**Background and Charge for the SAB Review of EPA's *Technical Support Document: National-Scale Mercury Risk Assessment Supporting the Appropriate and Necessary Finding for Coal- and Oil-Fired Electric Generating Units (March 2011)***

**May 23, 2011**

**Background**

On March 16, 2011, EPA proposed National Emission Standards for Hazardous Air Pollutants (NESHAP) for coal- and oil-fired Electric Utility Steam Generating Units (EGUs). The proposed NESHAP would protect air quality and promote public health by reducing emissions from EGUs of the hazardous air pollutants (HAP) listed in Clean Air Act (CAA) section 112(b), including both mercury and non-mercury HAP. Specifically, the proposed rule would require EGUs to decrease emissions of mercury, other metal HAP, organic HAP, and acid gas HAP. Section 112(n)(1) of the CAA requires EPA to determine whether it is "appropriate and necessary" to regulate HAP emissions from EGUs under section 112. Before the Agency is authorized to make the appropriate and necessary determination, section 112(n)(1) requires EPA to perform a study of the hazards to public health reasonably anticipated to occur as a result of HAP emissions, including mercury, from EGUs after imposition of the requirements of the CAA. EPA completed the required study in 1998. (Utility Air Toxics Study, 1998). Based in part on the results of that study , EPA made a finding in December 2000 that it was appropriate and necessary to regulate HAP emissions from coal- and oil-fired EGUs. In the recently proposed NESHAP, EPA confirmed that finding and concluded that it remains appropriate and necessary to regulate HAP emissions from coal- and oil- fired EGUs. EPA confirmed the finding in part by conducting a new analysis of the human health risks posed by consuming freshwater fish containing mercury that is attributable to U.S. EGU emissions of mercury. EPA is seeking peer review of the data and methods used in the national scale mercury risk assessment as documented in the *Technical Support Document: National-Scale Mercury Risk Assessment Supporting the Appropriate and Necessary Finding for Coal and Oil-Fired Electric Generating Units* (hereafter referred to as the "Mercury Risk TSD").

In determining whether U.S. EGUs pose a hazard to public health, we developed an approach for assessing the nature and magnitude of the risk to public health posed by U.S. EGU mercury emissions (the 2005 scenario). We also estimated the health risks associated with US EGU mercury emissions estimated to remain "after imposition of the requirements of the Act" (the 2016 scenario). Specifically, for the 2016 scenario, we looked at certain regulations, including, for example, the proposed Transport Rule, which have a co-benefit impact on mercury. Our approach focused on identifying the number of watersheds where the U.S. EGU contribution to total methylmercury (MeHg) risk is considered to represent a potential public health hazard. To do this, we focused on estimating risk associated with human exposures at those watersheds in the U.S. where we have measured data on fish tissue MeHg concentrations (about 4% of the watersheds, or 2,461 out of ~88,000 U.S. watersheds – see section 2.4 and Appendix B of the Mercury Risk TSD). For each of the 2,461 watersheds, we modeled potential risk from high-end (i.e., subsistence-level) self-caught fish consumption. Specifically, we used the fish tissue MeHg data combined with self-caught fish ingestion rates to model exposure, and then we translated that into estimates of total MeHg-related risk (see sections 1.3, 2.1 and Appendices C and D of the Mercury Risk TSD).

