GEORGIA INDUSTRY ENVIRONMENTAL COALITION
COMMENTS ON THE EPA-PROPOSED MERCURY TMDL FOR THE SAVANNAH RIVER

1) GIEC questions why a TMDL for mercury was done for the Savannah River. EPA has not demonstrated that the Food and Drug Administration's (FDA's) mercury action level of 1 ppm in fish tissue has been exceeded to a degree that human health or the fishing use of the river has been impaired or to the extent that a TMDL analysis is justified. The Savannah River was not initially proposed by the State of Georgia on its 1998 303(d) list. GIEC questions whether it is appropriate to list the Savannah River in 1998 and 2000 since there is insufficient evidence that the Savannah River has been adversely impacted by mercury.

Four segments of the Savannah River appear in the proposed 2000 303(d) list:

- Clarks Hill Lake to Stevens Creek Dam (Columbia County)
- Stevens Creek Dam to US Hwy 78/278 (Columbia / Richmond Counties)
- US Hwy 78/278 to Johnsons Landing (Richmond / Burke / Screven Counties)
- Brier Creek to Tide Gate (Screven / Effingham / Chatham Counties)

Of these listed segments, only a portion of the fourth segment, Brier Creek to Ebenezer Creek, was on Georgia's 303(d) list as initially proposed in February 1998 for water quality criteria violations, including mercury. There is no legal nor technical basis for adding these waters to the 2000 303(d) list, either for fish consumption advisories or for mercury water quality criterion violations, just as there was no basis for adding them to the 1998 303(d) list, as we shall subsequently show. In order to place our position in perspective, we will briefly review the recent history and evolution of the State's 303(d) list.

In its 1998 publication on fish consumption guidelines (GA DNR 1998), the Georgia Department of Natural Resources (DNR) identified five segments of the Savannah River, based on data collected in 1993 and 1996, as having advisories for fish consumption due to mercury in fish tissue:

- Columbia County	Largemouth bass, Spotted sucker
- Richmond / Burke Counties	Largemouth bass
- Effingham County	Largemouth bass, Channel catfish
- Chatham County	Largemouth bass
- Tide Gate	White catfish

These advisories formed the basis of 305(b) listings on Georgia's initially proposed 1998 "List of Waters". All of the listings were for "partial support" of the designated fishing use and were noted as follows:

- Clarks Hill Lake to Stevens Creek Dam
- Stevens Creek Dam to US Hwy 78/278
- US Hwy 78/278 to Butler Creek
- Butler Creek to McBean Creek
- McBean Creek to Screven County Line
- Brier Creek to Ebenezer Creek
- Ebenezer Creek to Tide Gate

The Georgia Environmental Protection Division (EPD) of the DNR first proposed its 1998 List of Waters on February 26, 1998. Only one of the above segments was included on Georgia's initially proposed 1998 303(d) list (Brier Creek to Ebenezer Creek – this segment was designated with an "X" in the 303(d) column. However, there is some data, although of questionable validity, indicating water quality criteria exceedances of lead, mercury and zinc in this segment, which may have formed the basis of the listing alone, rather than the fish consumption guidance).

It is imperative to point out that these segments were NOT included on Georgia's initially proposed 1998 303(d) list due to mercury fish consumption advisories. Only those segments listed with an "X" in the 303(d) column of this proposed 1998 combined 305(b), 303(d), 314, and 319 list are 303(d) listed waters, as the letter that transmits it to EPA Region 4 clearly states.

The segments of the Savannah River from Clarks Hill Lake to Stevens Creek Dam and Stevens Creek Dam to US Hwy 78/278 had designations of "3" in the 303(d) column. This designation indicated a water body for which EPA Region 4 established a TMDL in 1997. These TMDLs were for dissolved oxygen caused by a dam release. The segments from US Hwy 78/278 to Butler Creek, Butler Creek to McBean Creek, McBean Creek to Screven County Line, and Ebenezer Creek to the Tide Gate, all had designations of "2" in the 303(d) column. This designation indicated "expected to meet" segments, where ongoing actions leading to attainment of water quality standards had been implemented. In the transmittal letter for this 1998 Georgia list of waters, dated February 26, 1998, Georgia states that stream segments coded with a "2", "while listed on the 305(b) list, were not identified as active segments for the 303(d) list consideration *in accordance with US EPA guidance* [emphasis added] as actions are ongoing which will resolve the issues".

According to the transmittal letter, the 303(d) portion of the list was prepared using guidance provided by US EPA; specifically, the August 13, 1992 and November 26, 1993 memoranda from Geoffrey H. Grubbs (Washington – Office of Water) entitled "Supplemental Guidance on Section 303(d) Implementation" and "Guidance for 1994 Section 303(d) Lists". The excerpted page from the 1998 303(d) list that contains these segments, prefaced by the letter dated February 26, 1998 from Mr. Alan Hallum to Mr. Robert F. McGhee, which transmitted this list from the EPD to EPA Region 4, is attached as part of Appendix A.

As a result of the public notice, only two sets of comments were apparently received, neither of which impacted on these segments.

The first placement of a water body on Georgia's Section 303(d) list for fish consumption advisories occurred in 1998. On April 1, 1998, after receiving public comment, the State of Georgia formally transmitted a revised List of Waters to EPA. In this version, five of the segments of the Savannah not 303(d) listed in EPD's February proposal were listed. The segment from Butler Creek to McBean Creek was still designated as an "expected to meet" water. The letter that transmits the list to EPA admits that "the number of segments on the Georgia list substantially increased", noting that the additional segments included those listed due to "a single exceedance of a metals standard as a criteria recommended by the US EPA" and "fish and shellfish consumption guidelines". Due to the timing of the placement of the segments on the State's 303(d) list, these listings were never public noticed.

However, there was no discussion as to why EPD had designated these Savannah River segments as "expected to meet" waters, why that decision had been reversed, or why the State decided to elevate waters with fish consumption guidelines to the 303(d) list. In the same letter EPD goes on to say that "the vast majority of waters on the active list are a result of the exceedance of the criteria for fecal coliform bacteria or metals, poor fish communities (no criteria for fish communities at this time) due to urban runoff or nonpoint sources, or *fish tissue where PCBs, chlordane, or mercury were the cause and there are no known sources"* [emphasis added].

On June 3, 1998, EPA approved Georgia's 303(d) list, but disapproved that some waters had been excluded. As part of their disapproval, EPA objected that the segment of the Savannah from Butler Creek to McBean Creek had not been proposed and required EPD to list it, in part due to the fish consumption advisory, thus changing its "expected to meet" designation (this river segment was apparently impaired for other pollutants including lead and fecal coliform bacteria, and was also required by EPA to be 303(d) listed for these pollutants). In its "Decision Document for the Approval / Disapproval of Georgia's 1998 303(d) List" (Decision Document), EPA gives the following reason for requiring these segments to be included on the 303(d) list:

> "The State of Georgia has issued area wide stormwater permits for discharges of stormwater to these segments. Georgia has not indicated when they expect the waters to meet applicable standards. EPA has determined that these permits will not result in the attainment of applicable water quality standards by the time the 2000 303(d) submission is due."

EPA did not supply, to our knowledge, any calculations, data, modeling results, or other evidence to justify their determination. If EPA generated such an analysis, it should be made a part of the Administraive Record to justify the listing of these river segments. Neither did they direct the State to list the segment for mercury in fish tissue or justify their decision.

On October 8, 1999, the State of Georgia resubmitted their list of waters. On this list, the segment from Butler Creek to McBean Creek was included on the 303(d) list. We are not aware of documentation in which the Georgia EPD lodged any objection to the reversal of their "expected to meet" decision and/or the subsequent revision to the listing of the segment.

