TOTAL MAXIMUM DAILY LOAD (TMDL) DEVELOPMENT

For

Total Mercury

in the

Ohoopee Watershed

Including Listed Segments

GA Hwy 147 to confluence with Altamaha River

Hwy 292 to Hwy 147

Little Ohoopee River to US Highway 292

Neels Creek to Little Ohoopee

Sand Hill Lake

Gum Swamp Creek

TOTAL MAXIMUM DAILY LOAD (TMDL)

Total Mercury in Fish Tissue Residue

In the

In the Ohoopee River Watershed

Under the authority of Section 303(d) of the Clean Water Act, 33 U.S.C. 1251 et seq., as amended by the Water Quality Act of 1987, P.L. 100-4, the U.S. Environmental Protection Agency is hereby establishing a TMDL for total mercury for the protection of public health associated with the consumption of fish taken from the following segments of the Ohoopee River in Georgia:

GA Hwy 147 to confluence with Altamaha River

Hwy 292 to Hwy 147

Little Ohoopee River to US Highway 292

Neels Creek to Little Ohoopee

Sand Hill Lake & Gum Swamp Creek

The calculated allowable load of mercury that may come into the identified segments of the Ohoopee River without exceeding the applicable water quality standard is 3.77 kilograms per year. The applicable water quality standard is the State of Georgia's numeric interpretation of their narrative water quality standard for protection of human health from toxic substances, consumption of fish by the general population is not to exceed 0.3 mg/kg mercury in fish tissue. Based on a current estimated loading of 4.99 kilograms per year, an estimated 24% reduction in mercury loading is needed for the identified sections of the Ohoopee River to meet the applicable water quality standard of 3.5 nanograms per liter. It is anticipated that new legislation to control multiple air pollutants will achieve reductions in air deposition of mercury that will enable achievement of water quality standards. One facility permitted by the State of Georgia under the National Pollutant Discharge Elimination System Program is provided wasteload allocations in this TMDL.

This TMDL shall become effective immediately, and is incorporated into the Continuing Planning Process for the State of Georgia under Sections 303(d)(2) and 303(e) of the Clean Water Act.

Signed this _____ day of_____, 2002.

_____

Beverly H. Banister, Director
Water Management Division

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1. Introduction

The U.S. Environmental Protection Agency (EPA) Region 4 is establishing this Total Maximum Daily Load (TMDL) for total mercury for the Ohoopee River. The segments are as follows:

- GA Hwy 147 to confluence with Altamaha River
- Hwy 292 to Hwy 147
- Little Ohoopee River to US Highway 292
- Neels Creek to Little Ohoopee
- Sand Hill Lake
- Gum Swamp Creek

These segments are listed on the State of Georgia's 2000 Section 303(d) list of impaired waters because mercury in certain species of fish tissue exceeds the Georgia Department of Natural Resources (GDNR) Fish Consumption Guidelines State's guidelines.

TMDLs are required for waters on a state's Section 303(d) list by Section 303(d) of the Clean Water Act (CWA) and the associated regulations at 40 CFR Part 130. A TMDL establishes the maximum amount of a pollutant a waterbody can assimilate without exceeding the applicable water quality standard. The TMDL allocates the total allowable pollutant load to individual sources or categories of pollution sources through wasteload allocations (WLAs) for point sources regulated by the National Pollutant Discharge Elimination System (NPDES) program and through load allocations (LAs) for all other sources. The WLAs and LAs in the TMDL provide a basis for states to reduce pollution from both point and nonpoint sources that will lead to restoration of the quality of the impaired waterbody. The purpose of this TMDL is to identify the allowable load of mercury that will result in attainment of the applicable water quality standard, and the unrestricted use of the identified segments for fish consumption.

This TMDL satisfies a consent decree obligation established in Sierra Club, et. al. v. EPA, Civil Action: 94-CV-2501-MHS. The Consent Decree requires TMDLs to be developed for all waters on Georgia's current Section 303 (d) list consistent with the schedule established by Georgia for its rotating basin management approach. The State of Georgia requested EPA to develop this TMDL, and as such, EPA is establishing this TMDL for Georgia for the 4 segments of the Ohoopee River and Sand Hill Lake and Gum Swamp Creek public fishing areas.

2. Phased Approach to the TMDL

EPA recognizes that it may be appropriate to revise this TMDL based on information gathered and analyses performed after August 2001. With such possible revisions in mind, this TMDL is characterized as a phased TMDL. In a phased TMDL, EPA or the state uses the best information available at the time to establish the TMDL at levels necessary to implement applicable water quality standards and to make the allocations to the pollution

sources. However, the phased TMDL approach recognizes that additional data and information may be necessary to validate the assumptions of the TMDL and to provide greater certainty that the TMDL will achieve the applicable water quality standard. Thus, the Phase 1 TMDL identifies data and information to be collected after the first phase TMDL is established that would then be assessed and would form the basis for a Phase 2 TMDL. The Phase 2 TMDL may revise the needed load reductions or the allocation of the allowable load or both. EPA intends to gather new information and perform new analyses so as to produce a revised or Phase 2 TMDL for mercury for the identified segments of the Ohoopee River, if necessary, in 2011. The phased approach is appropriate for this TMDL because information on the actual contributions of mercury to the Ohoopee River from both point and nonpoint sources will be much better characterized in the future.

2.1. Phased Approach to Atmospheric Sources

The impairment of the Ohoopee River, Gum Swamp Lake and Sand Hill Lake is by mercury is largely due to the deposition of mercury from the atmosphere. This TMDL estimates that over 99 percent of the pollutant loads to the River come from the atmosphere (Section 6.1). An analysis of atmospheric deposition to the Ohoopee River watershed is included in this TMDL as Appendix A. Mercury is emitted into the atmosphere by a large number of different sources. The mercury that reaches the Ohoopee River watershed comes from nearby sources (local sources) as well as sources much farther away, both within the United States (national sources) and outside of the United States (international sources). Only a small part, less than 1 percent, of the mercury loading into the Ohoopee River is due to discharges from water point sources (e.g., pipes) into the Ohoopee River or its tributaries.

In Appendix A, EPA has made its best attempt to characterize the air sources of mercury to the watershed, given the time available to the Agency for establishing the TMDL. The analysis of deposition of mercury from the atmosphere to the Ohoopee watershed depends heavily on modeling conducted for the Mercury Study Report to Congress (EPA, 1997). This Study was based on the Regional Lagrangian Model of Air Pollution (RELMAP) modeling, which has several areas of uncertainty, and assumptions that could affect the level of reductions projected by the analysis. Many of these uncertainties are not unique to the analysis of atmospheric deposition prepared for the Ohoopee River Mercury TMDL. Some of these uncertainties include the estimates of the amount of the chemical form or species of mercury emitted by each source category; the projected level of reductions from each source category subject to the Clean Air Act (CAA) Section 129 or 111 or MACT; the definition of local sources contributing deposition to the watershed; the contribution from global sources; and other aspects of the modeling. While it is not possible to quantify the net effect of these factors, EPA believes the assumptions made to address these uncertainties are reasonable and consistent with the state-of-the art mercury modeling available at the time this TMDL was prepared. Also, EPA is currently developing legislation to establish additional controls on multiple air pollutants, including mercury, from electric utilities. EPA anticipates that this process will produce reductions in the atmospheric deposition of mercury that will enable achievement of water quality standards.

2.2. Phased Approach to Water Point Sources

At this time, there is relatively little data on the actual loading of mercury from NPDES point sources in the basin. Because, until recently, EPA's published method for the analysis of mercury was not sensitive enough to measure mercury at low trace level concentrations, most NPDES facilities have not detected mercury during their required priority pollutant monitoring. EPA assumes, however, that all facilities discharge some mercury into the River with their effluent because mercury is pervasive in the environment and is present in rainwater.

Recently, in 1998, EPA adopted a new analytical procedure that detects mercury at low trace level concentrations (0.5 nanograms/liter) (See EPA Method 1631, Revision B, 40 C.F.R. 136.3(a)). A sampling by EPA of a small subset of the NPDES dischargers in Middle Georgia using the trace level Method 1631 analytical technique verifies EPA's assumption that all facilities are discharging some mercury. As NPDES permits are reissued, dischargers will be required to use the version of Method 1631 then in effect for analyzing mercury. (Georgia Rules and Regulations for Water Quality Control, Chapter 391-3-6-.06). Therefore, in the Phase 2 TMDL, data on the concentration of mercury in point source discharges using the more sensitive analytical technique will be available to characterize the actual loading of mercury into the Ohoopee River. This will allow EPA, as appropriate, to refine wasteload allocations provided in the TMDL.

Because the impairment of the Ohoopee River by mercury is due predominantly to air deposition, the complete elimination or significant reduction of mercury from water point source discharges would produce little benefit in the quality of the Ohoopee River. In addition, the elimination or significant reduction of mercury would likely be expensive and possibly technically infeasible for point sources to implement. Since many of the NPDES facilities in the basin affected by this TMDL are municipal wastewater treatment plants that are funded through the taxpayers, EPA chooses to move cautiously before implementing wasteload allocations that may cause significant economic hardship in a situation where, as here, EPA expects most of the needed mercury reductions to be achieved through Clean Air Act reductions in mercury emissions from air sources. In this Phase 1 TMDL, EPA expects point source loadings of mercury will be reduced primarily through mercury minimization programs developed and implemented by some point sources.

In summary, during implementation of the Phase 1 TMDL, EPA expects the following activities to occur:

- 7 NPDES facilities will monitor for mercury and characterize it in their influent and effluent for mercury using the more sensitive analytical technique (the version of Method 1631 then in effect). These facilities consist of 7 municipal facilities. (See Section 10.2.)
- Where appropriate, NPDES point sources will develop and implement mercury minimization plans;
- Air point sources will continue to reduce emissions of mercury through implementation of the Clean Air Act Section 112 MACT requirements and Section

129 Solid Waste Combustion requirements;
- EPA and the regulated community will improve the mercury air emissions inventory;
- EPA will refine and revise the mercury air deposition modeling to better characterize sources of mercury; and
- EPA and the states will collect additional ambient data on mercury concentrations in water, sediment and fish.
- EPA expects Georgia to adopt a numeric water quality criterion for methylmercury for the protection of human health that is based on EPA's recent criteria guidance, either as published or as modified to reflect site-specific conditions, or that are based on other scientifically defensible methods. (See 40 C.F.R. 131.11(b))

EPA intends to use the data and information collected and developed during the next ten years to revise the Phase 1 TMDL, as necessary, to assure that the allowable load will be achieved by implementation of the TMDL. EPA's intention to revise the TMDL is consistent with the State of Georgia's Rotating Basin Management Program (RBMP) schedule. Under Georgia's current RBMP schedule, NPDES permits in the Ohoopee River Basin will be reissued in 2012. Therefore, EPA intends to revise the TMDL one year prior to reissuance of permits in the Ohoopee River Basin.

3. Problem Definition

Ohoopee River is on the State of Georgia's 2000 Section 303(d) list. Ohoopee River was listed because mercury in the tissue of largemouth bass, redbreasted sunfish and Spotted Sucker exceeded the Fish Consumption Guidelines (FCG) established by the State of Georgia. (See Georgia Department of Natural Resources, 2000.) The Fish Consumption Guidelines establish limits on the amount of fish that should be consumed over a given time frame (a week or a month) in order to protect human health.

The Georgia Department of Natural Resources (DNR) uses a risk-based approach to determine how often contaminated fish may be consumed at different levels of fish tissue contamination assuming a consumption rate of approximately 32.5 grams per day. Table 1 provides the frequency of consumption for three different levels of fish tissue contamination with mercury.

Table 1 Georgia Department of Natural Resources Fish Consumption Guideline

Mercury Fish Tissue Threshold (mg/kg)	Frequency of Consumption
0.23	Once a Week
0.70	Once a Month
2.3	Do Not Eat

If fish tissue contains 0.23 mg/kg (parts per million) or more of mercury, the State's FCG indicates that the fish should not be consumed more than once a week. If fish tissue contains 0.70 mg/kg (parts per million) or more of mercury, the State's FCG indicates the fish should not be consumed more than once a month, and if the fish tissue contains 2.30 mg/kg (parts per million) or greater of mercury, the State issues a "Do Not Eat" guideline. The following

FCG are in place for the Ohoopee River: largemouth bass (once a month), redbreasted sunfish and spotted sucker (once a week).

The methodology used by the State of Georgia in the development of the fish consumption guidelines targets specific species and size of fish, and uses a conservative risked-based approach in determining whether consumption guidance is warranted for a particular waterbody. EPA supports the State of Georgia's approach to establishing consumption guidelines as an appropriate way to inform the public of the potential risks in eating certain size and species fish.

4. Applicable Water Quality Standard

TMDLs are established at levels necessary to attain and maintain the applicable narrative and numerical water quality standards. (See 40 CFR Section 130.7(c)(1).) The State of Georgia's Rules and Regulations for Water Quality Control do not include a numeric criterion for the protection of human health from methylmercury. The State's regulations provide a narrative water quality standard, free from toxics. Since mercury may cause toxicity in humans, a numeric "interpretation" of the narrative water quality standard is necessary to assure that a TMDL will protect human health. EPA defers to the State water quality standard or criterion as the applicable water quality standard for development of the TMDL. States may establish (or interpret) their applicable water quality standards for protection of human health at a numeric concentration different from their fish consumption guidelines. The State of Georgia has made a numeric interpretation of their narrative water quality standard for toxic substances at a numeric concentration of no more than 0.3 mg/kg Methylmercury in fish tissue. (See the July 2001 letter from the State to EPA.) This numeric interpretation protects the "general population" which is the population that consumes 17.5 grams per day or less of freshwater fish. This approach is consistent with EPA's recently adopted guidance value for the protection of human health from methylmercury described in the document titled, "Water Quality Criterion for the Protection of Human Health: Methylmercury". (EPA 2001) Using this methodology, it is determined that the general population is consuming greater than 17.5 grams of fish per day, the waterbody is determined to be impaired and will be included on future State Section 303(d) lists when the weighted fish consumption concentration is greater than 0.30 mg/kg. The methodology uses a "weighted consumption" approach that assumes that 8 grams per day (58.4%) of the total fish consumption is trophic level 3 fish (e.g., catfish and sunfish), and 5.7 grams per day (41.6%) are trophic level 4 fish (e.g., largemouth bass). See Equation 4-1 below.

Equation 4-1 Weight Fish Tissue Calculation to Determine Impairment

$$Weighted\ Fish\ Tissue\ Concentration = (Avg\ Trophic\ 4\ Conc. * 41.6\%) + (Avg\ Trophic\ 3 * 58.4\%)$$

where:

Avg. Trophic 4 Concentration = 1.4 mg/kg
Avg. Trophic Level 3 Concentration = 0.3 mg/kg

EPA collected site-specific data from the Altamaha River on ambient mercury in fish tissue

and in the water column in March/April 2001 at 1 location in the lower Ohoopee River. Using Equation 4-1, site-specific fish tissue concentration date collected in the Ohoopee River yields a weighted fish tissue concentration of 0.9 mg/kg which is greater than the State's current, applicable water quality criterion of 0.3 mg/kg.

5. TMDL Target

In order to establish the TMDL, the maximum allowable concentration of total mercury in the ambient water must be determined that will prevent accumulation of methylmercury in fish tissue above the applicable water quality standard of 0.3 mg/kg level. To determine this allowable ambient water concentration, EPA referred to the "Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health" (EPA 2000). The methodology ~~is~~ expressed below (Equation 5-1):

Equation 5-1 Water Quality Standard Calculation

$$WQS = \frac{((ReferenceDose - RSC) * BodyWeight * UnitsConversion)}{(ConsumptionRate * Weighted\ BAF * FractionMeHg)}$$

where:

WQS = 3.5 ng/l
Reference Dose = 0.0001 mg/kg/day MeHg
RSC = 0.000027mg/kg/day MeHg (Relative Source Contribution from Saltwater Species)
Body Weight = 70 kg
Units Conversion = 1.0E6
Consumption Rate = 0.0175 kg/day Fish
Weighted Bioaccumulation Factor = 622,464
Fraction of the Total Mercury as Methylmercury = 0.14 as measured

In the determination of the allowable ambient water concentration, EPA used the recommended national values from the Human Health Methodology, including the reference dose of 0.0001-mg/k/day methylmercury; a standard average adult body weight of 70 kg; and the consumption rate for the general population of 17.5 grams per day. (Note that a recent report by the National Academy of Sciences confirms that methylmercury is a potent toxin, and concludes that EPA's reference dose of 0.0001 mg/kg/day is appropriate. (See NAS, Toxicological Effects of Methylmercury, July 2000)). For the other factors in the calculation, bioaccumulation and fraction methylmercury, EPA used site-specific data from the Ohoopee River collected in March/April of 2001. (See Section 6.3.) From this site-specific data, EPA determined a representative "weighted" bioaccumulation factor (BAF). This BAF was calculated by taking the average calculated BAF from each of the two trophic levels to determine a "weighted" BAF based upon the different consumption rates for trophic levels, and a the measured fraction methylmercury of 0.14. Using this approach, an allowable concentration of total mercury in the ambient water of Ohoopee River for the protection of human health is 3.5 nanograms per liter (parts per trillion). This concentration

or less in the ambient water will prevent the bioaccumulation of mercury in fish tissue above 0.3 mg/kg. The site-specific data for total mercury in the water column collected during the monitoring in 2001 was 8.9 ng/l.

6. Background

The Ohoopee watershed is located in mideastern Georgia (USGS Hydrologic Unit Code (HUC) 3070107). The Ohoopee watershed is presented in Figure 1.