In our analyses, we estimated both total risk associated with emissions from all emissions sources, including global emissions, and the incremental contribution to the total risk that was attributable to mercury emissions from U.S. EGUs. We used an assumption of proportionality between mercury deposition over a watershed and the levels of MeHg in fish (and, by association, the levels of exposure and risk). This proportionality assumption is based on the U.S. EPA Office of Water's Mercury Maps assessment (see section 1.3 and Appendix E of the Mercury Risk TSD). Mercury Maps demonstrated that, under certain conditions, a fractional change in mercury deposition will ultimately translate into a similar fractional change in MeHg levels in fish. We note that the time delay between changes in deposition and changes in MeHg levels in fish is not well characterized (there are a range of assumptions and limitations associated with the Mercury Maps approach which we have considered - see below). Application of the Mercury Maps approach allowed us to translate any changes in mercury deposition to changes in MeHg fish tissue levels. It also allowed us to apportion MeHg levels in fish (and, by association, exposure and risk estimates) based on the proportionality assumption. In other words, if the estimated U.S. EGU-related emissions comprise10% of total deposition over a watershed, assuming near steady-state conditions are met, we would assume that eventually 10% of the MeHg in fish (and, therefore, 10% of the total human exposure and risk) would be attributable to U.S. EGUs.

Mercury deposition modeling was completed for two scenarios: 2005 and 2016. The analysis included consideration of mercury emitted from (a) US EGUs, (b) other non-EGU sources in the U.S. (including natural and anthropogenic), and (c) sources outside of the U.S. (both anthropogenic and natural) whose mercury is deposited in the U.S. following long range atmospheric transport. Estimates of mercury deposition within the U.S., both of total deposition and of EGU-related deposition, were completed using the Community Multiscale Air Quality model (CMAQ) version 4.7.1, which generates estimates at the 12 km grid cell-level of resolution.[1,2] CMAQ modeling reflects mercury oxidation pathways for both the gas and aqueous phases in addition to aqueous phase reduction reactions. Mercury "re-emission" is not explicitly modeled in this version of CMAQ; however, approximations of these emissions are included in the CMAQ model and called "recycled" emissions. Speciation of U.S. EGU mercury emissions is based on a factor approach reflecting coal rank, firing type, boiler/burner type, and post-combustion emissions controls. Emissions of mercury from sources in Canada and Mexico are based on the 2006 Canadian inventory and 1999 Mexican inventory, respectively. Estimates of mercury transported into the U.S. from outside North America (i.e., specification of lateral boundary concentrations, pollutant inflow into the photochemical modeling domain, and initial species concentrations) are provided by a three-dimensional global atmospheric chemistry model, the GEOS-CHEM model (standard version 7-04-11). The GEOS-CHEM predictions

[1] Foley, K.M., Roselle, S.J., Appel, K.W., Bhave, P.V., Pleim, J.E., Otte, T.L., Mathur, R., Sarwar, G., Young, J.O., Gilliam, R.C., Nolte, C.G., Kelly, J.T., Gilliland, A.B., Bash, J.O., 2010. Incremental testing of the Community Multiscale Air Quality (CMAQ) modeling system version 4.7. Geoscientific Model Development 3, 205-226.

[2] Byun, D., Schere, K.L., 2006. Review of the governing equations, computational algorithms, and other components of the models-3 Community Multiscale Air Quality (CMAQ) modeling system. Applied Mechanics Reviews 59, 51-77.

were used to provide one-way dynamic boundary conditions at three-hour intervals and an initial concentration field for the 36 km CMAQ simulations. The 36 km photochemical model simulation is used to supply initial and hourly boundary concentrations to the 12 km domains.[3] Mercury initial and boundary conditions were based on a GEOS-CHEM simulation using a 2000 based global anthropogenic emissions inventory that includes 1,278 Mg/yr of Hg(0), 720 Mg/yr of Hg(II), and 192 Mg/yr of particle bound mercury.[4] The description of emissions and modeling presented above pertains to the 2005 scenario evaluated in the risk assessment. For the 2016 scenario, EPA projected US EGU emissions based on an Integrated Planning Model (IPM) run.[5] Mercury emissions from other U.S. anthropogenic sources are projected to 2016 based on growth factors and known controls (e.g., boilers, cement kilns). The estimates for non-U.S. global emission sources (i.e., both natural and anthropogenic) were not adjusted for the 2016 scenario.