EPA required the State of Georgia to add some very "marginal" waters to the 1998 303(d) list, including some where there was no direct evidence that a water quality criterion violation had occurred. For example, fish tissue concentrations are only presumptive evidence of a mercury water quality violation. EPA required waters to be listed where there were not criteria for listing (poor fish community). In each of these circumstances, there was only a presumption of impairment, and no actual violation of a water quality standard. The interpretation of such information may be cause to place water on the 305(b) list, but it is not sufficient to place water bodies on the 303(d) list. Due to the timing that the segments were placed on the State's 303(d) list, these listings were never properly public noticed.

Secondly, EPA reversed the State's decision, that certain waters would not meet standards by the next listing cycle without, to our knowledge, a published rationale for doing so. EPA never justified listing these waters in 1998 and the Agency should justify the listing in 2000.

No New Data to Justify Listing of Waters in 2000
No new data or information has been generated since 1998 that would justify placing Savannah River on the 2000 303(d) list. In its 1999 publication on fish consumption guidelines (GA DNR 1999), the State added two fish advisories affecting the Savannah River. The advisories are as follows:

- Screven County — Largemouth bass
- Fort Howard — Largemouth bass, White catfish, Bowfin

These advisories affected only the lower two sections of the river listed on the 1998 305(b) list: Brier Creek to Ebenezer Creek and Ebenezer Creek to Tide Gate. As we mentioned in our earlier comments and will detail later, fish consumption guidelines alone are not sufficient to place a water body on the State's 303(d) list.

No State Policy for Listing

The State of Georgia has no written policy for placing waters on the 303(d) list based on fish consumption advisories. Georgia does have a written guidance for posting fish consumption advisories but these guidelines were never intended as a basis for 303(d) listing. As we understand it, the State of Georgia developed its current fish consumption advisory guidelines in 1992 (GA DNR 1992).

Many states use the FDA's action level as a basis for fish advisories. FDA's action level of 1 ppm for mercury is based on considerations of the tolerable daily intake (TDI) for methyl mercury, as well as information on seafood consumption and associated exposures to methyl mercury. The tolerable daily intake is "the amount of methyl mercury that can be consumed daily over a long period of time with a reasonable certainty of no harm to adults" (EPA 1997). FDA established a TDI based on a weekly tolerance of 0.3 mg of total mercury per person. The TDI was calculated from data developed from a Swedish study of Japanese people poisoned in the episode of Niigata.

The FDA action level was calculated using standard inputs of 6.5 g/day consumption, 365 days/year exposure frequency, 70 years exposure duration, 70 kg body weight, and 70 x 365 days /year averaging time. Using the FDA model, levels below 1 ppm are generally considered safe, and levels above 1 ppm, unsafe for consumption.

The Georgia EPD adopted the model of Dourson and Clark (1990) to improve the credibility of fish consumption advisories and make the information provided by the State more useful to the average consumer. *According to Dr. Randy Manning, the State's proponent of this approach, this advisory was designed as a public information tool and was never intended to be used as criteria to place waters on Georgia's 303(d) list.*

The advisory for fish consumption is expressed as a safe intake rate, given varying levels of mercury concentrations in fish. The relationship of the fish consumption advisory to the meal frequency is given in the following table.

Fish Consumption Advisory	**Allowable Fish intake**	**Mercury Concentration**
	(g-fish/day)	**(mg-Hg/kg-fish)**
Do not eat	Nil to 3	2.3
One meal / month	>3 to 10	0.7
One meal / week	>10 to 30	0.23
Three meals / week	>30 to 100	0.07
One meal / day	>100 to 300	0.023
Unlimited consumption	>300	0.007

As expressed in Georgia's 1992 fish tissue monitoring strategy document (GA DNR 1992), an expression for the potential hazard associated with ingestion of mercury in fish tissue is:

$$HQ = \frac{\text{Intake (mg/kg-day)}}{\text{Reference Dose (mg/kg-day)}}$$

The intake rate can be defined by:

$$\text{Intake (mg/kg-day)} = \frac{CF\,(IR)\,(FI)}{BW}$$

where CF = contaminant concentration in fish (mg/kg)
IR = ingestion rate (kg/day)
FI = fraction ingested from contaminated source (unitless)
BW = body weight (kg).

The reference dose (RfD) indicates the amount of contaminant that may be consumed per kilogram of body weight without likelihood of non-cancer toxicity occurring.

Using the fish consumption rates and tissue concentrations in the table above, a conservative FI of 1, and a human body weight of 70 kg, and EPA's reference dose of 0.0001 mg/kg-day, the hazard quotient can be calculated for each advisory level. The hazard quotient thus derived is roughly equal for all combinations of fish consumption rate and mercury fish tissue level and has a value of about 0.65. A hazard quotient above unity indicates an unacceptable risk.

When setting its policy for public notification, EPD chose to truncate the advisory at the "one meal / week level". This is apparently the reason that the value of 0.23 came to be identified as a threshold level. The 0.23 ppm level, however, is *not* a risk threshold. It is *not* an "unsafe" level above which some risk begins to be incurred by the consumer, to any greater or lesser extent than the other levels in the table. These levels are *only* meaningful when taken in the context of the corresponding fish consumption rate. Had the State of Georgia chosen to truncate the advisory at the three meal per week level, then subsequent 303(d) listings would have occurred at a level of 0.07 ppm. Had the State truncated the advisory at the one meal per month level, then the threshold for 303(d) listing would have become 0.7 ppm.

Georgia developed its risk-based fish consumption advisory level for good reasons. However, it has been misinterpreted within the regulatory context of TMDLs as representing a "threshold risk" level above which an "impairment" occurs. By this logic, one could argue that *any* level of mercury in fish, no matter how small, represents an impairment at some level of fish consumption. Therefore, every waterbody in the United States would have to be listed as impaired, because *every* fish has *some* tissue concentration of mercury.

The challenge of listing the water as impaired for the purpose of 303(d) listing, therefore, becomes one of choosing a fish consumption level acceptable to protect the target population. A fish consumption level that represents an average consumption rate for this target group is about 6.5 g/day, the consumption rate chosen by EPD to represent a "one meal per week" level. The use of a consumption level of 6.5 g/day is also promoted by EPA (US EPA 1994) as representing the Agency's best estimate of average fish consumption of fish and shellfish from estuarine and fresh waters in the United States. The mercury concentration in fish tissue corresponding to this consumption rate, according to EPD's procedure, is 0.7 ppm. Our basis for support of the 6.5 g/day consumption rate is contained in Ogden 1999.

Even with the use of an average fish consumption rate, the methodology used by the State is still a conservative one. First, the consumption rate of 6.5 g/day is for fish and shellfish. In addition, the advisory levels assume that *all* fish consumed in the one meal per week are from this water body (i.e., FI as defined above is 1), and that the listed species is exclusively consumed. This clearly would not be the case. There are typically large differences in tissue burden among species.