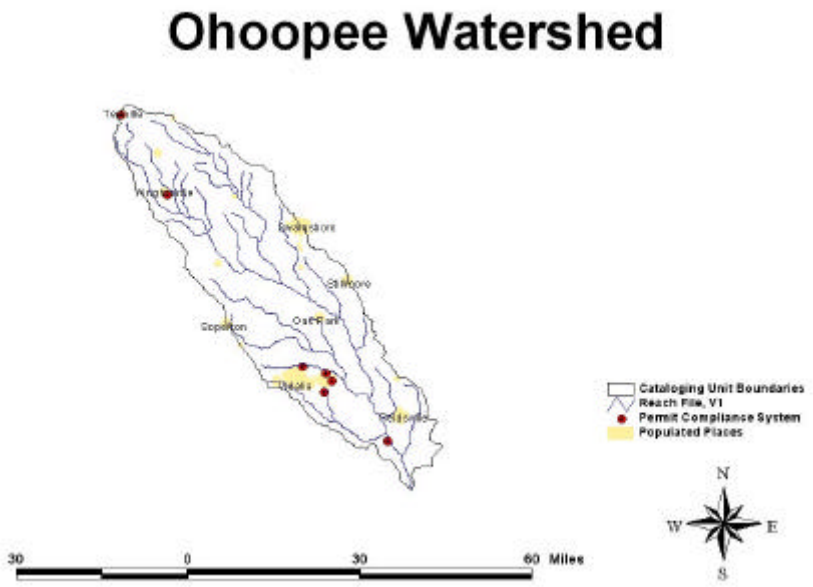

Figure 1 Ohoopee Watershed

The Ohoopee watershed has been divided into 9 subwatersheds (Figure 2) for this TMDL, representing all of the major tributaries to the Ohoopee River. A total mercury load will be determined for each of these subwatersheds to determine the impact of atmospheric deposition on the Ohoopee River.

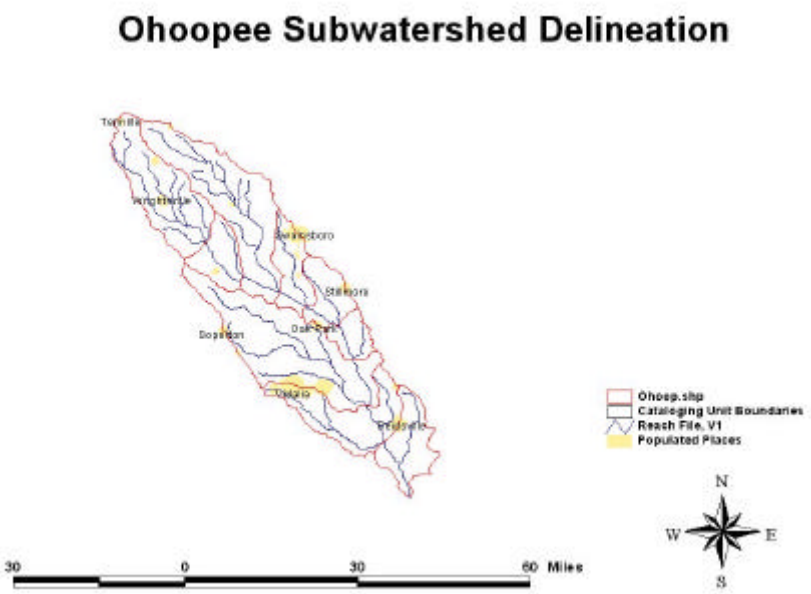

Figure 2 Ohoopee Watershed Delineation

The watershed contains several different types of landuses. The landuses for the Ohoopee watershed are given in Figure 3. Different landuses collect and distribute mercury at different rates as a function of runoff and erosion.

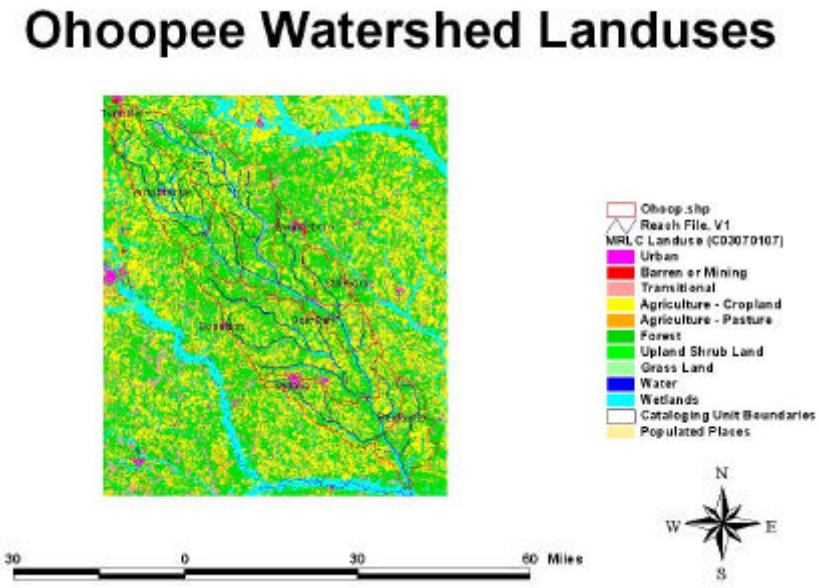

Figure 3 Ohoopee Watershed Landuses

This TMDL covers all waterbodies in the Ohoopee watershed. Because the spatial

distribution of mercury contamination is not completely known in the streams and creeks throughout the watershed, and fish move throughout the watershed, this TMDL is developed to protect all streams and creeks in the entire watershed from unacceptable accumulations of mercury in fish tissue. As discussed in previous sections of this document, the State of Georgia has issued a Fish Consumption Guideline for various segments of the Ohoopee River and tributaries. This guideline was issued due to elevated levels of mercury found in fish flesh collected in the watershed.

6.1. Source Assessment

A TMDL evaluation must examine all known potential sources of the pollutant in the watershed, including point sources, nonpoint sources, and background levels. The source assessment is used as the basis of development of a model and the analysis of TMDL allocation options. This TMDL analysis includes contributions from point sources, nonpoint sources and background levels. The point sources in the Ohoopee watershed, which could potentially have mercury in their discharge, are listed in Table 2.

Table 2 Permitted Facilities in Ohoopee Watershed

Facility	Permit #
Reidsville	GA0022900
Lyons	GA0033405
Lyons	GA0033391
Santa Claus	GA0050059
Vidalia	GA0025488
Wrightsville	GA0032395
Tennille	GA0049956

6.2. Watershed Background Load

Significant atmospheric sources of mercury often cause locally elevated areas of atmospheric deposition downwind. Mercury emitted from man-made sources usually contains both gaseous elemental mercury (Hg (0)) and divalent mercury (Hg(II)). Hg (II) forms, because of their solubility and their tendency to attach to particles, redeposit relatively close to their source (probably within a few hundred miles) whereas Hg (0) remains in the atmosphere much longer.

Based on a review of the Mercury Study Report to Congress, significant potential point sources of airborne mercury include coal-fired power plants, waste incinerators, cement and limekilns, smelters, pulp and paper mills, and chlor-alkali factories (USEPA, 1997).

Atmospheric deposition is a major source of mercury in many parts of the country. In a study of trace metal contamination in reservoirs in New Mexico, it was found that 80 percent of mercury found in surface waters was coming from atmospheric deposition (Popp et al., 1996). In other remote areas (Wisconsin, Sweden, and Canada) atmospheric deposition has been identified as the primary (or possibly only) contributor of mercury to the waterbodies

(Watras et al., 1994; Burke et al., 1995; Keeler et al., 1994).

6.2.1. RELMAP Mercury Deposition Rates

As part of the Mercury Report to Congress, a national airshed model (RELMAP) was applied to the continental United States. This model provides a distribution of both wet and dry deposition of mercury as function of air emissions and global sources. Figure 4 and Figure 5 illustrate the dry and wet deposition rates for South Georgia as derived by RELMAP. The RELMAP model, which was used to predict these deposition rates, was based upon an outdated emissions inventory and did not include other foreign airsheds (i.e. Mexico and others). Other data, presented below, has been relied on for this TMDL.

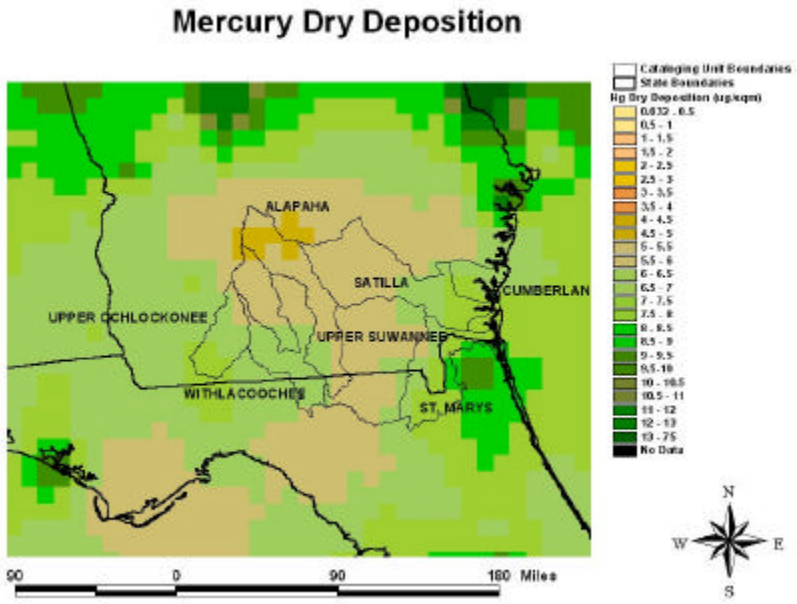

Figure 4 Mercury Dry Deposition Rates as Reported in the Mercury Report to Congress

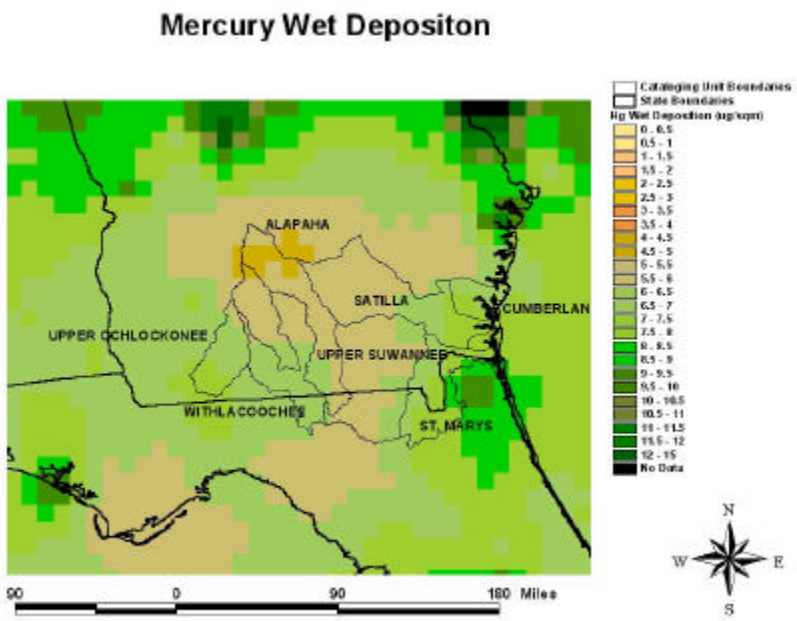

Figure 5 Mercury Wet Deposition Rates as Reported in the Mercury Report to Congress

6.2.2. Mercury Deposition Network

The objective of the Mercury Deposition Network (MDN) is to develop a national database of weekly concentrations of total mercury in precipitation and the seasonal and annual flux of total mercury in wet deposition. The data will be used to develop information on spatial and seasonal trends in mercury deposited to surface waters, forested watersheds, and other sensitive receptors. Locations of the MDN sampling stations are shown on Figure 6.

The EPA Region 4 Air Program reviewed the MDN data for sampling station GA09. This data was compared with the RELMAP deposition predictions and was found to be substantially higher. Using the MDN data, the average annual wet deposition rate was determined to be 12.75 ì g/sq. meter and the dry deposition rate was determined to be 6.375 ì g/sq. meter.

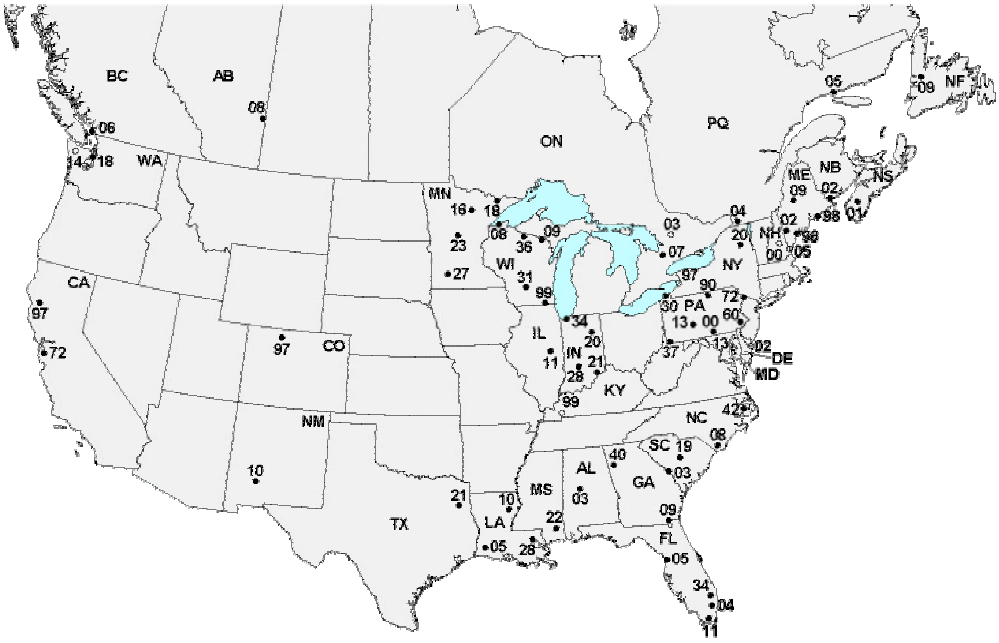

Figure 6 Mercury Deposition Network Sampling Locations

6.3. Available Monitoring Data

The State of Georgia's Environmental Protection Division and the Wildlife Resources Division routinely monitor water and fish tissue in State waters. Focused monitoring work for the Ohoopee River, in accordance with the Georgia river basin planning cycle, was conducted in 1998. The metals sampling and analysis work is done by contract with the United States Geologic Survey (USGS). Water samples were collected and analyzed for metals including mercury by the USGS in the Ohoopee River basin. Mercury analysis methodology for water samples at that time had a detection limit of 200 ng./l (parts per trillion). This methodology is used by EPA, the USGS and the states in the environmental monitoring programs. Mercury was not detected in water samples from the Ohoopee in 1998.

In June of 1998 EPA promulgated Method 1631 for mercury in water for data gathering and compliance monitoring under the Clean Water Act and Safe Drinking Water Act. (See 64 CFR 30417.) This method has a detection limit of 0.5 ng/l (parts per trillion). The availability of this methodology has made detection of mercury in the water column possible. Since low concentrations of mercury in water can lead to significant accumulation of mercury in fish tissue, it was necessary for EPA to sample the Ohoopee River using Method 1631 to determine the ambient concentration in the River.

6.3.1. EPA Region 4 Data

Because little ambient mercury data exists for the Ohoopee watershed, EPA Region 4 sampled the Ohoopee watershed in June 2000 & March/April 2001. The purpose of this data

collection effort was to collect data needed for the development of this mercury TMDL. The sample locations for the Ohoopee watershed are illustrated in Figure 7. Water column, sediment and fish tissue samples were taken from the mainstem of the Ohoopee River. The following sections provide the results of the field sampling for mercury.

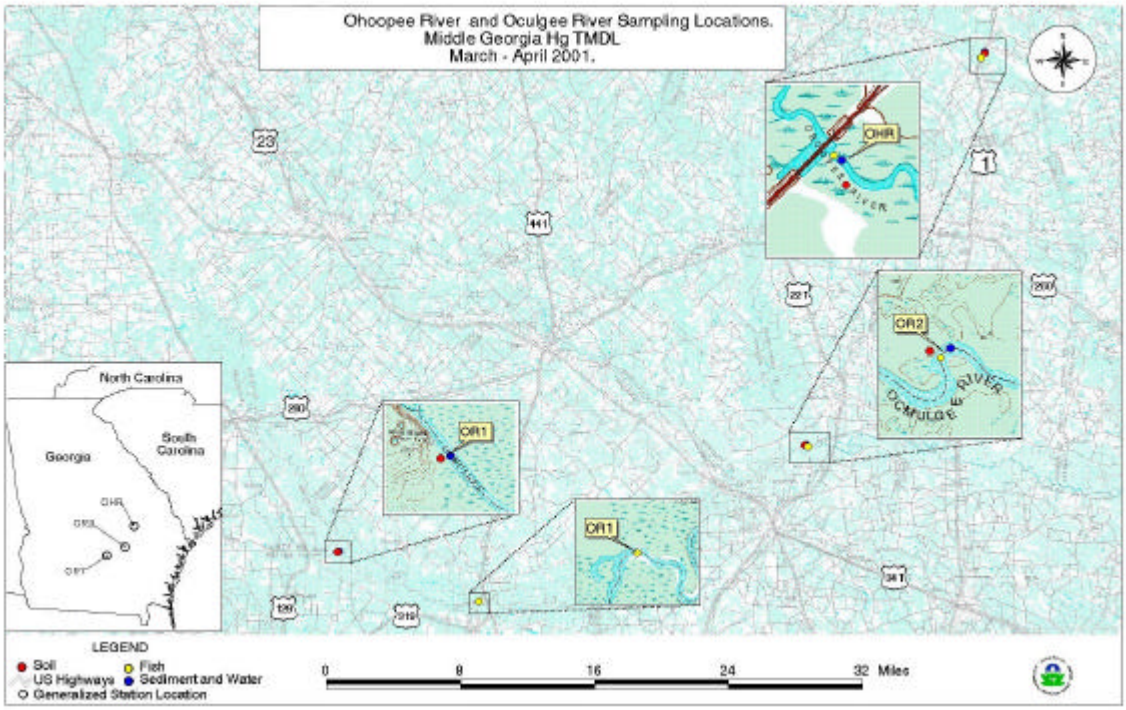

Figure 7 Ohoopee Watershed Sample Locations

6.3.2. Water Column Data

Water column samples were taken to determine the ambient concentration of mercury in the water column using Method 1631, an ultra-trace level clean sampling and analytical technique with a detection limit of 0.5 ng/l. The water column samples were analyzed for both total mercury and methylmercury. Because methylmercury is the primary form of mercury taken up in the food chain, it was important to quantify the fraction of the total mercury in the methyl form. Table 3 provides the measured mercury concentrations in the water column in the receiving waterbodies of the Ohoopee watershed.