The risk assessment for mercury focuses on two risk metrics: (a) comparison of estimated exposures to the MeHg Reference Dose (MeHg RfD) to determine the hazard quotient (HQ) for each watershed evaluated, and (b) an estimate of the number of IQ points lost to children born to mothers exposed to MeHg during pregnancy (see 1.2 of the Mercury Risk TSD). The current EPA MeHg RfD reflects the full range of potential neurodevelopmental impacts including effects on IQ, educational development, motor skills and attention. For the risk assessment, we did not estimate the incidence of adverse health effects for health endpoints other than IQ loss, as the literature and available data supporting the modeling of IQ loss is considered to be the strongest and has received the most review by the scientific community.

For each of the risk metrics modeled (RfD-based HQ and IQ loss), we identified a benchmark for a potentially significant public health impact to guide interpretation of the risk estimates. For the RfD-based HQ, we considered any exposure above the RfD (equal to an HQ of 1) to represent a potential public health hazard with recognition, as noted above, that the RfD provides coverage for the full range of neruodevelopmental impacts. In the case of IQ loss, we considered a loss of 1 or more points to represent a clear public health concern. This benchmark was based on advice received from the Clean Air Science Advisory Committee (CASAC) in relation to the Pb NAAQS review. It is important to note that CASAC identified this level of IQ loss in the context of a population-level impact (see 1.2 of the Mercury Risk TSD for additional detail on the benchmarks used to help interpret risk metrics).

For the risk assessment, we focused on high-end (subsistence) fish consumption by women of child-bearing age at inland fresh water bodies; the consumption rates used ranged from the 90$^{th}$ to 99$^{th}$ percentiles and were obtained from peer-reviewed studies of fish consumption by specific populations active within the continental U.S. (see section 1.3 and Appendix C of the Mercury Risk TSD). This overall approach reflects our assumption that U.S. EGUs will have the greatest

[3] USEPA, 2010. Air Quality Modeling Technical Support Document: Point Source Sector Rules (EPA-454/R-11-003), Research Triangle Park, North Carolina.
[4] Selin, N.E., Jacob, D.J., Park, R.J., Yantosca, R.M., Strode, S., Jaegle, L., Jaffe, D., 2007. Chemical cycling and deposition of atmospheric mercury: Global constraints from observations. Journal of Geophysical Research-Atmospheres 112.

[5] USEPA, 2010. Air Quality Modeling Technical Support Document: Point Source Sector Rules (EPA-454/R-11-003), Research Triangle Park, North Carolina.

public health impact on the subset of watersheds in the U.S. that (a) have relatively elevated fish tissue MeHg levels (increasing overall risk levels associated with MeHg exposure through fish consumption at those watersheds), (b) have relatively larger mercury deposition from U.S. EGUs (translating into a greater fractional risk associated with U.S. EGUs), and (c) have subsistence-level fishing activity (resulting in higher self-caught fish intake and higher risk). We have not focused on recreational fishing activity. Recreational fishing may be important from a population risk standpoint; however, these fishers consume less fish overall and will not have the levels of individual-risk likely to be experienced by subsistence fishers. Furthermore, we have not considered U.S. EGU impacts on commercial fish from international or near coastal locations. Although MeHg levels can be relatively high in fish from these locations, the U.S. EGU contribution (as a fraction of overall mercury impacts) is both highly uncertain and likely to be low. The high degree of uncertainty associated with linking U.S. EGU deposition to MeHg levels in fish that are either self-caught or commercially harvested near the U.S. shore led us to exclude consideration of risks linked to consumption of these fish. Specifically, given the greater mobility of these fish and the greater dilution of deposited mercury in the ocean and near coastal waters, application of the Mercury Maps approach is subject to significantly greater uncertainty relative to its application to inland fresh water bodies.