In addition, there is considerable debate about the reference dose. Although divalent mercury uptake can be a concern in aquatic systems when concentrations are several orders of magnitude greater than present-day ambient levels, the production of methyl mercury by microorganisms and its subsequent accumulation in fish is by far the greatest concern. Part of that concern arises from its long biological halflife in fish (1-2 years) as opposed to humans and other warmblooded creatures which have halflives of 1-3 months (Spry and Wiener 1991; Wiener and Spry 1996; Clarkson 1990). Thus, fish can accumulate methyl mercury to high levels, and the consumed fish -- especially long-lived predatory fish -- provide exposure of sensitive organisms to methyl mercury. In humans, methyl mercury may cross the blood-brain barrier, causing neurological damage in developing fetuses. Advisory levels are set to protect health of children, but at present there is some uncertainty about the level above which damage occurs (Clarkson 1990; Myers et al. 1997; WHO 1990; USEPA 1997; Carrington et al. 1997). ATSDR (1999) has published an MRL (minimum risk level) of 0.0003 mg/kg-day. Use of the ATSDR MRL in the above equation would result in a hazard quotient of one third the levels derived by use of EPA's reference dose.

Georgia's fish consumption guidelines are not a water quality standard. They do not go through the same procedures required for establishing a water quality standard; for example, they are not subject to public comment. Because the language in the Clean Water Act (CWA), requires that there be a water quality violation to cause a water to be included on the 303(d) list, fish consumption advisories alone cannot be used for this purpose.

No EPA Policy for Listing

Like the State of Georgia, EPA has no written policy for the role of fish consumption advisories in the 303(d) listing process. The Agency makes the presumption that if a fish consumption advisory has been posted, then the waterbody is impaired but suggests that the presumption of impairment can be rebutted by using local data. The presumption is unwarranted. Since aquatic organisms bioaccumulate mercury, they may have been exposed to low levels or background concentrations long enough to have accumulated enough mercury in their system to warrant a fish consumption advisory with little or no impairment in water quality. Just because a use has been affected does not mean that a water quality standard has been violated. There are two facets to a water quality standard, the standard itself and the use it is intended to protect. If a waterbody is to be placed on a 303(d) list, we believe it should be due to a violation of a water quality standard, not just a presumption of impaired use.

No Basis for Listing Using Fish Consumption Guidelines Alone

The mere fact that a waterbody is posted under Georgia's fish consumption guidelines does not equate to an impairment of the waterbody, requiring placement on the 303(d) list. If this was the case, segments of the Savannah would have been initially proposed for listing by the State in 1998 and yet they were not. The State's policy, according to the language in its 305(b) documents, is to place such waters on the 305(b) list as partially supporting the designated use.

Prior to the establishment of the 1998 List of Waters, the State of Georgia had never listed waters with fish consumption guidelines under Section 303(d). On the 1998 and proposed 2000 303(d) lists, EPD designated some listings for fish consumption guidelines by placing an "N/A" comment under the 303(d) column, for example in the St. Mary's basin (see the excerpt of the proposed 2000 303(d) list in Appendix A), with notes that "fish consumption guidelines are due to natural sources of mercury, no standard violation". By adding this comment, EPD acknowledges that a fish consumption advisory alone does not constitute the basis for 303(d) listing.

We are aware of EPA Regions where Agency staff have required States to list all waters that are covered by fish advisories. Such a requirement is improper, and EPA should clearly state that a fish advisory should not be used as the sole basis to list a waterbody. A waterbody should be listed for fish contamination under Section 303(d) only if there is objective evidence of a violation of a water quality standard that relates to the pollutant present in the fish.

We believe it is improper for EPA to require the State of Georgia to use fish tissue data alone to place waters on the 303(d) list. Legal precedent has been recently established in such matters. In the case of Western Carolina Regional Sewer Authority, et al. v. DHEC, et al. the court ruled that the use of the Trophic State Index (TSI) to place South Carolina water bodies on the Section 303(d) impaired waters list as nutrient impaired and/or aquatic life-use impaired constituted a "binding norm" and therefore should have been promulgated as a regulation pursuant to the Administrative Procedures Act. South Carolina was found to have exceeded its authority in using the TSI as the *sole* measure of whether a water body would be listed as aquatic life-use impaired. Contrary to the State's assertion that it was a mere tool, the court ruled that it was in fact applied as a binding norm and a *de facto* numeric criterion. The analogy to the use of fish consumption advisories as the sole criterion for 303(d) listing waters is obvious.

No Credible Evidence of Mercury Water Quality Criterion Violation

There is no credible data that would indicate that the water quality standard for mercury has been violated in the waters of the Savannah River. The available water quality data, presented in EPA's mercury TMDL document for the Savannah River (US EPA 2000), is from 1990-91, 1997-98, and 1999.

The 1999 data consists of a single sample, taken from the segment from Brier Creek to Ebenezer Creek (Savannah River @ Hwy 119) by the Georgia EPD. No mercury was detected in this sample at a detection limit of 200 ng/L. Therefore, it is impossible to tell if the water exceeds the State's mercury criterion of 12 ng/L.

The 1997-98 data consists of four samples collected by the US Geological Survey (USGS), two from the Savannah River at Highway 119 and two from upstream of the USGS gage near Clyo, Georgia. None of the four samples had detectable mercury at a detection limit of 100 ng/L; again, above the State standard of 12 ng/L, making it impossible to tell if the standard was being exceeded.

The data from 1990-91 consists of five samples, collected approximately over a one year period, presented in Appendix B of EPA's TMDL document. These data show exceedances of the mercury standard in four of the five samples at levels of 200, 300, 400, and 300 ng/L, respectively. The fifth sample shows no detectable mercury at a detection limit of 100 ng/L. However, there are several concerns about the validity of this data. First, the source of the data is unknown as EPA does not cite the source in the TMDL document. Second, there is no reported quality assurance control data (e.g., duplicate samples) by which the quality of the data can be judged. However, our fundamental concern is in the levels reported. These are dissolved, not total, mercury measurements and they are remarkably high.

Scientists have found that typical background concentrations of dissolved mercury in surface waters are in the range of 0.1 to 2 ng/L. The range of values for dissolved mercury from the literature (Porcella 1994), the rampant problems with older data (Zillioux 1993), and the known difficulties with collecting clean samples for mercury (Fitzgerald 1999), cast further doubt on the verity of these values reported for the Savannah.

Furthermore, data collected in 1997-98 for total recoverable mercury at the same location (Savannah River nr. Clyo, GA) and further upstream (Savannah River @ Hwy 301) do not support the elevated dissolved levels found in the 1990-91 sampling. Additional data discovered in EPD's files, perhaps overlooked by EPA in developing its TMDL document, shows that mercury levels in 1997-98 at a number of locations (Savannah @ US Hwy 1, Rocky Creek @ SR 56 nr. Augusta, Butler Creek @ US Hwy 1 near Augusta, Butler Creek @ Levee nr. Savannah, Savannah River @ Bluff Lock and Dam near Augusta, and Savannah below Spirit Creek near Augusta) were all below the detection limit of 100 ng/L.

GIEC is concerned that data from 1997 for the Savannah River near Clyo, Georgia were not utilized to remove the segment from Brier Creek to Ebenezer Creek from the 303(d) list for the mercury water quality violation, or at the very least to initiate a reevaluation of the original listing.

Based on an evaluation of all the available water quality data, our position is that there is no basis for the original listing. Barring the questionable data from 1990-91, water quality data from the Savannah River are all below the detection limit and offer no support for the 303(d) listing of the Savannah River based on mercury-in-fish tissue indicators or the establishment of a TMDL.

No Basis for Listing Waterbodies Due to Atmospheric Deposition

EPA has stated in its TMDL document for the Savannah River mercury TMDLs (US EPA 2000) that "it is clearly understood that atmospheric deposition (dry and wet) provides a major source of mercury entering the Savannah River". They go on to say later in the document that "the Phase II TMDL is not expected to change the wasteload allocation to the point sources because of the large nonpoint source (wet & dry deposition) of mercury". EPA's comments imply that the magnitude of the nonpoint sources are so great, that point source contribution can be viewed as being insignificant.