Table 3 Water Column Mercury Concentrations

Station	Total Mercury (ng/l)	MeHg (ng/l)	Percent Methyl
Ohoopee 1	8.86	1.19	0.13
Ohoopee 2	NA	1.21	

6.3.3. Sediment/Soil Data

Samples of river sediments were gathered at the same locations as the water samples to determine the amount of mercury associated with the sediments and porewater. This data provides important information that can be used to parameterize the water quality model by providing evidence of the effects of mercury in the sediments on the total mercury water column concentration. Soil samples were collected from the surrounding watershed where the other samples were taken. EPA collected the soil samples to be used in the calibration of the watershed model. . Table 4 provides the mercury concentrations associated with soils collected during the summer of 2001.

Table 4 Sediment/Soil Mercury Concentrations

		Total Mercury		Methyl Mercury	
Station	Waterbody	Sediment	Surface Soil	Sediment	Surface Soil
OH	Ohoopee	0.0076	0.0518	0.0498	0.114

6.3.4. Fish Tissue Data

Samples of fish were taken from the Ohoopee River within the same area as the water column and sediment samples. Trophic level four fish (largemouth bass) and trophic level 3 (sunfish) were targeted in the collection. The fish fillets obtained during EPA's sampling effort were analyzed for total mercury. Table 5 provides the individual fish data. The fish tissue mercury concentration will be used to determine a site-specific weighted bioaccumulation factor (BAF) for trophic level 3 and 4, and to determine the appropriate target for the TMDL.

Table 5 Fish Tissue Mercury Data

Fish Type	Fish Length (mm)	Fish Weight (g)	Total Mercury (mg/kg)
Largemouth Bass	487	1470	1.7
Largemouth Bass	318	325	1.5
Largemouth Bass	298	362	0.9
Largemouth Bass	319	503	1.3
Largemouth Bass	390	877	1.5
Redbreast Sunfish	198	170	0.48
Redbreast Sunfish	161	101	0.25
Redbreast Sunfish	145	67	0.35
Redbreast Sunfish	136	55	0.24
Redbreast Sunfish	130	48	0.2

7. Numeric Targets and Sources - Model Development

The link between the fish tissue end-point and the identified sources of mercury is the basis for the development of the TMDL. The linkage is defined as the cause and effect relationship between the selected indicators, the fish tissue end-point and identified sources. This provides the basis for estimating total assimilative capacity of the river and any needed load reductions. In this TMDL, models of watershed loading of mercury are combined with a model of mercury cycling and bioaccumulation in the water. This enables a translation between the end-point for the TMDL (expressed as a fish tissue concentration of mercury) and the mercury loads to the water. The loading capacity is then determined by the linkage analysis as a mercury-loading rate that is consistent with meeting the end-point fish tissue concentration.

7.1. Watershed Hydrologic and Sediment Loading Model

An analysis of watershed loading could be conducted at various levels of complexity, ranging from a simplistic gross estimate to a dynamic model that captures the detailed runoff from the watershed to the receiving waterbody. Because of the limited amount of data available for the Ohoopee watershed to calibrate a detailed dynamic watershed runoff model, a more simplistic approach is taken to determine the mercury contributions to the Ohoopee River from the surrounding watershed and atmospheric components. Therefore, a scoping-level analysis of the watershed mercury load, based on an annual mass balance of water and sediment loading from the watershed is used for the TMDL development.

Watershed-scale loading of water and sediment was simulated using the Watershed Characterization System (WCS). The complexity of this loading function model falls between that of a detailed simulation model, which attempts a mechanistic, time-dependent representation of pollutant load generation and transport, and simple export coefficient models, which do not represent temporal variability. The WCS provides a mechanistic, simplified simulation of precipitation-driven runoff and sediment delivery, yet is intended to be applicable without calibration. Solids load, runoff, can then be used to estimate pollutant

delivery to the receiving waterbody from the watershed. This estimate is based on pollutant concentrations in wet and dry deposition and processed by soils in the watershed and ultimately delivered to the receiving waterbody by runoff, erosion and direct deposition.

7.2. Water Quality Fate and Transport Model

WASP5 (Ambrose, et al., 1993) was chosen to simulate mercury fate in the Ohoopee River. WASP5 is a general dynamic mass balance framework for modeling contaminant fate and transport in surface waters. Based on the flexible compartment modeling approach, WASP can be applied in one, two, or three dimensions with advective and dispersive transport between discrete physical compartments, or segments. A body of water is represented in WASP as a series of discrete computational elements or segments. Environmental properties and chemical concentrations are modeled as spatially constant within segments. Each variable is advected and dispersed among water segments, and exchanged with surficial benthic segments by diffusive mixing. Sorbed or particulate fractions may settle through water column segments and deposit to or erode from surficial benthic segments. Within the bed, dissolved variables may migrate downward or upward through percolation and pore water diffusion. Sorbed variables may migrate downward or upward through net sedimentation or erosion.

Two WASP models are provided with WASP5. The toxics WASP model, TOXI5, combines a kinetic structure adapted from EXAMS2 with the WASP5 transport structure and simple sediment balance algorithms to predict dissolved and sorbed chemical concentrations in the bed and overlying waters. TOXI5 simulates the transport and transformation of one to three chemicals and one to three types of particulate material. The three chemicals may be independent, such as isomers of PCB, or they may be linked with reaction yields, such as a parent compound-daughter product sequence. Each chemical exists as a neutral compound and up to four ionic species. The neutral and ionic species can exist in five phases: dissolved, sorbed to dissolved organic carbon (DOC), and sorbed to each of the up to three types of solids. Local equilibrium is assumed so that the distribution of the chemical between each of the species and phases is defined by distribution or partition coefficients. The model, then, is composed of up to six systems, three chemical and three solids, for which the general WASP5 mass balance equation is solved.

The WASP model was parameterized to simulate the fate and transport of mercury for the development of this TMDL. Site specific and literature values were used to predict water column concentrations as a function of flow.

8. Total Maximum Daily Load (TMDL)

The TMDL is the total amount of a pollutant that can be assimilated by the receiving waterbody while achieving the water quality target protective of human health through fish consumption. This TMDL determines the maximum load of total mercury that can enter the Ohoopee watershed within a year and still achieve a water column concentration for total mercury at or below the 3.5 ng/l target concentration as determined in the Target

Identification Section.

8.1. Critical Condition Determination

EPA's derivations of human health criteria assume that effects of mercury are a long-term exposure to water column concentrations that lead to the accumulation of mercury in the fish tissue. The TMDL utilizes an average annual flow to determine the TMDL. Furthermore, the period of record for climate data stations in the watershed are used to calculate an annual average load of mercury to the system.

8.2. Seasonal Variation

Wet deposition is greatest in the winter and spring seasons. Mercury is expected to fluctuate based on the amount and distribution of rainfall, and variability of localized and distant atmospheric sources. While a maximum daily load is established in this TMDL, the average annual load is of greatest significance since mercury bioaccumulation and the resulting risk to human health that results from mercury consumption is a long-term process. Thus, daily or weekly inputs are less meaningful than total annual loads over many years. The use of an annual load allows for integration of short-term or seasonal variability.

Methylation of mercury is expected to be highest during the summer. High temperatures and static conditions result in hypoxic and/or conditions that promote methylation. Based on this enhanced methylation and high predator feeding activity during the summer, mercury bioaccumulation is expected to be greatest during the summer. However, based on the refractory nature of mercury, seasonal changes in body burden would be expected to be slight. Inherent variability of mercury concentrations between individual fish of the same and/or different size categories is expected to be greater than seasonal variability.

Because the water quality target was determined using data from a one-time sampling event under a single condition, the water quality target calculation could be re-visited when more data is available to determine the annual average condition.

8.3. Margin of Safety

A Margin of Safety (MOS) is a required component of a TMDL that accounts for the uncertainty about the relationship between the pollutant loads and the quality of the receiving waterbody. The MOS is typically incorporated into the conservative assumptions used to develop the TMDL. A MOS is incorporated into this TMDL in a variety of ways. These include:

- Selecting the highest predicted water column concentration of mercury in the entire stretch of river to determine the load reduction needed to achieve Georgia's water quality standard. This approach conservatively assumes that fish are exposed to the highest water column concentration and accounts for uncertainties associated with identifying the precise locations where the fish take in mercury.
- Assigning a load reduction to point sources. While EPA believes that such

reductions, considered together with reductions from air sources, are necessary to achieve water quality standards, EPA also recognizes that future studies of mercury emissions from air sources may indicate that water quality standards can be achieved solely by controlling air sources. By assigning this load reduction to point sources, EPA accounts for the possibility that air source reductions are insufficient. Thus, in addition to reflecting what EPA believes today are necessary load reductions from point sources, these reductions help account for EPA's lack of precise knowledge concerning the relationship between the effects of Clean Air Act controls and water quality.

- Incorporating a number of conservative assumptions in deriving the estimate of anticipated reductions in emissions to the air. These are described in the Analysis of Atmospheric Deposition of Mercury to the Ohoopee River Watershed (2000). In addition, the resulting estimate does not take into account reductions resulting from voluntary control measures or new regulations. Therefore, reductions from air sources may possible be greater than presently estimated.

9. TMDL Development

The TMDL development will integrate the watershed loading with receiving water fate and transport of mercury. Annual average loads and flows will be used to evaluate current loading conditions and to determine what the loads would have to be to achieve the water quality target.

9.1. Model Results

Both the nonpoint source runoff model and the receiving waterbody model were used to determine the maximum load that could occur and protect fish from accumulating mercury to unacceptable levels. This section provides detailed information on how the models were applied, how the watershed and waterbody were broken down into segments (computational boxes) and how the mercury was transported throughout the watershed.

9.1.1. Nonpoint Source

The main driving force for the WCS mercury model is the input of the appropriate wet and dry deposition rates for mercury. The wet and dry deposition rates that were used in the watershed model were determined by a comparison between the RELMAP model results as reported in the Mercury Report to Congress and the Mercury Deposition Network sample collection site located in the Okefenokee Swamp. Yearly average dry deposition rates of 6.375 ìg/sqm and wet deposition rates of 12.75 ìg/sqm are used in the model. These deposition rates were interpreted from the MDN data. The WCS model was used to calculate the total load of mercury entering the mainstem portion of the Ohoopee River from the sub basins delineated in Figure 2. The predicted annual loads are given in Table 6.

Table 6 Annual Average Total Mercury Load from each Sub Basin

Watershed Name	Area (ha)	Total Hg Load (mg)	Load (mg) /ha	Impervious Surface (mg/yr)	Sediment (mg/yr)	Runoff (mg/yr)	Deposition on Water (mg/yr)
Upper Ohoopee River	52492.31	697960.1	13.3	168321.03	299399.06	176681.28	53358.75
Mulpen Creek	19124.24	248297	12.98	67438.58	86794.7	68244.98	25818.75
Little Ohoopee River	71326.37	852303.1	11.95	259048.13	278013.97	261882.2	53358.75
Rocky Creek	40553.54	723674.1	17.84	199337.97	289175.59	161046.78	74013.75
Yam Dandy Creek	20727.1	298292.8	14.39	94169.59	99885.55	73255.2	30982.5
Jacks Creek	18869.84	268393.6	14.22	81053.66	95002.93	66518.29	25818.75
Beaver Creek	12064.06	244702.5	20.28	56525.85	123528.13	49157.27	15491.25
Thomas Creek	26598.91	410260	15.42	98662.05	151613.27	111789.63	48195
Pendelton Creek	86209.15	1246215	14.46	393976.91	383380	337742.97	130815

For each of the sub basins, the total load is presented in mg/yr, and the percentage of the contribution of mercury from soil/erosion, runoff, direct deposition and impervious soil are presented. A summary of the distribution of the total mercury load to the Ohoopee River basin is provided in Figure 8. The loads from each of the sub basins are passed onto the water quality model as an annual load.

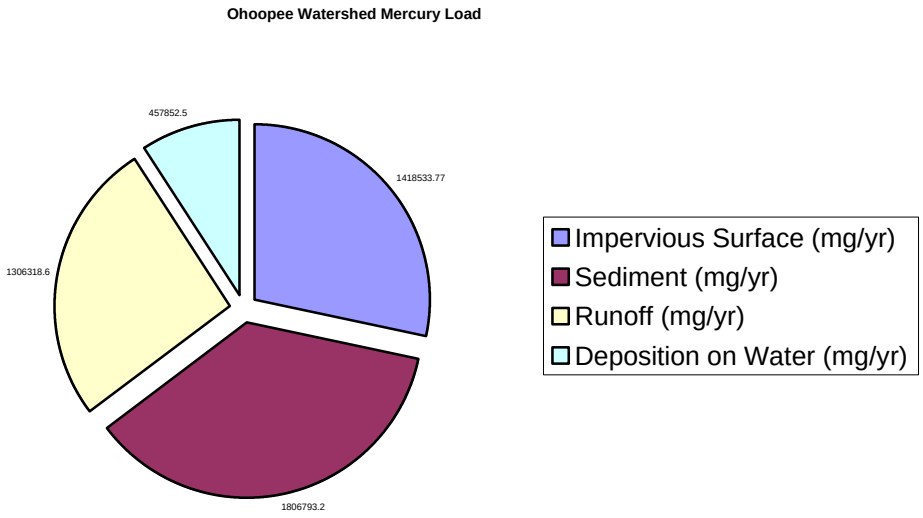

Figure 8 Mercury Load Distribution

9.1.2. Water Quality Model

The WASP5 toxic chemical program TOXI5 was set up to simulate mercury in the mainstem of the Ohoopee River. The mainstem of the river was divided into 6 reaches. Each reach was further divided into 2 vertical compartments representing surface water and surficial sediment. The 2 cm deep surficial sediment layer actively exchanges silt and clay-sized

solids as well as chemicals within the water column. In addition, this layer is the site for active microbial transformation reactions. Sediment-water column diffusion coefficients were set at 10^{-5} cm^2/sec.

Two solids classes were simulated sand and silt. Sand makes up most of the benthic sediment compartments, which have a dry bulk density of 0.5 g/ml. Given a particle density of 2.7 g/ml, the sediment porosity is about 0.8 and the bulk density is 1.3 g/ml. Silt is found both suspended in the water column and in the sediment. These simulations assumed that 10 mg/L of silt enters the mainstem from the subwatersheds, settling out at an assumed velocity of 0.3 m/day. Silt in the surficial sediment compartments is assumed to resuspend at a velocity of 0.006 m/day, giving a concentration of about 0.005 g/ml, or about 1% of the surficial sediment. The exchanging silt carries sorbed mercury between the water column and surficial sediment.

Mercury was simulated as 3 components **B** elemental mercury, Hg^0; inorganic divalent mercury, Hg(II); and monomethylmercury, MeHg. Hg(II) and MeHg partition to solids and dissolved organic carbon (DOC). These are represented as equilibrium reactions governed by specified partition coefficients. The three mercury components are also subject to several transformation reactions, including oxidation of Hg^0 in the water column, reduction and methylation of Hg(II) in the water column and sediment layer, and demethylation of MeHg in the water column and sediment layer. These are represented as first-order reactions governed by specified rate constants. Reduction and demethylation are driven by sunlight, and the specified surface rate constants are averaged through the water column assuming a light extinction coefficient (here, 0.5 m^{-1}). In addition to these transformations, Hg^0 is subject to volatile loss from the water column. This reaction is governed by a transfer rate calculated from velocity and depth, and by Henry's Law constant, which was set to 7.1 **H** 10^{-3} L-atm/mole-K. Under average flow conditions, velocity ranges from 0.2 to 0.3 m/sec, while depth ranges from 0.37 to 0.69 m. The specified and calculated reaction coefficients used here are summarized in Table 7.

Table 7 Specified and Calculated Reaction Rates and Coefficients

Component	Reaction	Compartment	Coefficient Value
Hg^0	Volatilization	Water	1.0 - 3.9 day^{-1} (calc)
	Oxidation	Water	0.001 day^{-1}
Hg(II)	Reduction	Water	0.05 day^{-1} (surface) 0.074 - 0.090 (calc)
	Methylation	Water	0.001 day^{-1}
	Methylation	Sediment	0.00002 day^{-1}
	Partitioning to silt	Water, Sediment	2 H 10^5 L/kg
	Partitioning to sand	Water, Sediment	4.8 H 10^4 L/kg
	Partitioning to DOC	Water, Sediment	2 H 10^4 L/kg
MeHg	Demethylation to Hg(II)	Sediment	0.0001 day^{-1}
	Demethylation to Hg^0	Water	0.1 day^{-1} (surface) 0.074 - 0.090 (calc)
	Partitioning to silt	Water, Sediment	2 H 10^5 L/kg
	Partitioning to sand	Water, Sediment	1 H 10^3 L/kg
	Partitioning to DOC	Water, Sediment	2 H 10^5 L/kg

The Ohoopee River simulation was conducted using annual average flow and load. The average flow simulation was run for 20 years, so that steady-state conditions are achieved in the water and surficial sediment. The flows, depths, velocities, and volumes used for annual average conditions are summarized in Table 8.