The RfD-based risk characterization was done by developing HQs for each watershed. The HQ is defined as the estimate of MeHg exposure divided by the MeHg RfD. Generally (both for methylmercury and for all pollutants) a HQ of 1 or less is considered to represent a level of daily exposure for the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. We developed a 3-stage risk characterization framework to estimate the number of watersheds where the U.S. EGU contribution to total MeHg risk is considered to represent a potential public health hazard based on consideration of the HQ metric:

- Stage 1: estimate the number of watersheds where (a) potential exposure for subsistence level fish consumers exceeds the RfD (e.g., HQ > 1.0), and (b) U.S. EGUs contribute a specific fraction of mercury deposition to those watersheds (and by association, a specific fraction of total exposure and risk). Several fractions of mercury deposition were considered ranging from >5 to >20%.
- Stage 2: estimate the number of watersheds where the deposition from U.S. EGUs would result in exposures to MeHg that exceed the RfD before considering exposures to MeHg attributable to other sources. While we may consider the U.S. EGU increment of exposure, particularly in the context of comparing exposure to the MeHg RfD, it is critical to place the U.S. EGU-incremental exposure in the context of the larger total exposure at a given watershed. This reflects the fact that the MeHg RfD is for total exposure and not increments of exposure considered in isolation.
- Stage 3: estimate the total number of watersheds where populations are at risk from exposures attributable to U.S. EGU mercury emissions by merging the two sets of watersheds identified in stages 1 and 2.

  (see section 1.2 of the Mercury Risk TSD for additional detail on the 3-stage framework)

The second risk characterization was done by modeling potential IQ loss attributable to U.S. EGU emissions resulting in increased MeHg exposure (see section 1.2 of the Mercury Risk

TSD). In modeling IQ loss, we first converted annual-average ingested dose estimates for MeHg into equivalent maternal hair mercury levels, since the CR function for IQ loss is based on estimated exposure characterized as maternal hair mercury levels. This was accomplished using a factor based on a one compartment toxicokinetic model used in deriving the methylmercury RfD. Then a CR function relating hair mercury levels to IQ points lost in children born to mothers whose exposure is modeled in this analysis was used to predict IQ points lost for those children. This CR function is based on application of a Bayesian hierarchical model which integrates data from the three key epidemiological studies (Seychelles, New Zealand and Faroe Islands).

As part of the risk assessment, EPA also addressed both variability and uncertainty. Regarding variability, we assessed the degree to which key sources of variability associated with the scenarios being modeled were reflected in the design of the risk model (see sections 1.4, 2.7 and Appendix F, Table F-1 of the Mercury Risk TSD). Regarding uncertainty we included a number of sensitivity analyses intended to consider the potential impact of key sources of uncertainty (with emphasis on application of the Mercury Maps assumption). We also qualitatively discussed additional sources of uncertainty and the nature and magnitude of their potential impact on risk estimates that were generated (see section 2.7 and Appendix F, Table F-2 of the Mercury Risk TSD).

Figure 1 provides a conceptual diagram for the key steps in the risk assessment.

This peer review is intended to focus on the linkages of the key data inputs, and the critical inputs related to fish consumption rates, dose-response information, and fish MeHg levels. Two key inputs to the risk assessment are the MeHg RfD and the estimates of mercury deposition from CMAQ. We believe the MeHg RfD is the appropriate indicator to use because it reflects the full range of potential neurodevelopmental impacts, including effects on IQ, educational development, motor skills, and attention. We are not requesting that this panel review the scientific basis for the MeHg RfD, rather, this review is focused on the estimation of potential exposures to MeHg for comparison against the existing RfD. The current RfD has been subject to extensive peer review and is the EPA reference value for assessing MeHg ingestion risk.[6] In addition, the CMAQ model has been extensively peer reviewed and the mercury fate and transport algorithms are documented in several peer reviewed publications.[7,8,9] Thus, we are not seeking peer review of the mercury components of the CMAQ model. However, as reflected in the charge questions, we are looking for comment on how CMAQ outputs (i.e., mercury deposition estimates) are integrated into the risk assessment to estimate changes in fish tissue

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[6] U.S. Environmental Protection Agency (U.S. EPA). 2002. Integrated Risk Information System File for Methylmercury. Research and Development, National Center for Environmental Assessment, Washington, DC. This material is available electronically at: http://www.epa.gov/iris/subst/0073.htm.