We believe it is beyond EPA's authority to require waterbodies impacted by atmospheric deposition be placed on the 303(d) list. Even so, EPA has been insisting that States list waters that are impaired from any sources, even if those sources are not regulated as point sources under CWA (US EPA 1997a). The language of 303(d) calls for States to list waters for which technology-based effluent limitations imposed on point sources under the Act are not stringent enough to implement water quality standards. The focus of this section is on effluent limitations for point sources, and the need to assess whether additional effluent limitations for point source would be necessary to adequately implement water quality standards. Congress did not contemplate, and the statutory language does not support, the use of 303(d) to address sources that are not directly regulated under CWA, such as nonpoint sources or air emission sources.

The legislative history of the Act further demonstrates Congress' intent that waters impaired due solely to nonpoint sources or due to air emission sources would not be addressed under

303(d).[1] The committee reports and debates surrounding that provision focus on how that provision would affect discharges of wastewater to a waterbody - in particular, through the possibility of additional discharge limits being imposed through the TMDL process. The following excerpts from the debates illustrate that focus:

> "These load limits would indicate, for those pollutants which are suitable for such calculations, the maximum quantity which can be *discharged into the water* and still not violate water quality standards." (remarks of Rep. Harsha, Oct. 4, 1972) (emphasis added) (contained in A Legislative History of the Water Pollution Control Amendments of 1972 at p. 245).
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> "The Committee heard extensive testimony during the oversight and legislative hearings to the effect that it is extremely difficult to apportion *the discharge load from all point sources along a waterway* or section of a waterway." S.Rep. 92-911 (Report of Senate Committee on Public Works) at 106 (emphasis added) (contained in A Legislative History at p. 793).
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> "Water quality standards will be utilized for the purpose of setting effluent limitations in those cases where effluent limitations for point sources would not be consistent with such standards. Even though all point sources must by January 1, 1976, as a minimum, meet the requirements of subsection (b)(1)(A) and subsection (b)(1)(B) of section 301 all point sources could be required to meet a more stringent effluent limitation consistent with the water quality standards of the receiving waters if the effluent limitations set pursuant to subsection 301(b)(1)(A) and subsection (b)(1)(B) of section 301 are inadequate to meet those water quality standards. In this case a more stringent effluent limitation will be imposed." Id. at pp. 792-93.

These excerpts from the debates show that Congress was thinking about regulating facilities located along a waterbody and that discharge substances directly into the waterbody from their wastewater. There is no discussion in the legislative history related to regulation under 303(d) of waters impaired by nonpoint sources or by atmospheric deposition to waterbodies.

Under EPA's guidance, waterbodies are to be listed under 303(d)(1) even if they have no point source discharges at all. This incorrect interpretation finds no support in either the law or the legislative history. In fact, Congress did not ignore those situations where point sources operating under technology-based effluent limitations are not the cause of the impairment. Congress addressed those situations in several other sections of the Act. For example, CWA 303(d)(3) specifies as follows:

> "For the specific purpose of developing information, each State shall identify all waters within its boundaries which it has not identified under paragraph (1)(a) and (1)(B) of this subsection and estimate for such waters the total maximum daily load."

[1]For purposes of these comments, waters impaired "solely" by nonpoint sources include waters where the predominant cause of impairment is nonpoint sources. Since reductions in the few point sources would not bring about attainment, there is no sense in requiring listing and development of TMDLs.

The legislative history explains that under 303(d)(3), "A maximum daily load shall also be developed by a State for all waters within its boundaries *which are not identified as requiring more stringent effluent limitations to meet water quality standards.*" (emphasis added).

In addition to enacting 303(a)(3), for use in situations that may not be appropriate for listing under 303(d)(1), Congress later put in place yet another provision to address nonpoint source 303(d)(1) situations: Section 319. This provision requires each state to identify and address waters which "without additional action to control nonpoint sources of pollution, cannot reasonably be expected to attain or maintain water quality standards or the goals and requirements of this Act."

Waters impaired by air deposition and waters impaired by nonpoint sources only simply do not belong under the listing and TMDL development requirements of 303(d)(1). Such a result was neither anticipated nor intended by Congress. Instead, EPA should address those waters under other existing mechanisms, which may include 303(d)(3), 319 and, as appropriate, the Clean Air Act.

Even if EPA had the authority to require that waterbodies be listed under 303(d), the technical challenges of establishing such a TMDL made doing so technically infeasible, especially in the case of mercury.

The science linking atmospheric emissions of chemicals with concentrations of those chemicals in water is not yet advanced to the state that defensible TMDL analyses can be done. In order to argue our position, we believe it most appropriate to quote EPA's own scientists. Statements from the Mercury Report to Congress (MRC) (US EPA, 1997b, US EPA 1997c) support our position. In the Executive Summary (Vol. I, Page O-2) EPA states "Given the current scientific understanding of the environmental fate and transport of this element, it is not possible to quantify how much of the methyl mercury in fish consumed by the US population is contributed by US emissions relative to other sources of mercury (such as natural sources and re-emissions from the global pool). As a result, it cannot be assumed that a change in total mercury emissions will be linearly related to any resulting change in methyl mercury in fish, nor over what time period these changes would occur."

The State of Georgia cannot seriously consider that TMDLs can be established for mercury taking into account atmospheric emissions as possible regulated sources at this time. In its existing regulation, EPA defines a TMDL as a quantitative assessment of a water quality problem. The above statement clearly states that such a quantitative assessment cannot be made with our current scientific understanding. Furthermore, in its proposed rules, EPA proposes that an implementation plan be made a part of each TMDL analysis. In the detailed guidance for the proposed implementation plans, EPA proposes that the time required for a waterbody to come into compliance given the actions taken in the implementation plan be reported. Clearly, given EPA's above statement, such an estimate is beyond the ability of EPA's top scientists and models to predict, and most likely beyond the ability of most state agencies.

A major facet of this inability to perform a quantitative assessment for mercury is the lack of knowledge about the species emitted by various sources, the transformations that occur to the emitted species in the atmosphere, and the differential rates at which the various mercury species are deposited to watersheds and waterbodies. Again, in its Mercury Study Report to Congress (MSRC) (Vol III p. 7-4), EPA states that "Given the simulated deposition efficiencies for each form of mercury air emission [...] the relative source contributions to the total anthropogenic mercury deposited to the continental US are strongly positively correlated to the mass of emissions in oxidized form. [...].

By EPA's own admission, their atmospheric models are not very good. In particular EPA was not able to account satisfactorily for local deposition (within a radius of 250 km), regional deposition (multiple states in US), or account for the effects of global background in its modeling assessment. EPA did not compare their model estimates to actual measurements, because such data do not exist. In the Agency's words, "There is a lack of adequate measurement data near the anthropogenic mercury sources considered in this report. [...] The lack of such measured data preclude a comparison of the modeling results with measured data around these sources." Agency scientists go on to say that "The true speciation of mercury emissions from the various source types modeled is still uncertain and is thought to vary, not only among source types, but also for individual plants as feedstock and operating conditions change. With further research, it may be possible to make a confident ranking of relative source contributions of mercury deposition in the continental US. However, no such confident ranking is possible at this time."

Further research is needed to develop "evaluated local and regional atmospheric fate and transport models" which can establish the linkages between source types, the form of mercury emitted, and atmospheric processes that may alter the species of mercury emitted versus that deposited in watersheds. The Agency states that "development of these models will require comprehensive field investigations to determine the important transformation pathways (e.g., aqueous cloud chemistry, gas-phase chemistry, particle attachment, photolytic reduction) for various climatic regions. The evaluation of these models will require long-term national (possibly international) monitoring networks to quantify the actual air concentrations and surface deposition rates for the various chemical and physical forms of mercury." This certainly does not sound like a situation that lends itself to yielding data or models adequate to address this class of problems over the next decade that most TMDLs must be established.