Table 8 Flows, Depths, Velocities and Volumes used in WASP Model

From	To	Length (m)	Depth (m)	Width (m)	Volume (cm)	Flow (cms)
Upper Ohoopee	Mulpen Creek	5350.26	0.13	9.56	6553.73	6.47
Mulpen Creek	Little Ohoopee	3924.68	0.14	10.55	5928.00	7.76
Little Ohoopee	Yam Dandy Creek	2866.52	0.21	18.14	11041.34	14.31
Yam Dandy Creek	Jack's Creek	3829.53	0.20	16.11	12188.32	16.29
Jack's Creek	Beaver Creek	3516.88	0.21	17.76	13309.37	18.19
Beaver Creek	Pendleton Creek	5156.99	0.30	28.13	43617.13	19.64
Pendleton Creek	Brazells Creek	2396.88	0.34	33.74	27299.25	28.38
Brazells Creek	Rocky Creek	1563.72	0.34	34.29	17932.82	30.38
Rocky Creek	Thomas Creek	2769.84	0.33	35.61	32286.18	35.62
Thomas Creek	End of Segment	3816.46	0.25	24.35	22828.61	38.74

The Watershed Characterization System calculates mercury loadings to each reach. These values are specified as constant Hg(II) and MeHg loadings for each surface water compartment. Loadings for average flow conditions reflect both wet and dry deposition throughout the watershed, followed by runoff and erosion to the tributary stream network. These loadings to the tributary network are subject to reduction and volatilization losses in transport to the mainstem. Average reduction factors were calculated for each tributary

inflow using a reduction rate constant of 0.001 day^{-1} along with that subwatershed's flow, water surface area, and assumed depth:

$$reduction\ \ factor = (1 - e^{-k_r \bullet T_{max}}) \ / \ k_r \bullet T_{max}$$

where k_r is the reduction rate constant in day^{-1} and T_{max} is the travel time for the tributary in days. The travel time is calculated as the total tributary surface area times its average depth divided by its average flow.

Table 9 provides the predicted water column concentrations under annual average load and flow for the Ohoopee River. The highest predicted water column concentration is used in the TMDL calculation to determine the maximum annual average load that could occur and still achieve the target.

Table 9 Predicted and Observed Mercury Concentrations under Annual Average Load and Flow

Calculated Concentrations	River Reach										
Total Mercury	Obs	1	2	3	4	5	6	7	8	9	10
Water Column (ng/l)	8.86	3.40	3.87	3.96	4.05	4.07	4.18	4.28	4.00	4.06	4.47
Sediment (ng/g)	7.6	6.15	7.01	7.15	7.31	7.35	7.54	7.72	7.21	7.32	8.17
Methylmercury (ng/l)											
Water Column	1.19	0.44	0.50	0.51	0.52	0.53	0.54	0.55	0.52	0.52	0.52

9.2. TMDL Determination

To determine the total maximum load that can come into the Ohoopee River the current loading conditions are evaluated and instream concentration is determined using the modeling approach described above. This allows the development of a relationship between load and instream mercury concentrations. Using this developed relationship, the total maximum load can be determined. Because the water column mercury concentration response is linear with respect to changes in load a proportion can be developed to calculate the total maximum mercury load from the watershed that would achieve the derived water quality target of 3.5 ng/l. The TMDL is calculated as given below:

$$\frac{HighestSegmentConcentration}{CurrentAnnualAverageLoad} \cdot \frac{WaterQualityTarget}{TMDLLoad}$$

where:

Highest Segment Concentration = 4.5
Current Annual Average Load= 4.99 kg/year
Water Quality Target= 3.5 ng/l

TMDL Load is calculated as 3.77 kg/year total mercury.

The estimated current loading of mercury to the Ohoopee River basin is 4.99 kg/year.

The percent reduction from atmospheric sources is calculated using the following equation:

$$\%\,\mathrm{Re}\,duction = \frac{TMDL}{CurrentLoadings} * 100$$

where:

TMDL = Total allowable Annual Load derived in TMDL Calculation

Current Loadings = Sum of all loads from the Watershed

In order to achieve this TMDL, a 24% reduction of mercury from all sources is needed.

10. Allocation of Loads

In a TMDL assessment, the total allowable load is divided and allocated to the various pollutant sources. This allocation is provided as a Load Allocation (LA) to the nonpoint sources, defined in this TMDL as the air sources, and as a Wasteload Allocation (WLA) to the point-source facilities in Georgia with a NPDES permit. The difference between the current load and the allowable load is the amount of pollutant reduction the sources need to achieve in order for the waterbody to ultimately achieve the applicable water quality target of 3.5 ng/l.

The calculated allowable load of mercury that can come into the Ohoopee River without exceeding the applicable water quality target of 3.5 ng/l is 3.77 kilograms/year. This assessment indicates that over 99% of the current loading of mercury is from atmospheric sources; therefore a 24% reduction from the current atmospheric loading is applied in deriving the LA and WLA. In the future when air deposition has been reduced by 24% to 3.58 kg/year, the contribution of the load from water point sources will be 5%. Therefore, the Load Allocation and Wasteload Allocation for the Ohoopee River is:

Load Allocation (atmospheric sources) = 3.58 kilograms/year

Wasteload Allocation (NPDES sources) = 0.19 kilograms/year

The estimated current loading of mercury to the Ohoopee River from the surrounding watershed is 4.99 kilograms/year. This load was determined by adding the predicted mercury load for each of the subwatersheds taking into account delivery times and volatilization that occurs in the tributaries. The difference between the estimated current mercury load (4.99 kg/year) and the calculated allowable load (3.77 kg/year) is 1.2 kilograms/year. Since 3.77 kg/year is 76% of the estimated current loading of mercury, it is estimated that a 24% reduction in total mercury loading is needed for the Ohoopee River to achieve a water column concentration of 3.5 ng/l.

10.1. Atmospheric Reductions

EPA estimates that over 99% of current mercury loadings to the River are from atmospheric

deposition; therefore, significant reductions in atmospheric deposition will be necessary if the applicable water quality standard is to be attained. Based on the total allowable load of 3.77 kilograms per year, a 24% reduction of mercury loading is needed to achieve the applicable water quality standard. An analysis conducted by the EPA Region 4 Air Program (Appendix A) concludes that an estimated 42% to 54% reduction in mercury deposition to the Ohoopee River watershed can be achieved by 2010 through full implementation of existing Clean Air Act Maximum Achievable Control Technologies (CAA MACT) and solid waste combustion requirements. (See Appendix A.) While these reductions will not achieve the load allocation provided in the TMDL, EPA is currently developing legislation to establish additional controls on multiple air pollutants, including mercury, from electric utilities. EPA anticipates that this process will produce reductions in the atmospheric deposition of mercury that will enable achievement of water quality standards.

It is anticipated that additional data and information collected during implementation of this Phase 1 TMDL will allow a more certain analysis of attainable air reductions to be accomplished in the Phase 2 TMDL. EPA will determine at that time whether it is appropriate to revise the load allocation, or the wasteload allocation, to assure that the applicable water quality standard will be achieved.

10.2. Allocation to NPDES Point Sources

This TMDL estimates that less than 1% of the current loadings of mercury to the River are from NPDES point sources. For a discussion of EPA's basis for this estimate, see Section 6.1. The TMDL identifies 1 NPDES point sources for a wasteload allocation in this TMDL that Georgia and EPA believe have the potential to discharge significant amounts of mercury in their effluent. 1 of these facilities have been identified because of their volume of flow (greater than 1 million gallons per day) or based on limited effluent data or the fact that they were rated as "major industrial" facilities by the State of Georgia. In making such "major industrial" facility determinations, Georgia takes into account factors such as toxic pollutant potential, public health impacts, and impacts on water quality. Another 4 facilities, considered to be "minor municipal" or "minor industrial" facilities, are also identified in the TMDL for a wasteload allocation. Data collected by EPA at these facilities in April/May 2001, indicate mercury concentrations in the facility's effluent above the applicable water quality standard of 3.5 ng/l. EPA believes it is reasonable to assume that mercury is present in the discharge of these 7 NPDES permittees because of the persistent nature of mercury, and its pervasive presence in the environment, including rainwater. Table 11 (below) provides the list of NPDES facilities that are provided a wasteload allocation in this TMDL.

There are approximately 6 other NPDES permitted facilities in Georgia located within the watershed. The TMDL does not provide a specific wasteload allocation to these facilities since they discharge less than 1 million gallons per day, or are considered "minor industrial" facilities. EPA assumes that these facilities are discharging mercury in concentrations below the 3.5 ng/l applicable water quality target, or are not adding concentrations of mercury above that in their source water. These facilities have a smaller flow rate (compared to the facilities identified above), and they are considered by the State of Georgia to be "minor municipal" or "minor industrial" facilities based on the factors set forth above (a "minor

municipal" facility has flow less than 1 million gallons pre day). As the new more sensitive EPA Method 1631 mercury analytical procedure is implemented in the NPDES program these "minor" facilities must verify through monitoring whether or not they are significant contributors of mercury (State of Georgia Rules and Regulations for Water Quality Control, April 2000, Chapter 391-3-6-.06, and January 1995 Reasonable Potential Procedures). EPA can consider this information in the revision of the TMDL in 2011, and will establish a wasteload allocation for any facilities for which data demonstrates mercury is present in their effluent at levels above the amount present in their source water.

In order to achieve the water quality standard for mercury in the Ohoopee River, EPA has assigned to all NPDES point sources in the basin a cumulative wasteload allocation of 0.05 kg/year. For the facility identified as potential significant contributors of mercury, EPA is providing a specific wasteload allocation (WLA). This WLA is expressed in two different forms. The first is described as Option A below, and the second is described as Option B. The NPDES permitting authority is authorized by this TMDL to apply either option to the NPDES point sources affected by this TMDL. In the context of this TMDL, EPA believes it is reasonable to offer this choice to the permitting authority for the following reasons. First, based on EPA's analysis, either wasteload allocation option, in the aggregate, is expected to result in point source mercury loadings less than the cumulative wasteload allocation. Second, EPA believes this flexibility is the best way of ensuring that the necessary load reductions are achieved without causing significant social and economic disruption. EPA recognizes that NPDES point sources contribute only a minute share of the total mercury contributions to the Ohoopee River. However, EPA also recognizes that mercury is a highly dangerous pollutant that can bioaccumulate in fish tissue at levels harmful to human health. Therefore, EPA has determined, as a matter of policy, that NDPES point sources known to discharge mercury at levels above the amount present in their source water should reduce their loadings of mercury using appropriate, cost-effective mercury minimization measure in order to ensure that the total point source discharges are at a level equal to or less than the cumulative wasteload allocation specified in this TMDL. The point sources' WLA will be applied to the increment of mercury in their discharge that is above the amount of mercury in their source water. EPA recommends that the permitting authority make this choice between Option A and Option B in consultation with the affected discharger because EPA is not able to make the case-by-case judgments in this TMDL that EPA believes are appropriate.

Option A: Criteria end-of-pipe

Under Option A, the wasteload allocation is equivalent to applying the TMDL water quality target to the discharger's effluent at the outfall point. For this TMDL, EPA has determined this water quality target to be 3.5 ng/l. Therefore, under this option, the wasteload allocation for each NPDES point source identified in this TMDL would be the product of multiplying 3.5 ng/l by the permitted or design flow rate of each identified NPDES point source. The result would be the maximum mass loading of mercury from that point source. The sum of these individual wasteload allocations is 0.009 kg/year, which is significantly less than the 0.19 kg/year cumulative wasteload allocation provided to all NPDES facilities. Under Option A, each NPDES point source affected by this TMDL are provided in Table 10.

Table 10 NPDES Permitted Facilities and Assigned Wasteload Allocation at 3.4 ng/l

Major Municipal	NPDES ID	MGD	Kg/Yr
VIDALIA WPCP	GA0025488	1.880	0.009

Option B: Mercury characterization or minimization

Under Option B, the individual wasteload allocations are equivalent to the level of mercury in a point source's effluent after implementation, when appropriate, of cost-effective and appropriate mercury minimization measures. EPA assumes that feasible/achievable mercury load reductions resulting from the mercury minimization efforts will, as a cumulative amount of all 7 facilities, result in a total loading of less than 0.19 kg/year. This assumption is based on information indicating wastewater treatment plants, which account for about 50% of the affected facilities, can attain significant mercury reductions through source reduction efforts. The effectiveness of mercury minimization efforts at industrial facilities is highly facility-specific; however, significant reductions may be attained through product substitution and other measures (See Mercury Report to Congress, 1997, Section 4, and Overview of Pollution Prevention Approaches at POTW's, EPA 1999). If the cumulative effects of mercury minimization planning efforts are shown during the Phase 2 TMDL evaluation in 2011 not to be less than the cumulative 0.19 kg/yr wasteload allocation, EPA will provide a specific wasteload allocation to each facility to assure that the cumulative wasteload allocation will be attained.

Affected NPDES permits would need to incorporate permit conditions or limitations as follows in order to be consistent with the assumptions of this TMDL. See 40 C.F.R. § 122.44(d)(1)(vii)(B). For NPDES facilities identified in Table 10 this TMDL assumes that the permits will includes:

- a requirement to characterize the effluent using the version of EPA Method 1631 then in effect in order to quantify the amount of mercury present in the influent and effluent, if any;
- a requirement to develop a mercury minimization plan if the monitoring data shows mercury is present in their effluent at levels greater than in their influent or source water, and the effluent concentration exceeds 3.5 ng/l).
- a requirement to implement appropriate cost-effective mercury minimization measures identified through mercury minimization planning if the monitoring data shows that an increased amount of mercury is present in the final effluent (as described above).

While this TMDL assumes that the State of Georgia, as the permitting authority, will determine the necessary elements of a mercury characterization/ minimization study plan, EPA would expect the plan(s) to have elements similar to the following: (1) influent/effluent monitoring with sufficient frequency to determine variability and to identify if an increased amount of mercury is present. If the facility's discharge is shown to result in an increased amount of mercury, the plan should also include the following additional elements: (2) the identification and evaluation of current and potential mercury sources; (3) monitoring to confirm current/potential sources of mercury; (3) the identification of potential methods for reducing/eliminating mercury, including housekeeping practices, material substitution,

process modifications, materials recovery, spill control & collection, waste recycling, pretreatment, public education, laboratory practices, and disposal practices, and the evaluation of the feasibility of implementation; (4) implementation of cost-effective and appropriate minimization measures identified in the plan; and (5) monitoring to verify the results of waste minimization efforts. In addition, EPA expects the permit to establish a reasonable schedule for the implementation of each element and to require appropriate progress reports.

This TMDL accords the permitting authority a certain amount of discretion in incorporating these wasteload allocations into NPDES permits. The permitting authority is free to determine the appropriate frequency, duration and location of monitoring associated with the mercury characterization component of the wasteload allocation. The permitting authority also has the discretion to determine the level of oversight in connection with the development of mercury minimization plans and the discharger's choice of appropriate, cost-effective measures to implement. EPA believes that each of these decisions is heavily fact-dependant and that the permitting authority is in a better position than EPA to make them.

As discussed below, this TMDL assumes that point sources will not be authorized to discharge mercury above current effluent levels. Option B is predicated on the judgment that the 0.19 mg/year cumulative wasteload allocation will be achieved by applying waste minimization measures to current point source effluent conditions. Allowing an increase in current effluent loadings of mercury could undercut the assumptions upon which this TMDL is based unless the permitting authority can demonstrate that any such increase is offset by decreases of mercury from other point source(s) so that the cumulative wasteload allocation of 0.19 kg/year is not exceeded.

EPA recognizes that the State of Georgia's regulations authorize compliance schedules for water quality-based effluent limitations and conditions once those requirements are imposed in NPDES permits. See Rules and Regulations for Water Quality Control, Chapter 391-3-6-.06(10). Under these regulations, the Director of EPD is authorized to establish as a compliance deadline the date that he or she determines to be "the shortest reasonable period of time necessary to achieve such compliance, but in no case later that an applicable statutory deadline." Because there is no applicable statutory deadline relating to the achievement of these WLA-based limitations, point sources affected by this TMDL may be eligible for compliance schedules under this provision of Georgia's regulations. This TMDL assumes that the permitting authority will establish the shortest reasonable period of time for compliance with permit limitations and conditions based on this TMDL. This TMDL also recognizes, however, that the permitting authority is in the best position to determine the timing of mercury characterization and the compliance schedules for developing and implementing mercury minimization plans.

Regarding the compliance schedules in permits to meet permit limitations and conditions based on Option B, EPA makes the following observations. First, EPA believes that a point source with a flow of under 5 million gallons per day can develop a detailed mercury minimization plan within three to six months after the mercury characterization phase is completed and it has been determined that a minimization plan is requires. Point sources

with a larger flow could develop a plan within about six to 12 months. Second, prompt characterization of the point sources' mercury discharges will assist EPA in determining whether it is necessary to revise the TMDL in the near future. Any unnecessary delay in obtaining this information could interfere with that effort. Third, with respect to implementation of appropriate, cost-effective mercury minimization measures, EPA believes that the permitting authority is in the best position to determine what constitutes "the shortest reasonable period of time for compliance." EPA recognizes that the implementation of mercury minimization measures can take several years, especially when they involve small, diffuse sources discharging mercury to Publicly Owned Treatment Works (POTWs).

Other Assumptions Incorporated into this TMDL.