[7] Bullock, O. R., Jr., et al. (2008), The North American Mercury Model Intercomparison Study (NAMMIS): Study description and model-to-model comparisons, J. Geophys. Res., 113, D17310, doi:10.1029/2008JD009803.

[8] Bullock, O. R., Jr., et al. (2009), An analysis of simulated wet deposition of mercury from the North American Mercury Model Intercomparison Study, J. Geophys. Res., 114, D08301, doi:10.1029/2008JD011224

[9] Pongprueksa, P., et al (2008), Scientific uncertainties in atmospheric mercury models III: Boundary and initial conditions, model grid resolution, and Hg(II) reduction mechanism, Atmospheric Environment 42: 1828–1845

MeHg levels and  in exposures and risks associated with the EGU-related fish tissue MeHg fraction.

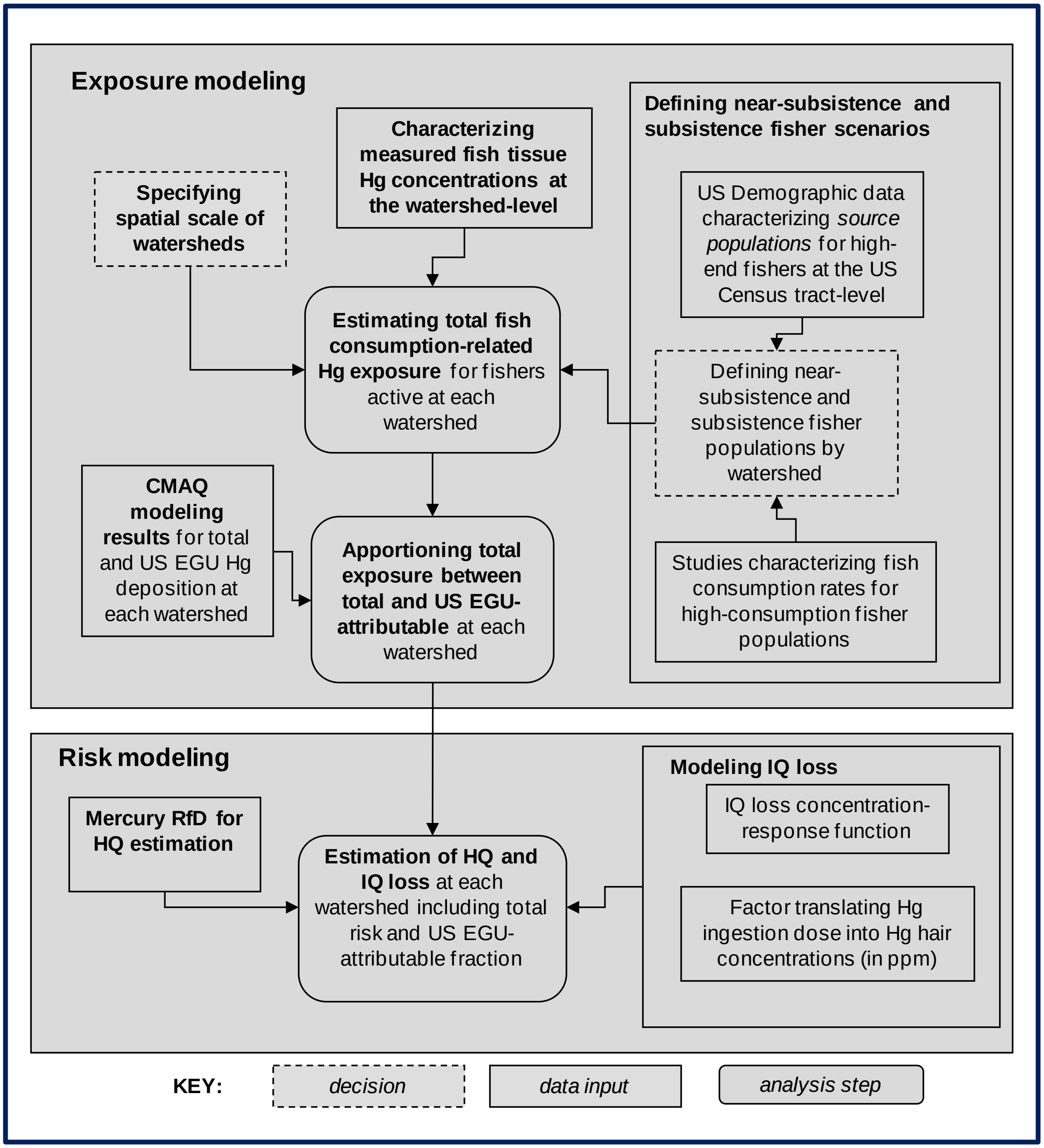


**Figure 1. Flow Diagram of Risk Analysis Including Major Analytical Steps and Associated Modeling Elements** (Note, GEOS-CHEM results are input into CMAQ modeling box)

**Charge Questions**

The charge questions presented below are organized by topic and track specific sections within the Mercury Risk TSD beginning with *Purpose and Scope of the Analysis* (section 1.1). We have included brief overviews of the technical focus of each section to help reviewers place each section in context with regard to the overall risk assessment (Note, we did not include any charge questions addressing elements of the *Executive Summary* since all technical content provided in that introductory section is covered in greater detail in the other sections of the TSD for which we have included charge questions).

<u>Purpose and Scope of the Analysis (section 1.1)</u>

This section presents the policy-related questions that were developed to guide the design of the risk assessment. It also highlights some important technical factors related to air-sourced mercury, in particular, mercury released from U.S. EGUs that were considered in designing the risk assessment. And finally, the section provides an overview of key elements of the scope of the risk assessment.