GIEC concludes this particular comment by making use of another quote from EPA's MSRC (Vol III, ES-1) in which the Agency scientists state that "The individual exposure assessment in this Report (Volume IV) which relies on the modeling results presented in this volume, is considered to be a qualitative study based partly on quantitative analyses; it is considered qualitative because of inherent uncertainties." If EPA's best effort to produce a quantitative assessment of the contribution of atmospheric sources of mercury to the risks posed by consumption of fish, how much less able will States or EPA Regions with limited, time, staff, and financial resources be able to deal with such issues in the context of establishing TMDLs?

2) Notwithstanding the issue we take with the EPA's "determination that the 12 ng/L numeric criterion [is] not protective for fish consumption", we disagree with the approach and many of the questionable assumptions EPA has used to calculate the 1 ng/L human health-based target concentration.

We refer to the memorandum dated February 8, 2000, from Ms. Eve Zimmerman to Mr. Tim Wool in which the 1 ng/L target concentration is derived. Our issues include the following:

- the legality of EPA's development of an alternative water quality target;
- the approach to estimating a water quality target as the basis of regulation;
- the estimation of bioaccumulation factors;

- the choice of a methylation translator; and
- the selection of fish consumption rates.

Legality of EPA's Action

Georgia's mercury standard is 12 ng/L. EPA admits that this figure is more stringent than EPA's own recommended standard for protection of human health using current EPA methodologies, but goes on to preempt the State standard and develop its own target for the TMDL of 1 ng/L. In support, EPA cites a statement from the National Toxics Rule, which states that if there are exceedances of the 12 ng/L standard, the State must determine if fish tissue exceeds the FDA's mercury action level (1 mg/kg). If the FDA action level is exceeded, the State must take a number of actions, including revising its mercury standard. However, nothing in that rule states that EPA is authorized to supersede the existing State standard and replace it with a number of its own choosing. There is a procedure in the CWA that allows EPA to declare a State standard to be inadequate; if the State does not make appropriate revisions, EPA can issue a new standard for the State. EPA has not followed that procedure here, and thus cannot use a TMDL target other than the legitimately derived, existing State standard of 12 ng/L.

EPA's Approach

Notwithstanding that EPA has not followed proper administrative procedures to affect a new State water quality standard for mercury, in deriving the water quality target for mercury in the Savannah River, EPA has made use of its Proposed Methodology for Establishing Ambient Water Quality Criteria (AWQC) for the Protection of Human Health published in the Federal Register (63FR 43755) dated August 14, 1998. While it is generally accepted that the proposed use of bioaccumulation factors (BAFs) represents better science than EPA's former guidance based on the use of bioconcentration factors, the approach presented in EPA's draft document has been widely criticized. GIEC is in strong disagreement with parameters used by EPA Region 4 to develop this target. Specific concerns are detailed in the following sections.

Estimation of Bioaccumulation Factors (BAFs)

EPA states that "in the affected area of the Savannah River Basin, the use of a more appropriate site BAF and localized population fish consumption rate would produce a criterion that is both (1) more appropriate of the localized population which may be consuming fish at a higher rate, and (2) lower than Georgia's current criterion of 0.012 ug/L". While we agree that site-specific BAFs would be more appropriate to use in this situation, we take issue with the statement that the use of such BAFs would lead to a criterion lower than the current 0.012 ug/L. This statement is unsubstantiated by EPA's subsequent demonstrations in the TMDL document. Such statements should be removed from the TMDL document.

Even the use of site-specific BAFs will not necessarily lead to a "one size fits all" human health-based water quality target for the river, as EPA apparently wishes to identify. Fish vary widely in their uptake of mercury. Porcella (1994) reports that mercury concentrations in yearling yellow perch in seven lakes in northern Wisconsin lakes, subjected to essentially the same rate of mercury deposition, varied over an order of magnitude. Such differences in fish tissue burdens lead to dramatic differences in calculated BAFs. Research from locations near Oak Ridge, TN, show the striking differences that can occur even within the same river system (LMER 1999). This study shows that measured total mercury BAFs for redbreast sunfish within the East Fork Poplar River, TN, averaged 2500 and ranged from 490 to 4100, a range of nearly an order of magnitude. These BAFs were much lower than BAFs measured in three similar mercury-contaminated streams (South River, VA, the North Fork of the Holston River, TN, and Abbotts Creek, NC), and other local reference streams. In these streams, the total mercury BAFs averaged 23,000, with a standard deviation of 4600. Thus, this study found a range of almost an order of magnitude within the same river and almost two orders of magnitude among rivers within the same geographic region.

We are concerned that EPA's use of BAFs from the MSRC (US EPA 1997) are inappropriate for use in waters of the Southeastern US. As justification for using these BAFs, EPA's February 8 memorandum states that "the BAFs in the MRC were developed from randomly-selected waterbodies within the US, Canada, and Europe." This statement is inaccurate and misleading. The sources of data for the MRC were not "randomly-selected"; in fact, the authors of the MRC used all the available data they could find from the literature to calculate BAFs. This data is regionally biased because almost all of the data come from oligotrophic northern lakes. These lakes are characterized by low suspended solids (TSS) and low dissolved organic carbon (DOC) both of which provide adsorption and complexation sites for divalent mercury.

Southeastern waterbodies are typically higher in both TSS and DOC, which effectively "compete" with organisms for mercury in solution. It can be shown theoretically that this competition lowers the dissolved concentration of mercury in water. Complexation of mercury by DOC is reported to make the divalent mercury less available for methylation (Gilmour and Henry 1991). Only one of the studies in the MRC was for a species common in the Savannah River Basin (largemouth bass in Clear Lake, CA). EPA states clearly on page D-27 of the MRC that "the relative abundance of these data introduce a regional bias into any type of analysis that is intended for nationwide application". By EPA's own reasoning, it is doubtful that the BAFs calculated for these waterbodies are applicable to waters of the southeastern US.

Another concern with the BAFs used by EPA is that they were developed for lakes rather than rivers. In the TMDL document, EPA suggests with their methylation translators that a factor of greater than two distinguishes the occurrence of methyl mercury in lakes and rivers. Lower methyl mercury to total mercury fractions combined with higher productivity of warmer southern waters could lead to substantially lower bioaccumulation factors.

Based upon the foregoing discussion, it would appear that no regionally relevant information exists to establish bioaccumulation factors for the Savannah River Basin. As these parameters are critically important to the estimation of an appropriate water quality target, we urge EPA to delay the establishment of the TMDL until such data becomes available.

Choice of Methylation Translator

EPA calculates trophic level 3 and 4 BAFs for freshwater fish consumption rates of 17.8 g/day and 39.04 g/day and converts the resulting methyl mercury BAFs to total mercury BAFs by using translators for lakes, rivers, and estuaries. In the end, however, EPA chooses the "estuarine" values (the system type with the highest-valued translator) as the most "representative" for the Savannah River Basin. The justification is that "the waters listed in the Savannah River Basin include swamp and marsh systems (in addition to river) where methylation is likely to occur at a higher rate".

We disagree with EPA's choice of the total mercury BAFs calculated using the estuarine system translator as the most appropriate for the Savannah River Basin. Dr. Randy Manning, who oversees the State of Georgia's fish tissue monitoring program, provided the following data for fish from various river basins in Georgia in a recent mercury TMDL seminar held in Atlanta on September 10, 1999.