The wasteload allocation component of this TMDL reflects the following additional assumptions:

- The permitting authority may write permit conditions that allow the discharge of mercury at levels equal to the amount of mercury in the facility's intake water (from the Ohoopee River or its tributaries), stormwater, and/or water drawn from the public water supply. If the permitting authority determines that mercury is present in the final effluent at levels above that level present in the influent, the permitting authority will establish permit limits consistent either Option A or Option B of this WLA. The permitting authority also should consider whether any increased mercury concentration in such discharges present potential for violation of an applicable acute standard for mercury, and include appropriate limits to protect against such violations.
- No NPDES point source will be authorized to increase its mass loadings of mercury above levels reflected in current water quality-based effluent limitations or current effluent quality, whichever is lower (in the case of facilities with such limitations) or current effluent quality (in the case of facilities subject to mercury characterization requirements).
- The permitting authority will establish the shortest reasonable period of time for compliance with permit limitations and conditions based on this TMDL.
- The State of Georgia will require those facilities rated as "minor municipal" and "minor industrial" facilities to monitor for mercury using the version of EPA Method 1631 then in effect to verify whether or not they have a added mercury. (State of Georgia Rules and Regulations for Water Quality Control, April 2000, Chapter 391-3-6-.06, and January 1995 Reasonable Potential Procedures).

This TMDL incorporates wasteload load allocations in the form of Option B only because each of the following factors is present:

- this TMDL addresses mercury, which EPA believes is best handled at these levels through waste minimization rather than through end-of-pipe treatment;
- the NPDES point sources, in the aggregate contribute less than 1% of the total current mercury loadings to the Ohoopee River;
- EPA anticipates that implementation of existing and future pollution controls will result in reductions sufficient to achieve the load allocation of 3.58 kg/year assigned

to air sources, thus authorizing a cumulative wasteload allocation of 0.19 kg/year.

- if the Ohoopee River were currently attaining water quality standards, mercury discharges from the identified NPDES point sources at levels equivalent to the cumulative wasteload allocation of 0.19 kg/year would not cause or contribute to an exceedance of applicable water quality standards for mercury.
- the recent adoption of EPA Method 1631 Revision B makes it difficult for EPA to state with certainty how many of the point sources identified in this TMDL actually discharge a net addition of mercury at levels exceeding 3.5 ng/l. Under these circumstances, waste characterization is a reasonable first step.

11. Implementation

EPA recognizes that a TMDL improves water quality when there is a plan for implementing the TMDL. However, CWA section 303(d) does not establish any new implementation authorities beyond those that exist elsewhere in State, local, Tribal or Federal law. Thus, the wasteload allocations within TMDLs are implemented through enforceable water quality-based effluent limitations in NPDES permits authorized under section 402 of the CWA. Load allocations within TMDLs are implemented through a wide variety of State, local, Tribal and Federal nonpoint source programs (which may be regulatory, non-regulatory, or incentive-based, depending on the program), as well as voluntary action by committed citizens. See New Policies for Establishing and Implementing Total Maximum Daily Loads (TMDLs), dated August 8, 1997.

EPA believes it is useful during TMDL development, if time is available, to gather information that would facilitate TMDL implementation. For example, the TMDL may identify management strategies that categories of sources can employ to obtain necessary load reductions. EPA believes, however, that TMDL implementation – and implementation planning – is the responsibility of the State of Georgia, through its administration of the National Pollutant Discharge Elimination System (NPDES) point source permit program and through its administration of any regulatory or non-regulatory nonpoint source control programs.

A consent decree in the case of Sierra Club v. EPA, 1:94-cv-2501-MHS (N.D. Ga.), requires EPA to develop TMDLs for all waterbodies on the State of Georgia's current 303(d) list that are not developed by the State that year, according to a schedule contained in the decree. That is, EPA and the State work cooperatively to develop all TMDLs for a given set of river basins each year, with all river basins in the State covered over a 5-year period. On July 24, 2001, the U.S. District Court entered an order finding that the decree also requires EPA to develop TMDL implementation plans. EPA disagrees with the court's conclusion that implementation plans are required by the decree and has appealed the July 24, 2001, order.

In the absence of that order, EPA would not propose an implementation plan for this TMDL. The Agency is moving forward, however, to comply with the obligations contained in the order. EPA has coordinated with the Georgia Environmental Protection Division (EPD) to prepare an initial implementation plan for this TMDL and has also entered into a Memorandum of Understanding (MOU) with EPD, which sets out a schedule for EPD to

develop more comprehensive implementation plans after this TMDL is established. The initial plan provides for an implementation demonstration project to address one of the major sources of pollution identified in this TMDL while State and/or local agencies work with local stakeholders to develop a revised implementation plan.

EPA understands, pursuant to the July 24, 2001, order, that it continues to have responsibilities for implementation planning if for any reason EPA cannot complete an implementation plan for this TMDL as set out in the MOU. If the July 24, 2001, order is vacated, EPA would expect to support efforts by the State of Georgia to develop an implementation plan for this TMDL. EPA recognizes that approximately 99% of the mercury load into this watershed is from air deposition. EPD activities to implement this TMDL, in addition to activities related to future air source reductions, will focus primarily on outreach and education regarding how households and other sources of mercury to POTWs can minimize the introduction of mercury to their wastewater.

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12. Appendix A. Analysis of Atmospheric Deposition of Mercury

Analysis of Atmospheric Deposition of Mercury to the Ohoopee River Watershed

EXECUTIVE SUMMARY

This document presents an estimate of mercury deposition from the atmosphere to the Ohoopee River watershed, located in southeastern Georgia. This analysis was done to support the development of a Total Maximum Daily Load (TMDL) limit for the Ohoopee River under the requirements of the Clean Water Act. The purpose of the TMDL is to restore this impaired water body to its designated use - fishable waters. Mercury has been identified as the primary contaminant contributing to the current impairment of the Ohoopee River for which fish consumption advisories have been established. Current information from the recent TMDL studies in the basin indicates that the main source of mercury loading to the River and its watershed is derived from atmospheric deposition.

This analysis estimates the level of mercury deposited from the atmosphere to the Ohoopee River watershed for a baseline period (1994-1996) and for a future date (2010). Our analysis for conditions in the year 2010 assumes that all applicable and currently promulgated standards under the Clean Air Act (CAA) – Section 112 for Maximum Achievable Control Technology Standards (MACTs), and Section 111 New Source Performance Standards, and Section 129 Solid Waste Combustion – will have been implemented. The calculations in this analysis indicate that mercury deposition in 2010 to the Ohoopee watershed can be reduced approximately 42% to 54% from the baseline period due to implementation of the CAA standards (and including a number of facilities that are known to have closed).

These predicted reductions were derived using the following methodology that calculates and compares the sum of estimated wet and dry deposition to the watershed in the baseline and future years:

1. The analysis begins with an estimate of annual deposition of mercury in precipitation to the watershed, utilizing the data gathered for three years at a Mercury Deposition Network monitor at the Okefenokee National Wildlife Refuge, near the southeastern corner of Georgia. The analysis also used the results of national atmospheric mercury deposition modeling (the RELMAP model) done for EPA's 1997 *Mercury Study Report to Congress* (referred to as *The Mercury Study*) to estimate the level of mercury in dry deposition to the Ohoopee River watershed during the baseline period (1994-1996). The national modeling also provides estimates of the relative contribution to deposition from

the various chemical-physical species of mercury, and distinguishes deposition from "U.S. sources" from a general atmospheric "background" which includes international transport, here termed "global sources." The model estimates both wet and dry deposition of divalent mercury gas [Hg(II) or Hg^{2+}] also known as "reactive gaseous mercury" (RGM) from "U.S. sources." This analysis presumes that essentially all the RGM deposited is derived primarily from "local sources," defined here as those sources located within the watershed and in counties within a 100 kilometer distance around the watershed. In addition, deposition of particle-bound mercury and some elemental mercury is derived from U.S. national sources (i.e. at distance >100 km); while global sources contribute gaseous elemental mercury which is gradually oxidized and included in wet deposition.

2. The total RGM emitted (released into the air) from local sources was estimated for the baseline period by using the same emissions data files and species composition tables for mercury emitted as were used to conduct *The Mercury Study* modeling. Local sources include categories such as hospital and medical waste incinerators, municipal waste incinerators, electric power plants, a chlor-alkali plant, pulp and paper mills (recovery furnaces), hazardous waste incinerators, and residential and industrial boilers. A baseline ratio of RGM deposition to the watershed over the local RGM emissions can then be calculated.

3. For the 2010 analysis, projected RGM emissions in 2010 from local sources were estimated using two factors:

   – Calculated reductions in mercury emissions due to MACT and Waste Combustion controls; and
   – Growth in activity, and thus in emissions, using projected population growth as the indicator.

4. Then an estimate of RGM deposition to the watershed was calculated for 2010 as proportional to local RGM emissions in 2010.

5. To continue with the analysis, the total deposition of all mercury species to the watershed in 2010 was developed by combining the RGM deposition value from step 4 with a proportional estimate of deposition of particle-bound mercury and elemental mercury from national sources, plus an estimate of deposition derived from global sources.

6. Comparison of the value for total mercury deposition estimated in step1 above, with the value for total mercury deposition calculated in step 5 indicates that a <u>42% to 54% reduction</u> of mercury deposition to the Ohoopee watershed is probable over the approximately 15 years from the baseline to 2010, based on currently promulgated standards in the Clean Air Act.

The particulars of this analysis are specific to the Ohoopee River watershed and the surrounding 100 km area and should not be applied to other geographic areas. If another region of the United States develops an analysis using similar methodology, that area must develop its own specific information on deposition of mercury, including data on the source categories present in the area, and estimates of the effects of promulgated regulations on emissions from those sources.

This document also provides a discussion of concepts related to atmospheric modeling and deposition. Some limitations in current approaches are presented along with discussion of how these can affect uncertainties in conclusions.

The document concludes with a brief summary of regulations promulgated to date on emissions sources of mercury under the sections of the Clean Air Act which address maximum achievable control technology (MACT), new source performance standards, and solid waste combustion. In addition, Appendix II provides an informational review of a variety of regulatory and related initiatives, some of which are enacted but many of which are subject to change as programs continue to develop.

In addition to the regulatory MACT and waste combustion standards mentioned above, and the determination that EPA will seek reductions in mercury emissions from electric power plants that burn coal (see Section 5.3), a number of voluntary programs to reduce mercury releases to the air, water, and land disposal are being developed and implemented in many states. These include:

- Recycling of mercury containing switches and other devices (e.g. from buildings and automobiles);
- Changes in industrial processes to reduce the use of mercury;
- Reduced use of mercury devices in health care, and reduction of mercury in related wastes;
- Substitution of non-mercury materials or devices for current uses, where possible; and
- Distribution of information to facilitate safe collection/recycling of stored mercury and other chemicals in laboratories, schools and colleges, and improved handling of mercury during waste collection efforts.

The effects of these and similar voluntary efforts on current or future reductions in mercury releases to the environment have not been estimated, to date. Therefore, these voluntary programs were not included in this document as part of developing the estimate of reduced emissions and reduced atmospheric deposition of mercury in 2010.

1.0 INTRODUCTION

The purpose of this analysis is to estimate the deposition of mercury to the Ohoopee River watershed, in kilograms per year (kg/yr) for:

1. A Baseline period (1994-1996); and
2. A future year (2010).

This information is needed for the development of a Total Maximum Daily Load (TMDL) for the Ohoopee River watershed under the requirements of the Clean Water Act. The purpose of the TMDL is to restore impaired water bodies to their designated uses. Mercury has been identified as the primary contaminant contributing to the current impairment (fish consumption advisories) of the watershed in question.

Mercury in the atmosphere is present primarily in four forms:

1. Gaseous elemental mercury vapor (Hg^0 or zero valent mercury);
2. Gaseous divalent mercury (Hg^{2+}), also called reactive gaseous mercury (RGM);
3. Particulate or particle-bound mercury (both Hg^0 and Hg^{2+}, relative proportion not known, and likely varying with type of particle); and
4. Organic mercury (mostly mono-methylmercury) which can be measured in rainfall, but in amounts so much below the other forms that it will not be discussed further in this document.[1]

As discussed in Volume III of the *Mercury Study Report to Congress* (EPA 1997; hereafter referred to as "*The Mercury Study*"), the deposition of mercury from the atmosphere occurs by two mechanisms:

> ***Wet deposition*** - In this mechanism, RGM dissolved in rain (or fog or snow) is deposited on to land and/or the surface of water bodies. Particle-bound mercury is also deposited by this mechanism, but is a relatively minor constituent in rain in most areas.
>
> ***Dry deposition*** - In this process, both gaseous and particulate forms of mercury are deposited on land, vegetation and/or the surface of water bodies by atmospheric mixing and adsorption, plus settling by gravity. Land uses and type of vegetation cover can affect the net dry deposition. Recent tests indicate that RGM represents the majority of mercury deposited by this mechanism.

The distance from the emission source, the forms of the mercury in the emissions, other

[1]Note that organic forms of mercury are important in the biomagnification of mercury in fish and, ultimately, in the exposure of humans to mercury through fish consumption. However, the amount of organic mercury depositing (as such) from air is considered negligible in comparison to that formed in the aquatic ecosystem.

pollutants in the emissions and the atmosphere, and the weather patterns of precipitation are important factors in determining where mercury released to the air will be deposited. This analysis utilizes the following recently developed information about mercury species and deposition relative to source location (Dvonch et al. 1999):

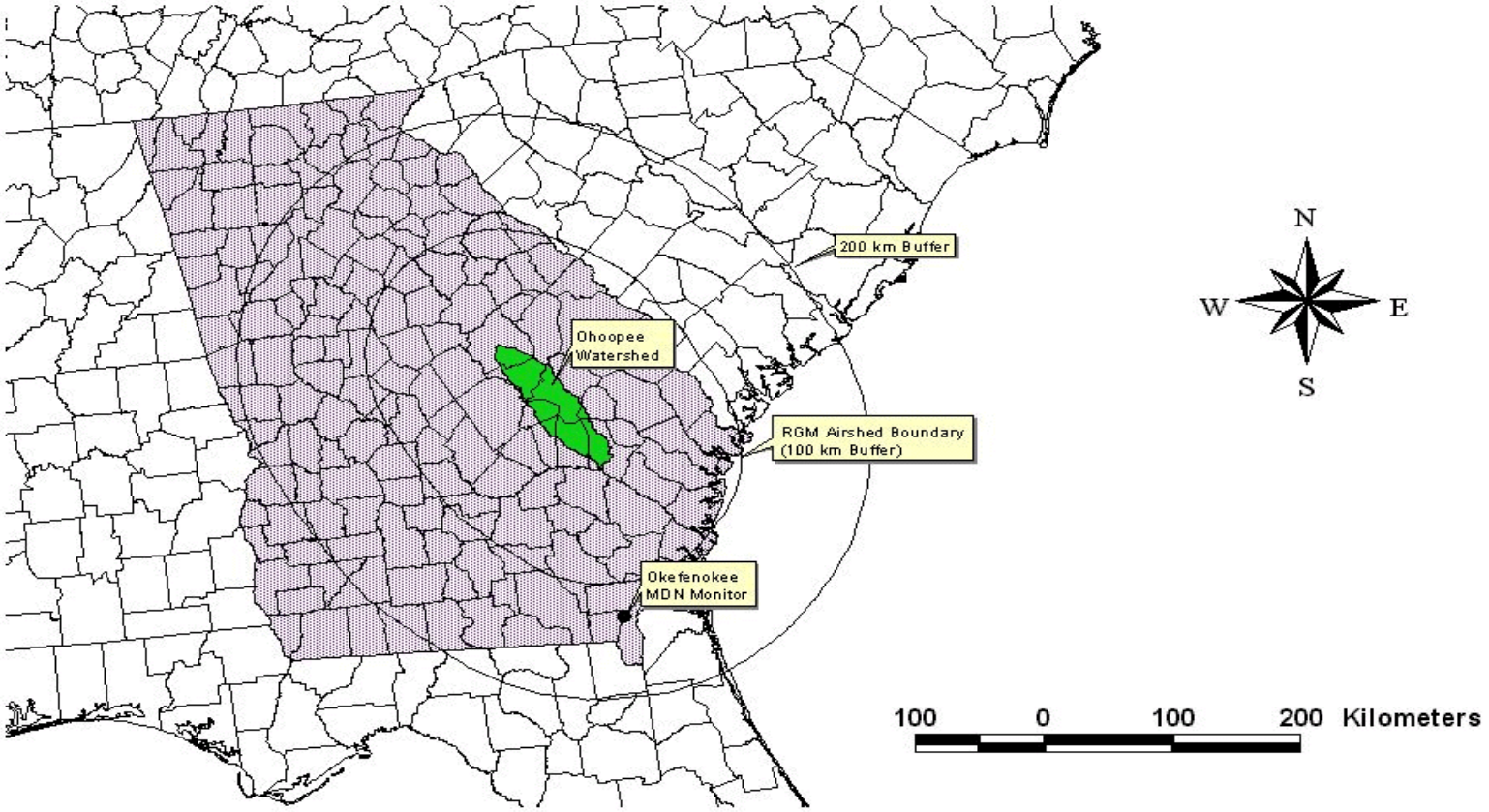
1. RGM released to the air has a relatively short residence time in the lower atmosphere (one to a few days), with the majority of the RGM in emissions being deposited within 100 km of the source.
2. Particle-bound mercury has a somewhat longer residence time in the atmosphere, but is generally deposited to the surface of the earth over longer distances (up to approximately a thousand km.)
3. Gaseous elemental mercury has a relatively long residence time in the atmosphere (approximately one year) and is deposited over international or "global scale" distances. Chemical conversion to the divalent form is important to its deposition, and is affected by other trace elements, gases, and aerosols in the atmosphere.