> *Question 1. Please comment on the scientific credibility of the overall design of the mercury risk assessment as an approach to characterize human health exposure and risk associated with U.S. EGU mercury emissions (with a focus on those more highly exposed).*

<u>Overview of Risk Metrics and the Risk Characterization Framework (section 1.2)</u>

This section describes the risk metrics used in the risk assessment (i.e., IQ loss and MeHg RfD-based HQs, including both total risk and U.S. EGU-attributable risk). The section also presents the 3-stage risk characterization framework which uses these risk metrics to estimate the number of watersheds where populations may be at risk due to MeHg exposure with consideration for the U.S. EGU attributable fraction of that exposure. Questions for this section focus on the IQ calculations. As explained above, we are not asking for peer review of the current mercury RfD or its suitability as a benchmark for comparison with mercury exposures.

> *Question 2. Are there any additional critical health endpoint(s) besides IQ loss which could be quantitatively estimated with a reasonable degree of confidence to supplement the mercury risk assessment (see section 1.2 of the Mercury Risk TSD for an overview of the risk metrics used in the risk assessment)?*

> *Question 3. Please comment on the benchmark used for identifying a potentially significant public health impact in the context of interpreting the IQ loss risk metric (i.e., an IQ loss of 1 to 2 points or more representing a potential public health hazard). Is there any scientifically credible alternate decrement in IQ that should be considered as a benchmark to guide interpretation of the IQ risk estimates (see section 1.2 of the Mercury Risk TSD for additional detail on the benchmark used for interpreting the IQ loss estimates).*

Overview of Analytical Approach (section 1.3)

This section of the Mercury Risk TSD (together with the referenced appendices) provides a detailed overview of the technical design and inputs to the risk assessment, with the section being further divided into subsections (unnumbered) that address each of the design elements. Charge questions presented below which address the design of the risk assessment are grouped by each of these design elements.