Basin	# Samples	Frequency of Detection	Size (in)	Hg Conc. (mg/kg)
Chattahoochee	83	0.99	15.2	0.23
Flint	32	0.97	14.9	0.21
Coosa	23	0.83	15.4	0.12
Tallapoosa	1	1.00	11.4	0.18
Tennessee	30	0.97	13.9	0.23
Oconee	38	1.00	12.9	0.14
Ocmulgee	46	1.00	14.0	0.23
Savannah	79	0.99	12.9	0.32
Suwannee	15	1.00	12.5	0.96
Satilla	6	1.00	12.2	0.58
St. Mary's	3	1.00	13.5	0.97
Altamaha	9	1.00	13.5	0.97
Ogeechee	21	1.00	14.3	0.84

This data shows that the levels of mercury in the Savannah River average 0.32 mg/kg, much closer to rivers of north Georgia and the Piedmont (weighted average concentration 0.20 mg/kg) than the rivers of south Georgia, influenced more by "swamp and marsh systems" (weighted average concentration 0.92 mg/kg). Savannah River concentrations are only a factor of one-and-a-half times the average of north Georgia and Piedmont rivers but the rivers of south Georgia have concentrations almost three times higher than the Savannah River.

Notwithstanding the fact that we disagree with EPA's choice of methylation translator in their analysis, the estuarine translator EPA uses is based on a single value for a single estuary (Chesapeake Bay). While the EPA has more data on translators for riverine systems, none of these are from rivers in the southeast. The closest geographically are the mid-Atlantic Anacostia and Patuxent Rivers. Methylation translators derived from the Oak Ridge report (LMER 1999) suggest that riverine translators could be much lower. The dissolved methyl mercury to total mercury translator calculated for all data from the East Fork Poplar River is 0.00056; for the Clinch River, 0.0035; and for Hind's Creek, 0.021. Other rivers investigated appear to have translators of 0.00002 and less. Currently, there are no data available from which to calculate accurate methylation translators for the Savannah River system.

Based on this analysis, GIEC believes that EPA should apply a translator more representative of "river" system translators to the Savannah River system, rather than an "estuarine" system translator, to derive the target water concentration. However, data from southeastern area rivers indicate that EPA's riverine methylation translator could be as much as four orders of magnitude too high. Based upon this observation, GIEC concludes that accurate, site-specific methylation translators are needed in order to perform a credible analysis.

Selection of Fish Consumption Rates

We disagree with the fish consumption rates utilized in the calculation of the total mercury criteria. EPA has used a fish consumption rate of 17.8 g/day for the general adult population and sport anglers. EPA has stated that there are subsistence fishers in the Savannah River Basin and proposes the use of a fish consumption rate of 39 g/day, but offers no substantiation of its assertion that a subsistence population exists. Nor does EPA offer any information of the type or size of fish consumed by the alleged subsistence fishing population, a critical body of data for the purpose of determining if this group is at risk.

EPA's use of fish consumption rates of 17.8 g/day for the general population and sport anglers and 38 g/day for subsistence population is questionable. The report of the peer review workgroup (US EPA 1999) "questions the use of short-term data to project long-term human consumption. The USDA survey is very short (three-day dietary recall) and is not appropriate to use when estimating long-term exposures". Scientists at Ogden in their comments on the EPA's proposed methodology for deriving ambient water quality criteria for the protection of human health (Ogden 1999) conclude that a mean fish consumption rate between 5 and 7 g/day is a reasonable estimate of long-term consumption by the general adult population and should result in reasonable and protective criteria for chemicals that demonstrate chronic health effects.

The use of the consumption rate of 39 g/day for subsistence anglers is suspect for other reasons. EPA has not specifically identified the demographics of the alleged subsistence fishing population in the Savannah River Basin. As pointed out by Ogden scientists (Ogden 1999), the literature on fish consumption fails to identify a significant difference in fish consumption rates based either on income level or ethic background.

Yet another motivation for the use of a 6.5 g/day fish consumption rate is that this consumption rate was used in developing the FDA's 1 ppm action level, which is the basis for EPA's determination of impairment stated in the TMDL.

Based on the preceding comments, GIEC suggests that the use of 17.8 and 39 g/day fish consumption rates is tenuous and that EPA utilize a fish consumption rate that protects the general population of consumers in the Savannah River Basin. We further maintain that an appropriate long-term consumption rate is 6.5 g/day.

3) There is no scientific basis for the selection and use of a one-in-twenty year low flow as a critical period.

The TMDL should be calculated from the mean flow rate or from the 7Q10 flow and not from the one-in-twenty year minimum daily flow. Mercury accumulation in fish is a phenomenon that occurs over the life of the organism, integrating the concentrations of mercury in the river under all flow regimes. Low flow scenarios are appropriate where a rather constant load of a contaminant is introduced into a waterbody and a "minimal dilution" estimate is made in order to protect aquatic life. In the case of mercury, a significant portion of the load is probably derived from nonpoint sources. Furthermore, protection of aquatic life under minimal dilution is not the issue. The use of a low flow rate, either a 7Q10 or a minimum daily flow, has no scientific basis in this case and only serves to artificially lower the TMDL. However, the 7Q10 has been used as a water quality standard flow for many years and would be the preferred flow rather than the one-in-twenty year flow. We are not aware of any basis for choosing the one-in-twenty year flow.

We have analyzed the streamflow from USGS gage at the New Savannah Bluff lock and dam, the same gage that EPA used to derive its one-in-twenty year low flow, and calculated the mean flow. The mean flow, based on 91 years of historical record at this gage, is 15,200 cfs. Thus EPA's use of a critical low flow of 2,810 is inappropriately low by a factor of 5.4.

Recalculation of the TMDL

Since EPA cannot supersede the State's water quality criterion for mercury, we believe that the TMDL should be calculated using the existing water quality criterion of 12 ng/L. Using the mean flow for the Savannah (15,200 cfs) and the State's water quality criterion total mercury, the TMDL is:

TMDL = 15,200 ft3/sec (86400 sec/day) (28.3 L/ft3) (12ng/L)

= 4.5 E11 ng/day or 450 g/day (about 1 lb/day)

Based upon the foregoing discussion, GIEC recommends that EPA consider support of Georgia's current water quality criterion for mercury until such time that it is proved to be inappropriate and a revised water quality criterion can be confidently established.

4) There is no scientific basis for the 1 ng/L discharge limit proposed for the individual discharges. EPA's TMDL guidance (US EPA 1991) says that the allocations should be made to point and nonpoint sources with a margin of safety. It was never intended that allocations for these sources should be done piecemeal and independently of one another.

EPA states that its TMDL is the first phase of a two-phase TMDL. The first phase, it is purported, will determine the maximum loading of mercury that can be assimilated in the listed segments (Clarks Hill Dam to the Tide Gate), and determine the impacts of point source dischargers to this segment. If this is the case, then EPA has failed to accomplish its goal. The "determination" EPA has made is a rather crude and grossly conservative estimate of the maximum allowable daily load. EPA has not made this estimate by listed segments, but in fact has established one number for the entire river. Furthermore, it appears that EPA has not made an attempt to estimate the impact of point source dischargers on the TMDL. This is a serious flaw in EPA's analysis. The fact is, because the nonpoint source load is unknown, EPA *cannot* estimate the impact that the assignment of a discharge limit to the point sources will have. Thus, the assignment of a 1 ng/L discharge limitation to the point sources is *completely* arbitrary. In EPA's own words (US EPA 1991), the TMDL establishes the "link between water quality standards and water quality-based control actions". If this is the essence of a TMDL, then this TMDL falls short.