Because RGM is the dominant form of mercury in both rainfall and most dry deposition processes, and because most of the RGM emitted from anthropogenic sources is deposited relatively quickly, this analysis focuses first on Clean Air Act regulated facilities (and estimates for small stationary sources) within the watershed and within a distance of 100 km around the watershed boundary, and on their emissions of RGM to the air. These stationary facilities and sources are referred to collectively in this document as "local sources", and the area within which they are located is referred to as the "RGM Airshed[2]." Thus, the RGM Airshed extends well beyond the borders of the Ohoopee River watershed. A graphical illustration of the RGM airshed is provided in Figure 1.

It should be noted that the sources evaluated in this analysis may emit all three forms of inorganic mercury. As noted above, emissions of RGM from a particular source will affect primarily the local area around the source (i.e., within 100 km), while emissions of particulate mercury from the same source are expected to be spread over a much larger area. As such, only a small proportion of the particulate emissions from local sources will be deposited within the RGM airshed. Additional studies within the U.S. have also shown that particulate mercury represents a relatively minor proportion of the mercury emitted by most sources, and contributes only a small to moderate fraction of the mercury in wet or dry deposition. Emissions of gaseous elemental mercury from local sources will also contribute little to the deposition within the RGM airshed, since elemental mercury gas can be transported long distances, and contributes only very small amounts directly to either wet or dry deposition until converted to RGM (a slow

[2] The term "RGM Airshed" is defined for this analysis to include an area extending 100 km from the boundary of the Ohoopee River watershed, including the area of the watershed (See Figure 1). For this analysis, we located sources of mercury emissions by county. In cases where the 100 km boundary included a fraction of a county, we conservatively included all sources within that county for our analysis. (Also see Section 4.3, "The Airshed" in 4.0 Discussion of Concepts and Uncertainties.)

Figure 1. Ohoopee RGM Airshed



process) or adheres to particles, which as noted, tend to be transported and deposited over a much larger area than the RGM airshed or the watershed.)

With regard to non-local stationary sources, they also contribute some of the total mercury depositing to the Ohoopee River watershed. That is, some proportion of gaseous elemental and particulate mercury from these non-local sources is incorporated in the wet and dry deposition to the watershed. The calculations in this report do include estimated contributions from U.S. sources as a group, outside the RGM airshed, based on results from the RELMAP model. However, to more quantitatively calculate the contribution from these more distant U.S. and global sources would require complex computer air deposition modeling. Such modeling is beyond the scope of this first analysis in support of the TMDL.[3]

2.0 METHODOLOGY FOR THE BASELINE PERIOD AND RGM

2.1 Overview of Baseline Deposition and Baseline Emissions

Analysis of current data on water discharges and estimates of atmospheric deposition indicate that virtually all of the mercury loadings into the Ohoopee River watershed are caused by atmospheric deposition (both in rainfall and as dry deposition). No new atmospheric deposition monitoring or modeling of mercury to the watershed was performed for this analysis. Rather, we relied on two sources of information: rainfall data from 3 years at a monitor in the Mercury Deposition Network (MDN), and on the results of a previous national modeling study, the Regional Lagrangian Model of Air Pollution (RELMAP.) The results of the RELMAP computer modeling runs are analyzed in detail in *The Mercury Study*, and provide detailed estimates for both wet and dry deposition.

Deposition of mercury in precipitation (wet deposition) onto the Ohoopee River watershed was estimated by using the average annual value for mercury in rainfall measured for three years, 1998 through 2000, at the Okefenokee National Wildlife Refuge a MDN site. EPA considered that this value would be representative of the entire watershed. Dry deposition was calculated based on examination of relative wet and dry deposition values from the national RELMAP modeling runs for the Ohoopee watershed and adjacent watersheds of south Georgia.

As noted above, recent research indicates that RGM is the dominant form of mercury in both rainfall and most dry deposition processes in the eastern United States. Therefore, EPA determined that RGM is the primary chemical form of mercury depositing to the Ohoopee River watershed, and that the RGM airshed (i.e., the area within the Ohoopee River watershed and

[3]This initial attempt to characterize mercury deposition to the Ohoopee River Watershed is referred to as the first "Phase" of TMDL analysis, to indicate the reliance on existing information to develop an estimate of deposition to the area. Future work, in the next several years, may utilize complex computer models in conjunction with a more refined emissions inventory for the RGM airshed and possibly including larger areas of Georgia and Florida.

within 100 km of the watershed boundary) is a reasonable geographic scope for an analysis of sources which contribute significantly to atmospheric deposition of mercury to that watershed.

The national modeling provides numeric estimates for wet and dry deposition of mercury as derived from the chemical species in emissions from U.S. sources, and from international or global "background." This analysis utilizes the relative proportions of the chemical species in deposition, as discussed in *The Mercury Study* analysis of the RELMAP results, to estimate deposition to the watershed that was derived from RGM emissions during the baseline period.

The next step was to relate the baseline deposition of RGM to the baseline emissions of RGM from local sources. The annual emissions data, which the model used to calculate deposition, were developed primarily for the time period 1994-1996 (referred to here as the baseline period.) First, detailed data on emissions of total mercury from the sources in all counties located within the RGM airshed were extracted from the emission inventory developed for the RELMAP modeling in *The Mercury Study*. Then the emissions of total mercury by each individual facility of local sources were multiplied by the estimate of RGM percent in emissions from each source category (as provided in *The Mercury Study)* to calculate the total RGM emitted from local sources.

2.2 Baseline Deposition

This analysis used data from measured wet deposition of mercury at a standard monitoring site, and also the results of EPA's national atmospheric modeling of mercury's transport and deposition across the conterminous U.S. Mercury in rainfall is measured by standard methods at sites participating in the Mercury Deposition Network (MDN). Weekly samples are taken and analyzed at a central Laboratory for the MDN, and weekly data tables are available on the Internet web site for the MDN including data for: total precipitation, concentration of total mercury in the collected rainfall, and calculated wet deposition in micrograms per square meter. The only MDN site in Georgia (before late in 2000) is located in the Okefenokee National Wildlife Reserve, in Charlton County, and is located within the St. Marys River watershed. The monitor site is approximately 190km (118 miles) south of the central portion of the Ohoopee watershed (and about 130 km, or 81 miles, south of the southern portion of the Ohoopee watershed.) Three full calendar years of data are available for the Okefenokee monitoring site: 1998, 1999, and 2000. The average annual wet deposition is 12.75 micrograms per square meter (12.75 ug/m^2), with an average total annual rainfall of 1.12 meters. Total wet deposition is affected by total rainfall; this rainfall average for the 3 years is close to long term average annual rainfall at nearby weather service stations. So the value of 12.75 ug/m^2 was taken as the estimator of wet deposition for the baseline period. The "baseline" for this analysis is generally taken as 1994-1996, and our analysis considers the baseline period as essentially average in weather and in human economic activities. EPA considers that the chosen wet deposition estimate is suitable because it is related to average rainfall conditions, and because controls on mercury emissions in 1998-2000 were not significantly changed from the baseline period.

Dry deposition of most pollutants cannot be measured or monitored directly, but estimates are calculated based on various modeling approaches using information on concentrations in the ambient air plus detailed weather information. *The Mercury Study* provides a detailed analysis of both wet and dry deposition estimates calculated with the RELMAP computer modeling studies for the conterminous United States. The RELMAP study included input data on mercury emissions in various forms, meteorological data, and algorithms for atmospheric processes. The results of the national RELMAP modeling provide annual wet and dry mercury deposition rates within each cell in a grid over the entire U.S., where each grid-cell is approximately 40 km x 40 km. In this analysis, we examined in detail the RELMAP results which include the area of the Ohoopee River watershed and also adjacent watersheds in south Georgia. The deposition estimates within each of the grid cells that overlay the Ohoopee River watershed were averaged to obtain estimates of the wet and dry deposition of mercury within the watershed. The average modeled value for annual **wet** deposition of total mercury was 7.05 ug/m^2 and the average annual **dry** deposition of total mercury was 4.08 ug/m^2. The model estimate for wet deposition is considerably lower than the monitored measurements (based on 3 years). EPA considers the measured value to be more representative of actual conditions, because models may be reasonably correct over broad areas yet not necessarily be accurate for a particular location. However the model does provide a ratio of dry deposition to wet deposition equal to 0.58. Considering this value, and similar ratios for adjacent watersheds, EPA decided to use a ratio for dry to wet deposition of simply half, or 0.50, and to apply this ratio to the monitored value for wet deposition. That is, the estimate for dry deposition was calculated as exactly half of the average value for monitored wet deposition. For additional discussion of resolving differences between model and monitored estimates, see Section 4.4 . Thus, for this analysis of Ohoopee River watershed, the average **wet** deposition of total mercury was taken as 12.75 micrograms per square meter per year, and the average **dry** deposition of total mercury was taken as 6.375 micrograms per square meter per year.

The Ohoopee watershed covers an area of approximately 3,480 square kilometers. Thus, based on the 3 years of recent monitored data for wet deposition, and using RELMAP model results to estimate a proportional dry deposition, the total deposition (wet and dry) of mercury in the baseline period to this watershed is approximately 66.5 kilograms (147 pounds) per year.

We used additional analysis of the RELMAP modeling presented in *The Mercury Study* to estimate the mercury deposition to the Ohoopee River watershed from distant sources of particulate-bound and gaseous elemental mercury. The RELMAP national maps show a distinct pattern: the eastern half of the country receives considerably more deposition than the western half. The analysis in *The Mercury Study* provides ranges of deposition values as percentiles for wet and dry deposition by each form of mercury to the U.S. east of 90^o W longitude. (A separate set of deposition percentiles was developed for the U.S. west of 90^o W longitude.) A summary of the 50^{th} percentile deposition values from Tables 5-5 and 5-6 in *The Mercury Study* is presented below for the eastern wet and dry mercury deposition values. The 50^{th} percentile values are generally close (within a factor of 2) to the monitored wet deposition (at the MDN site in Okefenokee N.W.R.) and estimated dry deposition values used for the Ohoopee River watershed (provided above.)

As noted above, the national RELMAP analysis included separate modeling runs for wet deposition and dry deposition for each type of mercury (gaseous elemental, divalent forms (RGM), and particulate forms) and our analysis used these percentile results of different mercury species to generate data on wet and dry deposition by mercury species in the watershed. Specifically, the "percent of sum wet" and "percent of sum dry" columns in Tables 1a and 1b were calculated by dividing the estimated deposition for each form of mercury by the sum within each table (wet or dry). For example, the "percent of sum wet deposition of mercury" for divalent mercury (Hg^{2+}) for U.S. sources was calculated by dividing 2.652 *ug/m²/yr* by 9.927 *ug/m²/yr*, which equals approximately 26.7%.

Table 1a. RELMAP Wet Deposition Estimates from *The Mercury Study* (U.S. East of 90° W Longitude)

Deposition Variable	Deposition at 50th Percentile (ug/m²/yr)	% of Sum Wet Deposition of Mercury
Hg^{2+} (RGM) from U.S. sources	2.652	26.7 %
$Hg_{particle}$ from U.S. sources	1.956	19.7 %
Hg^0 (elem) from U.S. sources	0.181	1.8 %
Hg^0 from global sources	5.138	51.8 %
Sum of the Sources Above	9.927	100 %

Table 1b. RELMAP Dry Deposition Estimates from *The Mercury Study* (U.S. East of 90° W Longitude)

Deposition Variable	Deposition at 50th Percentile (ug/m²/yr)	% of Sum Dry Deposition of Mercury
Hg^{2+} (RGM) from U.S. sources	4.101	98.1 %
$Hg_{particle}$ from U.S. sources	0.078	1.9 %
Sum of the Sources Above	4.179	100 %

The discussion of RELMAP modeling in *The Mercury Study* considers the deposition which results from atmospheric gaseous elemental mercury vapor (Hg^0) in two ways: (i) as emitted from U.S. sources, and (ii) as general atmospheric "background" which this analysis

refers to as "Hg^0 from global sources". Note that Table 1a, above, represents the contribution to deposition from elemental gaseous mercury, not the relative amounts of mercury which can be measured in ambient air. The RELMAP model calculated the contribution to deposition from "background" elemental mercury separately from elemental mercury emissions from U.S. sources, and considered the "background" contribution to be constantly available across the U.S., though weather patterns strongly affect its atmospheric chemistry and net deposition in different geographic regions. This analysis for the Ohoopee River watershed notes that elemental mercury is transported internationally, even globally, and thus considers deposition from "background" to represent primarily the effects of global transport, thus very little affected by control measures which reduce mercury emissions specifically within the U.S. See Sections 4.1 and 4.6 for additional discussion of elemental mercury and assumptions related to global transport and deposition within the U.S. As shown in Table 1a, approximately 52% of the total wet deposition of mercury is derived ultimately from "background" or global sources. If the total wet and dry deposition are combined, the global sources contribute about 36% of the total mercury to areas in the eastern U.S. which receive "median" deposition of mercury.

In this analysis, in order to estimate the separate contribution that each species and type of mercury (listed in Table 1 as "deposition variable") makes to total wet deposition and to total dry deposition, EPA utilized the analysis of the RELMAP results, using values in the 50^{th} Percentile distribution for deposition within the eastern half of the U.S. 48 conterminous states. That is, the RELMAP model generated data sets and maps of deposition across the U.S. which would be the result if each type of mercury were the sole contributor to emissions and to deposition. In *The Mercury Study* the range of RELMAP's deposition values for each type of mercury was analyzed into percentiles, and values for the 10^{th}, 50^{th}, and 90^{th} percentiles were presented. (Values for the percentiles are shown in Tables 5-5 and 5-6 of Volume III of *The Mercury Study*.) This analysis for the Ohoopee River watershed used the values for deposition at the 50^{th} percentile as the main estimators to divide total wet deposition, and total dry deposition, into their constituent source types. EPA recognizes that the deposition values for each deposition variable shown in Table 1 (e.g. wet deposition of Hg^{2+} from U.S. sources) appear to have been modeled and analyzed separately in *The Mercury Study*, and that using these values in one set of calculations to allocate total mercury deposition into source types constitutes an additional step of analysis. EPA considers it valid to use these values of the 50^{th} percentiles as estimators for relative contribution to deposition because these percentiles are based on a coordinated set of RELMAP model runs that utilized the same inputs for emissions, and the same model algorithms for atmospheric chemistry and deposition processes. Also, application of these general estimators (based on the eastern half of the U.S.) for the specific case of the Ohoopee River watershed is suitable because the national maps for deposition (in *The Mercury Study*) show that the geographic area of the Ohoopee River watershed is fairly typical of the general eastern U.S. (Also see Section 4.5 "Relating Chemical/ Physical forms of Mercury to Deposition.")

We have an estimate for deposition of total mercury to the Ohoopee watershed, and we wish to use this to obtain an estimate of deposition of RGM to the Ohoopee watershed. In order to calculate the deposition of mercury from various origins in relation to the total mercury deposition during the baseline period (1994-1996), we used the percentages shown in Table 1a

and Table 1b. That is, the relative percentages are drawn from the results of the national RELMAP modeling and applied to the estimated deposition values derived for the Ohoopee River watershed. The calculations are done separately for wet deposition and for dry deposition. Specifically, the estimated wet deposition for the Ohoopee River watershed is calculated by multiplying each value in the column "Percent of Sum Wet Deposition of Mercury" in Table 1a by the value for wet deposition of total mercury to the Ohoopee River watershed (12.75 ug/m^2/yr.) For the overall relationship, see Equation 1 (Note that each term in Equation 1 represents annual deposition per square meter):

$$[DEP_{Base\text{-}Wet}]_{Total} = [DEP_{Base\text{-}Wet}]_{US\text{-}elem} + [DEP_{Base\text{-}Wet}]_{RGM} + [DEP_{Base\text{-}Wet}]_{Particle} + [DEP_{Base\text{-}Wet}]_{Global} \quad \textbf{(Equation 1)}$$

Where:

$[DEP_{Base\text{-}Wet}]_{Total}$ = the total amount of wet deposition in the baseline period (this is the value derived above for average wet deposition of total mercury within the Ohoopee River watershed);

$[DEP_{Base\text{-}Wet}]_{US\text{-}elem}$ = the amount of wet deposition in the baseline period due to U.S. sources releasing elemental mercury;

$[DEP_{Base\text{-}Wet}]_{RGM}$ = the amount of wet deposition in the baseline period due to U.S. sources releasing RGM;

$[DEP_{Base\text{-}Wet}]_{Particle}$ = the amount of wet deposition in the baseline period due to U.S. sources of particulate mercury; and

$[DEP_{Base\text{-}Wet}]_{Global}$ = the amount of wet deposition in the baseline period due to global sources of elemental mercury.

Note that the value for $[DEP_{Base\text{-}Wet}]_{Total}$ was determined in this study by using the average annual wet deposition results (total mercury) from 3 years of rainfall monitoring at the MDN monitor site located in the Okefenokee N.W.R., which is located about 130 km (81 miles) south of the southern portion of the Ohoopee River watershed. As described above, for the baseline period the value for the average wet deposition is equal to 12.75 micrograms or total mercury per square meter per year.

Substituting the percentages from Table 1a and the above estimate for $([DEP_{Base\text{-}Wet}]_{Total})$ gives us:

$[DEP_{Base\text{-}Wet}]_{US\text{-}elem} = (0.018)([DEP_{Base\text{-}Wet}]_{Total}) = (0.018)(12.75$ ug/m^2/yr) = 0.230 ug/m^2/yr

and

$[DEP_{Base\text{-}Wet}]_{RGM} = (0.267)([DEP_{Base\text{-}Wet}]_{Total}) = (0.267)(12.75$ ug/m^2/yr) = 3.404 ug/m^2/yr

and

$[DEP_{Base\text{-}Wet}]_{Particle} = (0.197)([DEP_{Base\text{-}Wet}]_{Total}) = (0.197)(12.75\ ug/m^2/yr) = 2.512\ ug/m^2/yr$

and

$[DEP_{Base\text{-}Wet}]_{Global} = (0.518)([DEP_{Base\text{-}Wet}]_{Total}) = (0.518)(12.75\ ug/m^2/yr) = 6.605\ ug/m^2/yr$

.