Specifying the spatial scale of watersheds (presented within section 1.3)

This section describes the spatial unit used as the basis for the risk assessment (the HUC-12 watershed, representing a fairly refined level of watersheds approximately 5-10 km on a side) and provides the rationale for the decision to use that specific spatial scale and spatial unit in the analysis.

*Question 4: Please comment on the spatial scale used in defining watersheds that formed the basis for risk estimates generated for the analysis (i.e., use of 12-digit hydrologic unit code classification). To what extent do HUC12 watersheds capture the appropriate level of spatial resolution in the relationship between changes in mercury deposition and changes in MeHg fish tissue levels? (see section 1.3 and Appendix A of the Mercury Risk TSD for additional detail on specifying the spatial scale of watersheds used in the analysis).*

Characterizing measured fish tissue Hg concentrations (presented within section 1.3)

This section describes the fish tissue MeHg sampling data used in the risk assessment, including the underlying sources of data used in developing the dataset and factors considered in developing the dataset (e.g., inclusion of data sampled between 2000 and 2009). This section also provides the rationale for using the 75$^{th}$ percentile fish tissue MeHg value (within a given watershed) as the basis for exposure and risk characterization.

*Question 5: Please comment on the extent to which the fish tissue data used as the basis for the risk assessment are appropriate and sufficient given the goals of the analysis. Please comment on the extent to which focusing on data from the period after 1999 increases confidence that the fish tissue data used are more likely to reflect more contemporaneous patterns of mercury deposition and less likely to reflect earlier patterns of mercury deposition. Are there any additional sources of fish tissue MeHg data that would be appropriate for inclusion in the risk assessment?*

*Question 6: Given the stated goal of estimating potential risks to highly exposed populations, please comment on the use of the 75th percentile fish tissue MeHg value (reflecting targeting of larger but not the largest fish for subsistence consumption) as the basis for estimating risk at each watershed. Are there scientifically credible alternatives to use of the 75th percentile in representing potential population exposures at the watershed level?*

Defining subsistence fisher scenarios (presented within section 1.3)

This section describes the high-end self-caught freshwater fish consuming populations evaluated for exposure and risk in the risk assessment. The section includes detailed discussion of the self-caught fish consumption rates used in modeling exposure for these study populations.

*Question 7: Please comment on the extent to which characterization of consumption rates and the potential location for fishing activity for high-end self-caught fish consuming populations modeled in the analysis are supported by the available study data cited in the Mercury Risk TSD. In addition, please comment on the extent to which consumption rates documented in Section 1.3 and in Appendix C of the Mercury Risk TSD provide appropriate representation of high-end fish consumption by the subsistence population scenarios used in modeling exposures and risk. Are there additional data on consumption behavior in subsistence populations active at inland freshwater water bodies within the continental U.S.?*

*Question 8: Please comment on the approach used in the risk assessment of assuming that a high-end fish consuming population could be active at a watershed if the "source population" for that fishing population is associated with that watershed (e.g. at least 25 individuals of that population are present in a U.S .Census tract intersecting that watershed). Please identify any additional alternative approaches for identifying the potential for population exposures in watersheds and the strengths and limitations associated with these alternative approaches (additional detail on how EPA assessed where specific high-consuming fisher populations might be active is provided in section 1.3 and Appendix C of the Mercury Risk TSD).*

Apportioning total MeHg exposure between total and U.S. EGU-attributable exposure (presented within section 1.3)

This section describes the application of the Mercury Maps based proportionality assumption to link changes in mercury deposition (over watersheds) to changes in fish tissue MeHg levels. The section also discusses the use of CMAQ modeling output (i.e., gridded mercury deposition estimates for both total mercury and U.S. EGU-attributable mercury) as part of this process of linking changes in U.S. EGU mercury emissions ultimately, to changes in fish tissue MeHg levels in watersheds assessed for risk in the risk assessment.