The link between water quality and water quality controls cannot be established as long as there are significant sources of unknown magnitude. In its 1991 guidance document, EPA describes the TMDL process as a "rational method for weighing the competing pollution concerns and developing an integrated pollution reduction strategy for point and nonpoint sources". This simply cannot be done if point sources are addressed in one phase and nonpoint sources are addressed in another. It was never intended that the phasing of a TMDL would separate point and nonpoint sources. In fact, the opposite is implied in the 1992 guidance document where it states that "under the phased approach, the TMDL has LAs (load allocations) and WLAs (waste load allocations) calculated with margins of safety to meet water quality standards". This TMDL does not meet the Agency's definition of a phased TMDL.

If EPA persists with establishing a target water concentration and discharge limits in Phase I of this TMDL, it must take into account all the known sources of mercury in order to allocate load reductions. In establishing its proposed TMDL, EPA has seemingly overlooked a body of information that exists in the literature and could easily take this data into consideration to make estimates of nonpoint source contributions, however crude those estimates might be at this time. Information is available to estimate the contribution from terrestrial sources as well as atmospheric sources, as pointed out in the following sections.

Terrestrial Sources
There is ample evidence of terrestrial nonpoint sources of mercury in this region. According to Zillioux et al., the leaching of mercury from wetlands soils is elevated compared to mineral soils, providing an increased mercury input to downstream water bodies. In addition, the transport of mercury from watersheds shows a strong association with organic matter, which in turn is associated with wetlands. These observations suggest that mineral mercury accumulated in wetlands over long periods of time from both natural and anthropogenic sources are significant contributors of mercury to waters which drain them, especially in cases where those wetlands may have been disturbed.

In this area, evidence of mercury accumulation by wetlands is provided by cores taken from the Okefenokee (Casagrande and Erchull, 1976). In two cores taken from marsh and swamp environments (up to 1.9 and 3.5 meters, respectively), mercury concentrations averaged 191 ug/kg and 598 ug/kg, respectively. Although concentrations did not vary widely throughout the cores (coefficients of variation were 71% and 48% respectively), some of the highest concentrations occurred deeper in the profiles, indicating that the deposition events are not recent and probably attributable to natural sources. These levels tend to be as high or higher than those reported in soils and freshwater sediments by EPA in its Mercury Report to Congress and should certainly be considered as a source in any TMDL analysis for mercury in this region.

More recently, Delfino et al. (1993) made measurements of mercury in Okefenokee organic soils as well. Their data, taken from cores up to 20 to 24 cm in depth, show average concentrations from 78 to 83 ng/g (ppb), somewhat lower than the earlier data of Casagrande and Erchull. However, they also give values for organic mercury in their profiles, which indicate that organic mercury averages about 35% in these soils. Thus, wetlands in the area appear to be a potent source of methyl mercury and should be taken into account by EPA in its TMDL analysis.

Assuming a sediment total mercury concentration of 100 ug/kg and that 35% of this is methyl mercury, the use of EPA's partition coefficient of 3000 L/kg (US EPA 1997) yields a pore water concentration of 12 ng/L of methyl mercury. To put this number in perspective, the use of this concentration with EPA's methyl mercury trophic level 4 BAF of 6.8 million would result in a fish tissue concentration of over 80 ppm. Thus it is apparent that the wetlands in the lower Savannah River could be a very potent source of methyl mercury.

It is well known that gold mining operations of a considerable extent were historically conducted in North Georgia. The earth's crust contains approximately 50 ppb Hg, mainly as sulfides. In the vicinity of gold, molybdenum and base metal deposits, soils may contain higher concentrations, ranging from 50 to 250 ppb, and in one instance, as high as 2000 ppb Hg (Adriano 1986). Sediments from such operations could historically have been the source of elevated mercury concentrations into headwater reaches of the Savannah River and may potentially be an ongoing source as these sediments have been hydraulically sorted and deposited throughout the basin (Leigh 1994).

Atmospheric Sources
In the TMDL, EPA must be able to differentiate global background, regional and local sources of mercury deposition. Background sources would include atmospheric deposition from global cycles of mercury (Mason et al. 1994; Hudson et al. 1995; Pai et al. 1997). These background atmospheric sources include evasion of natural mercury via forest fires and geologic deposits of mercury, evasion from previously deposited mercury in soils and plants, and local and regional atmospheric emissions from US industry, as well as emissions from anthropogenic activities in

other parts of the world. Several investigators have tried to estimate global and/or regional emissions (e.g., Pirrone et al. 1996; Pai et al. 1998; Porcella et al. 1996; Nriagu and Pacyna 1988).

Wet deposition may be among the largest contributors of mercury to the river basin. The Mercury Deposition Network (MDN 2000) reports 1998 data for a station located in South Carolina and one in Georgia. These stations show a range of 13-16 ug/m^2-yr of wet deposition to the Savannah River Basin, with volume-weighted mean concentrations of a little less than 12 ng/l. Considerable data collected in Florida suggest wet deposition concentrations in the range of 10-25 ng/l (Guentzel et al. 1995). Thus, rainfall in the basin exceeds EPA's target concentration for the Savannah River of 1 ng/L by over an order of magnitude.

Dry deposition in forested areas can be equal to double the wet deposition values (Lindberg et al. 1998). However, the evasion of mercury back into the atmosphere from terrestrial environments can nearly equal the total dry deposition (Lindberg et al. 1998). Dry deposition over water sources is generally less than 50% of wet (Fitzgerald 1986).

Only a fraction of Hg deposition in watersheds is actually transported into waterbodies. Values ranging from 5-50 percent have been reported, and a common value of 25 percent has often been quoted (Watras, et al. 1996). Most of the Hg entering the watershed remains in the soil or terrestrial biota, or is reduced to Hg(0) and transfers back to the atmosphere by evasion (Lindberg, et al. 1998; Gustin, et al. 1996; Gustin, et al. 1999). Thus, direct deposition on the waterbody frequently overshadows delivery from the watershed in many aquatic systems studied in the northern US (Watras et al. 1994).

Ore refining, usually performed in retorts or furnaces near mining sites, is another source of atmospheric sources. The problems with historical emissions of metals from the Copper Hill, TN site are well-documented. It has been mentioned that refining of these ores in the early days of this smelter operation occurred in earthen retorts open to the atmosphere. It is possible that considerable quantities of the mercury emitted from this facility could have found its way into the headwaters of the Savannah River due to atmospheric wet and dry deposition.

In addition, mercury in the lower, estuarine portions of the Savannah River could be derived in large part from naturally occurring levels in seawater.

Given the research that has been conducted over the last decade on wet and dry deposition of mercury and the flux of mercury from watersheds to aquatic systems, GIEC believes it is possible for EPA to make estimates of both the atmospheric and terrestrial contribution of mercury to the Savannah River. Such estimates are necessary in order to make a meaningful estimate of background loading and to correctly allocate mercury load reductions among point and nonpoint sources.

5) The establishment and enforcement of a 1 ng/L total mercury concentration either as a discharge limit or as an ambient water quality standard will not guarantee that fish tissue concentrations will be at or below 1 ppm because mercury in fish tissues is not necessarily correlated to mercury loading.