The estimated dry deposition sum the species for the Ohoopee River watershed is calculated in an analogous fashion (Equation 2) by multiplying the "percent of total dry deposition of mercury" values from Table 1b by the average dry deposition of total mercury determined for the Ohoopee River watershed, that is 6.375 $ug/m^2/yr$, presented above.

(In Equation 2, note that each term represents annual deposition per square meter.)

$$[DEP_{Base\text{-}Dry}]_{Total} = [DEP_{Base\text{-}Dry}]_{RGM} + [DEP_{Base\text{-}Dry}]_{Particle} \quad \textbf{(Equation 2)}$$

Where:

$[DEP_{Base\text{-}Dry}]_{Total}$ = the total amount of dry deposition in the baseline period; (this is the value derived above for average dry deposition of total mercury within the Ohoopee River watershed);

$[DEP_{Base\text{-}Dry}]_{RGM}$ = the amount of dry deposition due to RGM from U.S. sources in the baseline period; and

$[DEP_{Base\text{-}Dry}]_{Particle}$ = the amount of dry deposition due to particulates from U.S. sources in the baseline period.

Note that the value for $[DEP_{Base\text{-}Dry}]_{Total}$ is determined in this study by examining the proportion of dry deposition to wet deposition in the results from the RELMAP model for the Ohoopee River watershed and nearby watersheds in south Georgia. As described above in Section 2.1, third paragraph, this value for the average dry deposition during the baseline period is equal to 6.375 micrograms per square meter per year.

Substituting the percentages from Table 1b and the model-based estimate for $([DEP_{Base\text{-}Dry}]_{Total})$ gives us:

$[DEP_{Base\text{-}Dry}]_{RGM} = (0.981)([DEP_{Base\text{-}Dry}]_{Total}) = (0.981)(6.375\ ug/m^2/yr) = 6.254\ ug/m^2/yr$

and

$[DEP_{Base\text{-}Dry}]_{Particle} = (0.019)([DEP_{Base\text{-}Dry}]_{Total}) = (0.019)(6.375\ ug/m^2/yr) = 0.121\ ug/m^2/yr$.

For the Baseline portion of this analysis (calculating the ratio of RGM deposition to RGM emissions in the baseline period) we are interested in the total wet and dry deposition of RGM to the Ohoopee River watershed. To obtain total deposition to the Ohoopee River watershed derived from RGM, we added wet deposition of Hg^{2+} from "U.S. sources" to dry deposition of Hg^{2+} from "U.S. sources," as shown in Equation 3. Throughout this document, EPA considers that nearly all of Hg^{2+} which is emitted from sources will deposit within approximately 100 km of the source. Therefore, the "local" sources within the RGM Airshed for Ohoopee account for essentially all the deposition of RGM to the Ohoopee watershed which is derived from "U.S. sources"

$$[DEP_{Base}]_{RGM} = [DEP_{Base\text{-}Wet}]_{RGM} + [DEP_{Base\text{-}Dry}]_{RGM} \quad \textbf{(Equation 3)}$$
$$= 3.404 \text{ ug/m}^2\text{/yr} + 6.254 \text{ ug/m}^2\text{/yr}$$
$$= 9.658 \text{ ug/m}^2\text{/yr}$$

The annual total deposition of RGM within the Ohoopee River watershed , as an average per square meter, is equal to **9.66 ug/m^2/yr** (9.66 micrograms per square meter per year) for the baseline period. The watershed covers an area of approximately 3,480 square kilometers. Thus, based on the analysis above, the total wet and dry deposition of RGM in the baseline period to this watershed area is approximately 33.6 kilograms (74 pounds) per year.

2.3 Baseline Emissions Inventory

In this analysis, our procedure is to develop a ratio for the baseline period which will relate the deposition of RGM into the watershed (calculated just above) to the emissions of RGM from local sources. (As discussed above in Section 1.0, "local sources" are Clean Air Act regulated facilities and estimated data for small stationary sources located either within the Ohoopee River watershed or in counties within 100 km of the watershed boundary.) We examined the mercury emissions data used for the RELMAP modeling in *The Mercury Study* and we summed the emissions of "total" mercury (all species and forms taken together) from all the sources in the RGM airshed. This process is discussed immediately below.

2.3.1 Calculating $[EI_{Base}]$: the emissions of "total" mercury in the baseline period.

To develop the "baseline emissions inventory," EPA examined the emissions inventory (EI) files that were used for the RELMAP modeling in order to identify stationary facilities emitting mercury in Georgia and South Carolina that are in the Ohoopee River watershed or in counties within 100 km of the watershed boundary (i.e., within the RGM airshed.) See section 4.3 for additional discussion of the airshed concept and its use in this study. We recognize that there may be additional sources of mercury emissions within the RGM airshed (i.e., mobile sources, landfills, crematories, etc.). However, emissions estimates for these categories of sources in the RGM airshed are currently unavailable (e.g. mobile sources) or are included in "area sources" which the EI for RELMAP considered to have no emissions of RGM. As stated in Section 1.0, where the RGM airshed distance of 100 km from the watershed included a

fraction of a county, EPA conservatively included the entire county and all sources in that county. The source categories located within the RGM airshed for the Ohoopee River include:

- Municipal Solid Waste Incinerators [2 Sources];
- Hospital, Medical, and Infectious Waste Incinerators [49 Sources];
- Hazardous Waste Incinerators [2 Sources];
- Coal-fired Electric Utility Boilers [19 Sources];
- Oil-fired Electric Utility Boilers [2 Sources];
- Gas-fired Electric Utility Boilers [2 Sources];
- Pulp and Paper Plant Recovery Furnaces [14 Sources];
- Sewage Sludge Incinerators [2 Sources];
- Chlor-Alkali Plants (mercury cell) [1 Source]; and
- Residential and Industrial Boilers [77 Counties].

The emissions inventories available for these source categories provide only the value for the total amount of mercury (total-Hg) released and do not specify the physical and chemical species of mercury (gaseous elemental, divalent, or particulate). This limitation on details of species of mercury emitted is characteristic of essentially all emissions inventories at state and national levels.

The results of this analysis for emissions of "total-mercury" in the 1994-1996 base period are summarized in Table 2 (the four columns to the left.) A detailed presentation listing each individual source is provided in Appendix I. Based on this approach, the total emissions for the baseline period from individual facilities and county estimates for small stationary sources within the Ohoopee River RGM airshed (***[EI$_{Base}$]***) was determined to be 2,849 kilograms per year.

EPA and the States are continuing to refine mercury emissions inventories (EIs), and more recent EIs than those used in *The Mercury Study* are being developed. We recognize that these newer EIs may provide updated estimates of the current mercury emissions in the RGM airshed. However, our analysis relies on general relationships between emissions used for the RELMAP model and the deposition values calculated from that specific inventory. For the Ohoopee watershed we supplement the model information with monitor data from measured mercury in rainfall. Future work for a later phase of the TMDL may include development of a more recent and refined EIs to be used in conjunction with an updated modeling analysis.

2.3.2 Calculating $[EI_{Base}]_{RGM}$: emissions of RGM in the baseline period.

To relate deposition of RGM to emissions of RGM, it was necessary to refine the emissions data of "total-mercury" to focus on emissions of RGM. The national RELMAP modeling for *The Mercury Study* developed estimates of the percentage of RGM in the total mercury emitted for each source category. This analysis uses the same percent RGM estimates developed for the national RELMAP modeling, using the values in Table 4-2 in Volume III of *The Mercury Study*. The percentages of RGM in mercury emissions from each source category in the Ohoopee River RGM airshed are as follows:

- Municipal Solid Waste Combustors: 60%;
- Hospital, Medical, and Infectious Waste Incinerators: 73% ;
- Hazardous Waste Incinerators: source specific (here, one 8% and one 95%);
- Fossil Fuel Electric Utility Boilers (Coal, Oil, and Gas): 30%;
- Pulp and Paper Plant Recovery Furnaces: 30%;
- Sewage Sludge Incinerators: 60%;
- Chlor-Alkali Plants (mercury cell): 30%
- Residential and Industrial Boilers 30%.

The Mercury Study RELMAP modeling inventory also included estimated emissions from "area sources[4]" on a per county basis, and assigned a speciated profile of 0% (zero percent) emitted as RGM. Therefore, RGM emissions from area sources were not included in this analysis. (In years after 2000, data in EPA's Toxics Release Inventory will include all stationary sources which emit 10 pounds or more of mercury per year. However, special studies will be required to establish what if any percent of RGM is in such emissions.)

The results of this analysis for RGM emissions in the 1994-1996 base period are summarized in Table 2 in the three columns to the right. A detailed presentation of data on each individual facility and county estimates for small sources is provided in Appendix I. Based on this methodology (summing the data shown in Appendix I), the total RGM emissions for the baseline period from sources within the Ohoopee River RGM airshed ($[EI_{Base}]_{RGM}$) was determined to be **1,389.9 kilograms per year**.

2.3.3 Calculating $[DEP_{Base}]_{RGM} / [EI_{Base}]_{RGM}$: the baseline ratio.

The "baseline ratio" expresses a central concept in this overall analysis. In any given year for which information can be gathered on emissions of a pollutant from sources in a region and on deposition of that pollutant to a specific watershed within that region, a ratio can be generated which expresses the relationship of deposition to emissions. Weather patterns from year to year are known to influence deposition, particularly wet deposition which can be measured directly. Dry deposition can only be estimated from a set of ambient measurements (or calculations) and meteorological conditions by using numerical models. EPA considers that for modeling results or annual monitoring data which are based on "average" weather for a year, that the ratio of

[4]Use of the term "area sources" here refers to its meaning in the Clean Air Act. An "area source" is any stationary source of hazardous air pollutants (HAP) that is not defined as a "major source." A "major source" is one that emits or has the potential to emit 10 tons or greater per year of any single HAP or 25 tons per year or greater of HAPs in aggregate. (Note that standards under CAA Section 129 are not limited to "major sources".) Thus "area sources" may be a number of small stationary sources, such as residential or commercial heating units, within a given area. The term "area sources" also may refer to net diffusion into the air from land uses, such as plowed land or forestry, where such data have been determined by quantitative studies. Under the CAA, "area sources" do not include mobile sources regulated under Title II of the Act.

deposition to emissions will also be representative of average conditions. EPA's analysis for mercury deposition focuses on RGM because most of its deposition is strongly influenced by local sources, and its transport time in the atmosphere is short, generally accepted to be approximately one day.

For this analysis of deposition to the Ohoopee River watershed, the monitored data on 3 years of precipitation at the MDN site in Okefenokee N.W.R. has an average which is close to the average precipitation in the region, thus EPA considers that the average wet deposition value of mercury is also reasonably representative of the average for the south Georgia region. The RELMAP model used meteorological data from the year 1989 because the weather patterns across the U.S. for that year were close to average. The emissions inventory data which were input to the model were based on information from individual facilities for the years 1994 to 1996. While the wet deposition data was for later years (1998-2000), both emissions and deposition represent conditions prior to implementation of the MACT or waste-combustion regulations, and thus are suitable for estimating "baseline" conditions in this analysis.

$$\underline{\text{Baseline Ratio}} = \frac{[DEP_{Base}]_{RGM}}{[EI_{Base}]_{RGM}} \qquad \textbf{(Equation 4)}$$

For the Ohoopee watershed, the Baseline Ratio = (33.6 kg/yr)/ (1,389.9 kg/yr) = 0.0242

A fundamental assumption in this analysis is that in a future year which also has generally average weather conditions will have a ratio of RGM-deposition to RGM-emissions with essentially the same value as the baseline ratio. While this analysis presents expected reductions in emissions of mercury which are projected to occur by a future year, we assume that the general physics and chemistry of mercury in the atmosphere will be little changed, so that the ratio of deposition to emissions will remain essentially the same. Thus the absolute value of the ratio is of limited value in the baseline year, though we present it here for completeness. The main value of the ratio is its use to estimate future deposition, when we can work out a future emissions value. See section 3.3.1 and Equation 5. EPA also assumes that the future year, 2010 in this analysis, will have "average" weather. Of course the actual year of 2010 when it comes may not have average weather, so this analysis is only for a general estimation or example. See Section 4.5 for further discussion.

Table 2. Summary of Mercury Emissions in the Ohoopee RGM Airshed during the Baseline Period (1994-1996)						
Source Category	**No. of Sources**	**Total Hg Emissions Baseline Period (kg/yr)**	**% of Total Hg**	**% of Total Hg that is RGM**	**RGM Emissions Baseline Period (kg/yr)**	**% of Total RGM**
Municipal Waste Combustors	**2**	**298.7**	**10%**	**60%**	**179.2**	**13%**
Medical Waste Incinerators	**49**	**1030.2**	**36%**	**73%**	**752.1**	**54%**
Hazardous Waste Incinerators	**2**	**1.1**	**0.04%**	**8%-95%**	**0.3**	**0.02%**
Coal Burning Power Plants	**19**	**592.3**	**21%**	**30%**	**177.7**	**13%**
Oil Burning Power Plants	**2**	**0.1**	**0.005%**	**30%**	**0.041**	**0.003%**
Gas Burning Power Plants	**2**	**0.001**	**0.00003%**	**30%**	**0.0002**	**0.00002%**
Pulp and Paper Mills	**14**	**138.6**	**5%**	**30%**	**41.6**	**3%**
Sewage Sludge Incinerators	**2**	**8.6**	**0.3%**	**60%**	**5.2**	**0.4%**
Chlor-alkali Production	**1**	**597.4**	**21%**	**30%**	**179.2**	**13%**
Residential/ Industrial Boilers	**77***	**181.9**	**6%**	**30%**	**54.6**	**4%**
Totals	**170**	**2849.0**	**100%**		**1389.9**	**100%**

* This value indicates the number of counties in the study area with residential or industrial boilers. The emissions inventory for the residential/industrial boiler source category provides total mercury emissions by county. Of the 77 total counties, 69 counties are in Georgia and 8 counties are in South Carolina.

3.0 METHODOLOGY for YEAR 2010 BASED on PROMULGATED REGULATIONS.

3.1 Overview of Estimating emissions and deposition in the year 2010

To continue this analysis, EPA needed to develop a table of estimated future emissions of RGM from local sources. Then we used a ratio which relates the future deposition of RGM onto the watershed to the future emissions. The year 2010 was selected as the future date because all sources subject to currently promulgated Clean Air Act (CAA) regulations for control of mercury emissions under Maximum Achievable Control Technology (MACT), and under CAA Section 129 for solid waste combustion sources, are required by the CAA to meet the new standards or close by that calendar year, or by earlier years.

To develop estimated future emissions for this analysis, EPA began with the detailed baseline emissions inventory of sources within the Ohoopee RGM airshed, and multiplied the emissions of total mercury from each facility by two numbers: (1) a growth factor, and (2) the percent of mercury emitted after implementing additional controls required by the Clean Air Act (CAA) regulations promulgated from the baseline period (1994-'96) to the present. The growth factor for each source category reflects an estimate of increased activity by that source as the human population and economic activity increase between the baseline period (1994-'96) and the future year, 2010. As an estimator for industrial activity, EPA used projected growth in the human population, 1995 - 2010.

For this analysis, implementation of promulgated CAA controls on mercury was applied to only two source categories in the Ohoopee RGM Airshed: Municipal Waste Combustors and Medical Waste Incinerators. An additional MACT standard has been promulgated for Hazardous Waste Incinerators but as of August, 2001, has been suspended during litigation; so this analysis did not include a reduction in emissions due to controls under MACT. Also, MACT standards are being developed for the Chlor-Alkali Production plants which use mercury-cell technology. For the one such plant in this analysis, no reduced emissions of total mercury under MACT were assumed; however, the percent of mercury emitted as RGM was reduced to reflect a special study at this particular plant.

The above calculation gives estimated values for emissions of total mercury in 2010 from individual facilities (and per-county summed values for small boilers) in the airshed. For the next step, EPA used the projected percent of RGM for each source category to estimate the emissions of RGM from each source, and summed to get the projected total RGM emissions in 2010 from sources in the Ohoopee RGM airshed.

To obtain an estimate for deposition of RGM in 2010 to the Ohoopee River watershed, this analysis assumes that the simple proportion of deposition to emissions will remain the same in 2010 as it was in the baseline period. See Equation 5 and further description below in Section

3.3.1. To calculate deposition to the Ohoopee River watershed of total mercury in 2010 (i.e. all species and forms of mercury in both wet and dry deposition) EPA estimated deposition values for particle-bound and elemental mercury for 2010 and added these to RGM deposition. The estimates for deposition of species other than RGM are based on the RELMAP modeled deposition of each species in the eastern U.S. as analyzed in *The Mercury Study*. Deposition values of these other forms of mercury were derived using the assumption that they are directly proportional to the deposition of RGM in 2010 as they were during the baseline period. The calculation methodology is described below in Section 3.3.2, and the assumptions regarding proportional deposition of the forms of mercury are discussed in Section 4.5.

3.2 Projected Future Emissions Inventory (for 2010) (**Calculating** $[EI_{2010}]$ and $[EI_{2010}]_{RGM}$)

To develop an estimate for emissions of RGM from local sources, we considered both: probable growth in their activities (thus growth in their emissions), and the reductions in emissions of mercury that will be required for specific source categories by regulations and standards currently promulgated. Also, for the source categories which implement MACT or MACT-like regulation we included a change in the percentage of RGM in the overall emissions if it had changed as the MACT controls were implemented.