*Question 9: Please comment on the draft risk assessment's characterization of the limitations and uncertainty associated with application of the Mercury Maps approach (including the assumption of proportionality between changes in mercury deposition over watersheds and associated changes in fish tissue MeHg levels) in the risk assessment. Please comment on how the output of CMAQ modeling has been integrated into the analysis to estimate changes in fish tissue MeHg levels and in the exposures and risks associated with the EGU-related fish tissue MeHg fraction (e.g., matching of spatial and temporal resolution between CMAQ modeling and HUC12 watersheds). Given the national scale of the analysis, are there recommended alternatives to the Mercury Maps* *approach that could have been used to link modeled estimates of mercury deposition to monitored MeHg fish tissue levels for all the watersheds evaluated? (additional detail on the Mercury Maps approach and its application in the risk assessment is presented in section 1.3 and Appendix E of the Mercury Risk TSD).*

*Question 10: Please comment on the EPA's approach of excluding watersheds with significant non-air loadings of mercury as a method to reduce uncertainty associated with application of the Mercury Maps approach. Are there additional criteria that should be considered in including or excluding watersheds?*

<u>Estimating risk including HQ and IQ loss (presented within section 1.3)</u>

This section describes how exposure estimates generated for the high-end fish consuming populations modeled in the analysis are translated into risk estimates for those populations (in the form of both MeHg RfD-based HQs and IQ losses). This section also includes a detailed discussion of the concentration-response function used in modeling IQ loss.

*Question 11: Please comment on the specification of the concentration-response function used in modeling IQ loss. Please comment on whether EPA, as part of uncertainty characterization, should consider alternative concentration-response functions in addition to the model used in the risk assessment. Please comment on the extent to which available data and methods support a quantitative treatment of the potential masking effect of fish nutrients (e.g. omega-3 fatty acids and selenium) on the adverse neurological effects associated with mercury exposure, including IQ loss. (detail on the concentration-response function used in modeling IQ loss can be found in section 1.3 of the Mercury Risk TSD).*

<u>Discussion of key sources of uncertainty and variability (section 1.4)</u>

This section describes the extent to which the risk assessment design reflects consideration for potentially important sources of variability associated with the type of exposure being modeled. It also discusses sources of uncertainty associated with the analysis, including the nature and potential magnitude of their impact on risk estimates (Note, also that an important part of the analysis – the sensitivity analyses completed primarily to examine the potential impact of uncertainty related to the Mercury Maps approach – are discussed in section 2.7 of the Mercury Risk TSD).

*Question 12: Please comment on the degree to which key sources of uncertainty and variability associated with the risk assessment have been identified and the degree to which they are sufficiently characterized.*

<u>Discussion of analytical results (section 2)</u>

This section presents estimates generated as part of the risk assessment, including important intermediate calculations as well as the risk estimates themselves – subsections include: (a) estimates of mercury deposition over watersheds (section 2.3), (b) characterization of changes in fish tissue MeHg levels based on modeling the impact of changes in mercury deposition (section 2.4) and (c) presentation of MeHg RfD-based HQ estimates and IQ loss risk estimates (section 2.6). Key observations from the analysis are presented in section 2.8.

*Question 13: Please comment on the draft Mercury Risk TSD's discussion of analytical results for each component of the analysis. For each of the components below, please comment on the extent to which EPA's observations are supported by the analytical results presented and whether there is a sufficient characterization of uncertainty, variability, and data limitations, taking into account the models and data used.*

- *Mercury deposition from U.S. EGUs*
- *Fish tissue methyl mercury concentrations*
- *Patterns of Hg deposition with HG fish tissue data*
- *Percentile risk estimates*
- *Number and frequency of watersheds with populations potentially at risk due to U.S. EGU mercury emissions*

*Question 14: Please comment on the degree to which the final summary of key observations in Section 2.8 is supported by the analytical results presented. In addition, please comment on the degree to which the level of confidence and precision in the overall analysis is sufficient to support use of the risk characterization framework described on page 18.*