Modeling of mercury transformations followed by accumulation of methyl mercury in aquatic food chains leading to fish has a potential flaw in that methyl mercury uptake is assumed to be linearly related to the input mass loading of mercury. While this approach is logical, it is unfortunately not supported by any evidence. In fact, there are indications that fish tissue accumulation is not linear with loading. As pointed out in Porcella (1994), a ten-fold variation in mercury in standardized fish where inputs are relatively uniform does not suggest a linear relation with loading. Furthermore, Engstrom and Swain (1997) show data from lake sediment cores indicating that deposition has decreased in northeastern Minnesota. Previously, Swain and Hedwig (1989) provided data suggesting that fish mercury concentrations had increased during the same time periods.

One may ask why fish mercury levels do not correlate well with loading. As described in Hudson et al. (1994) and Wiener and Spry (1996), much of the net methylation of mercury takes place in sediments. This occurs because the greatest mass of mercury is in sediments, and methylation is important in the surface (1-2 cm) layers of sediments. Current levels of mercury in the water column are quite low in most bodies of water, and apparently do not support large amounts of net methylation (Gilmour et al. 1998). The relatively rapid transfer of mercury to the sediments lessens the probability that methylation will take place in the water column. Further, annual loading does not alter substantially the mass of mercury in the top layers of sediments. Thus, loadings over decadal periods of time do not appear to relate linearly to the accumulation of methyl mercury by fish. To make an analogy, the sediments are like a huge capacitor, slowly producing and releasing methyl mercury into the overlying water. The relatively small fluctuations in the input "current" coming into this capacitor do little to change the output "current".

This hypothesis relates very closely to the Savannah River TMDL. If fish mercury levels do not respond to changes in loading, how will discharge and emission controls lead to a situation where fish meet a standard different from current fish tissue concentrations? More importantly, how can EPA guarantee that enforcing a standard of 1 ng/L will lead to fish levels below the FDA standard of 1 mg/kg?

Almost all methyl mercury accumulation in fish comes through the food chain. Only about five percent passes through the gills from water (Hudson et al., 1994). Much of the accumulation in fish depends on bioenergetics, that is consumption of food chain organisms that provide energy for the fish for reproduction, growth and maintenance metabolism. Given that this is the case, the resulting concentrations in fish would appear to be much more dependent of methylation rates and the structure of the food web than on total mercury concentrations in the water column. This suggests that basing the control of fish tissue concentrations on control of total mercury in the water column is fundamentally flawed.

Dr. Manning's data presented earlier make another important point concerning mercury; that is, methylation rate is a factor as important, perhaps more important, than loading rate in determining fish tissue concentrations. His data show that the geographic location of a river basin in the state is a major determinant of mercury concentration – South Georgia rivers tend to have four to five times higher concentration than North Georgia and Piedmont rivers, despite the fact that there are probably more anthropogenic mercury sources in the northern than in the southern part of the State. This conclusion is also supported by the data of Couch (1997), who concluded that biological tissue concentrations are higher in the Coastal Plain of Georgia, even though mercury sediment concentrations are higher in North Georgia and the Piedmont. This conclusion is further supported by analysis of fish tissue concentrations within the Savannah River, which shows higher concentrations as one moves for the northernmost reaches of the river in the Piedmont, to the southern reaches of the river in the Coastal Plain.

From this data, GIEC concludes that it is impossible to determine the link between water quality concentrations and water quality-based actions without considering the fate and transport of mercury and the effects of all sources in the TMDL. Therefore, the 1 ng/L target concentration is arbitrary and there is no basis for assigning it as a discharge limit to point sources in the basin.

6) EPA has assumed that mercury is a conservative substance. This is clearly not the case. This omission will have a huge impact on allowable loads when all sources are considered and cannot be neglected.

If EPA takes all the loads into account, then it must take fate and transport issues into account in order to realistically develop a TMDL. EPA is well aware of the behavior of mercury in aquatic systems. Yet, in this and previous TMDL analyses for mercury in Georgia, the Agency has chosen to treat mercury as a conservative substance, discounting the scientific facts compiled by its own experts (US EPA 1997).

In its MRC on pages 2-13 of Volume III, EPA acknowledges that volatilization and sediment deposition are major processes that affect the amount of mercury in the water column. EPA reports that mercury is strongly bound to sediments, having partition coefficients of 10 to 100,000 ml/g-soil and 100,000+ ml/g-suspended material, "indicating a strong preference for Hg(II) and methyl mercury to remain bound to soil, bottom sediment or suspended matter." They conclude that for many lakes, "sedimentation of Hg(II) and methyl mercury bound to particulate matter is expected to be the dominant process for the removal of mercury from the water column." Gilmour and Henry (1991) report that mercury is removed from the water column and deposited to sediments along with particulate organic carbon, a process that is enhanced at lower pH. High DOC and lower pH are conditions likely to be found in the lower reaches of the Savannah River drainage.

The same EPA report goes on to say that Hg^0, the volatile species of mercury, "is produced in freshwater by humic acid reduction of Hg(II) or demethylation of methyl mercury mediated by sunlight. An amount will remain in the dissolved gaseous state while *most* will volatilize" [emphasis added]. The report also notes that "Hg^0 constitutes very little of the total mercury in the water column but may provide a significant pathway for the evolution of mercury out of the waterbody via Hg(II) or methyl mercury volatilization."

We understand that, given the lack of specific information on the processes affecting mercury fate-and-transport in this system, it is compelling to treat mercury as a totally dissolved, conservative substance. However, enough is known about mercury fate-and-transport that these effects on dissolved concentrations could be estimated. EPA needs to give credit to the dischargers in the analysis by accounting for these loss mechanisms and assuming that all the mercury potentially discharged appears in the system as dissolved mercury.

GIEC suggests that some estimates of sediment partitioning and loss through volatilization could be made which would realistically portray the dissolved concentration of mercury in this system and form the basis of a much more appropriate TMDL.

7) EPA has made use of the "implicit" margin of safety, allowing the Agency to arbitrarily establish a TMDL, without regard for the degree to which it is overly-protective and unjustifiably punitive to basin dischargers.

Based on the recalculation of the TMDL in Comment 2, GIEC believes the margin of safety employed by EPA in this TMDL is, at a minimum, on the order of 6400%, and could possibly be larger. We find it difficult to imagine that EPA needs to apply a margin of safety of this order when it is debatable that the fishing use of the river is even impaired. EPA is establishing an overly restrictive standard, which could potentially cost millions of dollars to point source dischargers to the Savannah River in monitoring, identification of in-plant sources, and source reductions, when at the present time EPA cannot show that such restriction will result in any detectable or positive impact on mercury concentrations in water or in fish.

Recommendations: Alternatives for EPA

Based upon the foregoing discussion, GIEC proposes three scenarios to EPA as alternatives to finalizing the TMDL:

- Withdraw the TMDL based upon the fact that there was never a basis for 303(d) listing the waters of the Savannah River.

- Establish the Phase I TMDL using the State's current mercury criterion of 12 ng/L and a reasonable estimate of mean flow for segments of the Savannah River. Develop load allocations for point sources by capping them at their current discharge limits. Obtain critical site-specific information in order to establish a scientifically defensible TMDL in Phase II, including load allocations for point and nonpoint sources, including both terrestrial and atmospheric background.

- Establish the Phase I TMDL using the State's current mercury criterion of 12 ng/L and a reasonable estimate of mean flow for segments of the Savannah River. Estimate impact of loads and establish a load allocation for all sources, both point and nonpoint, natural and anthropogenic, based on relative contribution, and processes affecting mercury fate and transport in the river. Obtain critical site-specific information in order to establish a scientifically defensible TMDL in Phase II, including load allocations for point and nonpoint sources.

Appendices

Appendix A. Excerpts from Georgia's 1998 and Proposed 2000 List of Waters

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