estimated fish consumption rates for the U.S. population and selected subpopulations (NHANES 2003-2010)*. While EPA did invite four outside experts to conduct a peer review of the draft version of the method, the procedure used by EPA is complex and the data and support documentation needed to allow external review have not been made publicly available. The Department should request from EPA all information necessary to allow its analysis to be fully vetted by external scientists. In particular, information should be made available that allows fish species consumption rates to be linked to the habitats those species occupy when harvested. This is necessary not only for purposes of scientific transparency, but also to allow state agencies the opportunity to reconsider certain of these assumptions and thereby develop more state-specific information for purposes of deriving appropriate state water quality criteria.

Development of Flow as Water Quality Criteria

In its November 13, 2015, letter to SCDHEC, EPA Region 4 encouraged the state to consider explicit expression of flow as a water quality standard through either a narrative or a numeric standard. Addressing this request would appear to be a matter of state discretion. If SCDHEC

elects to pursue a flow standard, NCASI offers that its review of approaches to developing flow standards suggests that there is no simple and accurate means for establishing relationships between flow and aquatic system health (even though EPA seems to imply that there are such methods).

Submitted with these comments is NCASI Technical Bulletin No. 961, *A review of the relationship between flow, habitat, and biota in lotic systems and methods for determining instream flow requirements* (NCASI 2009). It examines a number of methods used for establishing flow criteria and considers their regional applicability in five, free-flowing waterbodies in the southeastern US. Among the conclusions from this study is that although all methods have merit provided they are used within their limitations, the relative drawbacks of each method need to be weighed against the complexity of the system examined and the desired goals for the output. Thus the Department is urged to use caution should it decide to pursue revised flow standards and recognize, especially, that site-specific conditions must be considered in development of meaningful flow standards.

Adoption of Recreational Water Quality Criteria

In the same letter referenced above, EPA recommends that SCDHEC consider updating certain fecal indicator bacteria standards for the protection of human health in recreational waters. If SCDHEC adopts EPA's Recreational Water Quality Criteria (RWQC) for *Escherichia coli* (*E. coli*) in freshwater and enterococci in marine waters, consideration should be given to provisions whereby an industry can provide scientifically defensible data demonstrating that non-anthropogenic sources are responsible for elevated levels of these indicator bacteria. For example, *Enterococcus cassiliflavus* is a species of enterococci commonly found in nature that is associated with plant decay. This species is often the predominant species measured in pulp and paper wastewaters where there are no sanitary connections. In addition, a high rate of false positive results has been demonstrated using some indicator test methods when applied to industrial sources. Oregon's Department of Environmental Quality (ODEQ) recently issued its draft RWQC. An accompanying issue paper (Borok 2016) discusses ODEQ's position regarding non-fecal sources, in which it notes the following provision:

> This change acknowledges that certain non-fecal discharges, such as pulp and paper effluent, may contain bacteria that are detected as E. coli or enterococcus, but are not pathogenic and do not indicate the presence of fecal contamination. (Gauthier and Archibald 2001; Degnan 2007; Croteau, et al. 2007). Due to the potential interference of plant-based bacteria in enterococcus tests, it may be difficult for pulp and paper mills to achieve compliance with enterococcus criteria even if the discharge poses little risk to public health due to the lack of pathogenic bacteria in the discharge. The proposed provision will allow flexibility to entities that can demonstrate to DEQ that their discharge does not come from fecal sources. DEQ would require such entities to demonstrate through biochemical species identification techniques that the effluent contains non-fecal based

bacteria species. Once the demonstration is made, DEQ would include appropriate effluent limits in the permit to ensure that public health is protected.

NCASI appreciates the opportunity to provide comments on SCDHEC's triennial review. We would be pleased to meet with the Department to provide further input or clarification related to any of the comments and documents provided.

Respectfully submitted,

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NCASI

Documents Submitted with these Comments

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Documents Submitted with these Comments (continued)

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Borok, A. 2016. *Issue paper: Revisions to the water quality standard for bacteria*. Portland, OR: Oregon Department of Environmental Quality. http://www.deq.state.or.us/eqc/docs/081716eqc/081716ItemI.pdf

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