To estimate the emissions inventory in the year 2010, we developed "growth factors" for each of the source categories in the RGM airshed. The growth factors use projected human population increase between the years 1995 and 2010 as a surrogate for growth in activity which produces mercury emissions from the source categories in question. The U.S. Census Bureau only provides estimated population increases between 1995 and 2010 at the State level. These population projections were obtained from an U.S. Census Bureau report titled "Population Projections: States, 1995 - 2025" (U.S. Census 1997). EPA developed a "Regional" level for population increases by averaging the values for the eight states in EPA's Region 4 (namely: Alabama, Florida, Georgia, Kentucky, Mississippi, North Carolina, South Carolina, Tennessee.)

We also identified the Maximum Achievable Control Technology (MACT) and Solid Waste Combustion standards (CAA Section 129) applicable to these source categories for which compliance must be achieved between 1995 and 2010, with the amount by which each standard is expected to reduce emissions of total mercury or RGM from each source category. Once EPA developed growth factors and identified expected MACT-related emission reductions, EPA estimated the projected emissions of total-mercury in 2010 by multiplying the baseline period (1994-1996) emissions of total mercury from each individual facility by the growth factor, and multiplied that value by the percent of the baseline total mercury that EPA expects would still be emitted (i.e. 1.00 minus the emission reduction) following implementation of the applicable MACT or waste combustion standard. To estimate the 2010 emissions of RGM ($[EI_{2010}]_{RGM}$), we then multiplied the estimated 2010 total mercury emissions for each individual facility by the percentage of the mercury emitted that is RGM for that source category. The results of these

calculations are summarized in Table 3 and are presented for each individual facility in the tables included in Appendix I.

In the particular geographic area of Georgia and South Carolina included in the Ohoopee "RGM Airshed", there were eight source categories which emitted significant amounts of mercury to the air. Table 2 lists these categories and their emissions, with "fossil fuel electric utility power plants" divided into the 3 main fuel types (thus giving 10 source categories.) In our calculations of the estimated reductions in future emissions, only those standards which were promulgated by July 2001, were included. That is, this document calculates that expected reductions in emissions by 2010 in the RGM airshed for Ohoopee River will reflect full implementation of CAA regulations for only two source categories: Municipal Waste Combustors (MWC), and Medical Waste Incinerators (MWI, known more formally as Hospital, Medical and Infectious Waste Incinerators). For the category Hazardous Waste Incinerators, regulations under MACT are suspended during a court case, so were not applied for this analysis. Section 6.0 gives additional information on the relevant sections of the Clean Air Act, and promulgation dates for these standards. This document used for calculations only those reductions in emissions which are based on promulgated standards.

In our calculations for all but three source categories, we project that the percentage of total mercury emissions comprised by RGM will remain constant from the baseline period to 2010. For two source categories, implementation of the Clean Air Act standards is expected to result in changes to the RGM percentage. EPA expects that compliance with the CAA standards (reflecting MACT) for municipal waste combustors (MWCs) will reduce emissions of RGM by 100% (i.e., emissions will have zero% as RGM after MACT compliance.) For medical waste incinerators (MWIs), EPA expects the RGM percentage to be reduced from 73% to 50%. Except for these two categories and the chlor-alkali plant (see next paragraph), all of the RGM percentages used here for each of the other categories are the same as those used for the RELMAP modeling done for *The Mercury Study*. (See Table 4-2 of Volume III of *The Mercury Study*). For our calculations concerning MWCs and MWIs, we used the pre-MACT RGM percentages for the baseline period and post-MACT RGM percentages for 2010.

In addition, for the calculation in this document, EPA revised the percentage RGM in emissions from the sole chlor-alkali plant in the Ohoopee RGM airshed – to use 5% RGM for 2010 calculations compared to 30% RGM for the baseline period (derived from the RELMAP emissions database.) This change in percentage RGM is based on recent emissions testing at this particular facility. Preliminary results indicated the percent RGM in the emissions from the cell room ranged from 1% to 5%. Because the testing was short term and limited by weather, and because the change in RGM percentage is significant, the value of 5% was chosed for this analysis. The value of 5% is less of a revision of the earlier estimate of 30% used in the RELMAP database and calculations, than using a lower percentage. Note that because of the preliminary nature of the tests at that facility, the use in this document of 5% RGM in emissions does not constitute an official EPA position concerning the nature of speciated mercury emissions from this plant, or for the source category of mercury-cell chlor-alkali production

facilities.

Facilities in the baseline emissions inventory that have closed between 1995 and 2000 (based on recent information from Georgia and South Carolina agencies) were considered to have no emissions of mercury in 2010. Each facility which is still active (not closed) in the year 2000 is assumed to still be active in 2010. For purposes of estimation, we assumed that each facility would have growth in its activity the same as the average growth factor for that source category. The growth factors for each category were developed as follows:

1. For municipal waste combustors, it was presumed that most waste comes from the nearby populations (i.e., that waste is not shipped in from distant locations). Since the state is the lowest division of geographic detail provided by the U.S. Census Bureau for population increase, the projected percentage increase in state population was used as a surrogate for the increase in waste generation and the corresponding increase in RGM emissions for each of the municipal waste combustors in question. We recognize that the mercury content in the solid wastes being generated may be decreasing due to voluntary recycling and reduction efforts. However, data to support this reduction is not readily available so a conservative approach of assumed growth is included in this analysis.

2. For medical waste incinerators, it was presumed that most people visiting a medical facility come from nearby populations (this is especially true with county hospitals). Since the state is the lowest division of geographic detail for population increase, the projected percentage increase in state population was used as a surrogate for increase in medical waste generation and the corresponding increase in RGM emissions from each of the hospital incinerators in question. As with municipal waste combustors, we recognize that the mercury content in the medical wastes being generated may be decreasing due to voluntary recycling and reduction efforts. However, data to support this reduction is not readily available so a conservative approach of assumed growth is included in this analysis. Because of new MACT requirements, most small hospital medical waste incinerators in Georgia were closed by the year 2000. The information on sources in Florida was updated where possible and many of the small facilities are also expected to close, but data on operating status since 1996 was not available for some of the sources. For these sources, we conservatively assumed continued operation and typical growth rates for waste incineration and emissions to 2010.

3. For hazardous waste incinerators, the two stationary sources within the RGM airshed are known to be on-site units, handling wastes generated at the corporate facility. One incinerator (at Savannah, GA) has closed since the baseline period. The Hazardous and Solid Waste Amendments to the Resource Conservation and Recovery Act (RCRA) require facilities that handle hazardous wastes to have a "Waste Minimization Plan" which is required to be updated periodically. We

assumed that such ongoing efforts to reduce the generation of hazardous wastes would offset possible growth in mercury emissions from this facility. Thus no net growth in emissions of RGM was assumed for 2010 for the category of hazardous waste incinerators.

4. For electric utility power plants, it was presumed that energy usage would generally be expected to rise as population over a large area increases, since power companies commonly sell their electricity over a regional (or larger) grid. The projected percentage increase in the population of the Southeast Region was used as a surrogate for RGM emission increases for each of the power plants in question.

5. For pulp and paper plants, it was presumed that production would increase as population over a larger area increases, since pulp and paper plants commonly sell their product to customers over a large area. The projected percentage increase in the Southeast Region's population was used as a surrogate for pulp and paper plant RGM emission increases at each of the facilities in question.

6. For municipal sludge incinerators, it was presumed that most municipal sludge results from the nearby populations (i.e., that sludge is not shipped in from distant locations). Since the state is the lowest division of geographic detail for population increase, the projected percentage increase in state population was used as a surrogate for the increase in sludge incineration and the associated RGM emission for each of the municipal sludge incinerators in question.

7. For the chlor-alkali plant, it was presumed that production would increase as population over a larger area increases, since the chlor-alkali plant commonly supplies its product (chlorine) to a paper mill which in turn sells their product to customers over a large area. Thus the projected percentage increase in the Southeast Region's population was used as a surrogate for increases in RGM emissions from the chlor-alkali plant in question.

8. For residential and industrial boilers, the original emissions inventory data was supplied as county totals for mercury emissions. Since it was not known what portion of the county level aggregates is due to industrial and residential boilers, the larger projected growth factor (state versus regional) was used as a conservative estimate of growth in RGM emissions from these sources.

Based on this methodology (See Table 3), for the future emissions analysis EPA calculated that in the year 2010 the emissions of RGM from individual facilities and small or area sources within the RGM airshed ($[EI_{2010}]_{RGM}$) are estimated to be **392.3 kg/yr** (392.3 kilograms per year.)

Table 3. Summary of Mercury Emissions in the Ohoopee RGM Airshed Projected for 2010						
Source Category	**No. of Sources Projected in 2010**	**Total Hg Emissions 2010 (kg/yr)**	**% of Total Hg**	**% of Total Hg That is RGM**	**RGM Emissions 2010 (kg/yr)**	**% of Total RGM**
Municipal Waste Combustors	**2**	**35.9**	**2%**	**60%**	**0.0**	**0.0%**
Medical Waste Incinerators	**4**	**49.3**	**3%**	**73%**	**24.7**	**6.3%**
Hazardous Waste Incinerators	**1**	**0.2**	**0.01%**	**8%**	**0.1**	**0.02%**
Coal Burning Power Plants	**19**	**698.9**	**37%**	**30%**	**209.7**	**53%**
Oil Burning Power Plants	**2**	**0.2**	**0.0%**	**30%**	**0.1**	**0.0%**
Gas Burning Power Plants	**2**	**0.001**	**0.00004%**	**30%**	**0.0003**	**0.0001%**
Pulp and Paper Mills	**14**	**163.6**	**9%**	**30%**	**49.1**	**13%**
Sewage Sludge Incinerators	**2**	**10.6**	**1%**	**60%**	**6.4**	**2%**
Chlor-alkali Production	**1**	**704.9**	**37%**	**5%****	**35.2**	**9%**
Residential/ Industrial Boilers	**77***	**223.8**	**12%**	**30%**	**67.1**	**17%**
Total	**124**	**1887.4**	**100%**		**392.3**	**100%**

* This value indicates the number of counties in the study area with residential or industrial boilers. The emissions inventory for the residential/industrial boiler source category provides total mercury emissions by county. Of the 77 total counties, 69 counties are in Georgia and 8 counties are in South Carolina.
** Based on recent emissions testing done to characterize mercury emissions from chlor-alkali facilities, the projected 2010 % RGM for the Olin facility was changed from 30% to 5%.

3.3 Projected Future Deposition (for the year 2010)

One key goal in this analysis is to estimate deposition of total mercury (all forms, from all sources and areas) to the Ohoopee River basin for the year 2010. Our basic assumption is that, for RGM, the ratio of deposition to emissions in the future year will be essentially the same as the ratio of deposition to emissions in the baseline period. Equation 5, below, expresses this relationship. EPA believes this is a reasonable assumption because the ratio represents a general relationship resulting from basic chemistry and physics of atmospheric transport, which will remain essentially the same in future years. That is, we have no reason now to project that the atmospheric conditions in south-central Georgia and southeast South Carolina will be greatly different (due to events such as widespread, long-lasting forest fires or major changes in the regional atmospheric chemistry) in 2010 than during the baseline period of 1994-1996. For both time periods, the deposition under analysis is an annual sum of deposition to the Ohoopee River watershed, and the emissions for both time periods are from Clean Air Act regulated facilities in the "RGM airshed" (the watershed plus the counties within 100 kilometers of the watershed). In addition, we are assuming that the year 2010 will be a year with "average" meteorology for the U.S., comparable to the RELMAP model use of "average" meteorology for the baseline period. (In the RELMAP model runs, the weather data from 1989 was used, because meteorology in that year was generally average across the country). For the MDN monitor data, we consider that the wet deposition amount averaged from three years of data is fairly representative of "average" meteorology because for those three years the average of annual rainfall was similar to long term average rainfall in the area. (For additional discussion, see Section 4.4 .)

3.3.1 Calculating $[DEP_{2010}]_{RGM}$: the future deposition of RGM to the watershed.

To estimate the RGM deposition in 2010 that results from anthropogenic sources within the RGM airshed, the ratio of the modeled RGM deposition in the Baseline period (1994-1996) to the RGM emissions from sources in the RGM airshed for the same period was compared to a similar ratio for 2010 by a simple proportion (**Equation 5)**:

$$\frac{[DEP_{Base}]_{RGM}}{[EI_{Base}]_{RGM}} = \frac{[DEP_{2010}]_{RGM}}{[EI_{2010}]_{RGM}} \qquad \textbf{(Equation 5)}$$

Where:

$[DEP_{Base}]_{RGM}$ = the total annual deposition of RGM to the Ohoopee River watershed in the baseline period (1994-1996), as calculated above in Equation 3.

$[DEP_{2010}]_{RGM}$ = the projected total annual deposition of RGM to the Ohoopee River watershed in 2010 (this is the value to be solved for in Equation 5.)

$[EI_{base}]_{RGM}$ = the annual emissions of RGM from local sources within the RGM airshed, based on data gathered during the 1994-1996 base period (Table 2.)

$[EI_{2010}]_{RGM}$ = the projected emissions estimate for RGM during 2010 from a projected inventory of sources within the RGM airshed (Table 3.)

Substituting values for these parameters gives us:

$$[DEP_{2010}]_{RGM} = \frac{[DEP_{Base}]_{RGM} \times [EI_{2010}]_{RGM}}{[EI_{base}]_{RGM}}$$

$$= \frac{(9.658\ ug/m^2/yr) \times (392.3\ kg/yr)}{(1{,}389.9\ kg/yr)} = 2.726\ ug/m^2/yr$$

As discussed in Section 2.1, the Ohoopee River watershed covers an area of approximately 3,480 square kilometers. Thus, the projected total wet and dry deposition of RGM on the watershed in 2010 is approximately 9.49 kilograms (21 pounds) per year.

3.3.2 Calculating $[DEP_{2010}]_{Total}$: future deposition of "total" mercury to the watershed.

In Section 2.4.1, we calculated an estimate of the amount of RGM deposited from the air to the Ohoopee River watershed in a future year, 2010. However, we know that additional sources of mercury from outside the RGM airshed will contribute to the overall depositional loading. In earlier sections, we estimated what this overall loading would be for a baseline period. However, we do not know what the loadings of these additional sources of mercury would be for the future year. Thus, to estimate the deposition of **total** mercury to the watershed for the year 2010, additional steps were needed. Specifically, we added an estimated value for annual deposition from global sources of elemental mercury as well as values for U.S. sources of both elemental and particulate mercury. The procedure we used to obtain these values is provided below.

Calculating $[DEP_{2010}]_{Global}$: Deposition from global background.

Since we had no way to determine how the deposition from global background mercury would change over the approximately 15 year projection period (approximately 1995 to 2010), we presumed that the deposition from globally circulating mercury will be essentially the same during the year 2010 as for the baseline period (1994-1996). This assumption reflects the expectation that, while mercury emissions from fossil fuel combustion for energy production are likely to increase in developing countries, the industrialized nations are expected to continue adding new controls on their sources to reduce mercury emissions. Based on this assumption, EPA projected mercury deposition from global background sources in 2010 to be the same as for

the baseline period (Equation 6):

$$[DEP_{2010}]_{Global} = [DEP_{Base\text{-}Wet}]_{Global} = 6.605 \text{ ug/m}^2\text{/yr} \quad \textbf{(Equation 6)}$$

Where: $[DEP_{Base\text{-}Wet}]_{Global}$ is calculated in the lines following Equation 1 (in Section 2.2 .)

Calculating $[DEP_{2010\text{-}Wet}]_{US\text{-}elem}$, $[DEP_{2010\text{-}Wet}]_{particle}$, and $[DEP_{2010\text{-}Dry}]_{particle}$.

To estimate deposition resulting from U.S. elemental and particulate mercury sources for 2010, EPA presumed that the relative amounts of these species, compared to the amount of RGM deposited from U.S. sources, would not vary between the baseline period and the future year. That is, the relationship among the species of mercury deposited, based on analysis of the RELMAP model runs is used as an estimate for both the baseline and future conditions. From Tables 1a and 1b we obtain the modeled amount of RGM from U.S. sources in wet and dry deposition (50th percentile) during the baseline period, and calculate their sum (Equation 7):

$$[DEP_{Model\text{-}RGM}]_{US\text{-}Total} = [DEP_{Model\text{-}Wet}]_{US\text{-}RGM} + [DEP_{Model\text{-}Dry}]_{US\text{-}RGM} \quad \textbf{(Equation 7)}$$
$$= 2.652 \text{ ug/m}^2\text{/yr} + 4.101 \text{ ug/m}^2\text{/yr}$$
$$= 6.753 \text{ ug/m}^2\text{/yr}$$

Once this value is calculated for total-RGM-deposited, it is compared to the amounts of deposition from U.S.-derived particulate and elemental mercury during the baseline period, using the values at the 50th percentile as given in Tables 1a and 1b. Table 4 presents these values as percentages of the 50th percentile of RELMAP modeled RGM amount.

Table 4. Elemental and Particulate Deposition from U.S. Sources Relative to RGM Deposition from U.S. Sources
From *The Mercury Study* (RELMAP model)
U.S. East of 90° W longitude

Deposition Variable	Deposition at the 50th Percentile (ug/m²/yr)	% (Relative to Total Hg^{2+})
Wet Hg^0 from U.S. sources	0.181	2.7 %
Wet $Hg_{particle}$ from U.S. sources	1.956	29.0 %
Dry $Hg_{particle}$ from U.S. sources	0.078	1.2 %
Total (Wet +Dry) Hg^{2+} from U.S. sources	6.753	100 %

Using these percentages and the assumption that they do not vary between the baseline period and the future year (see Section 4.5 for a discussion of this assumption), we can calculate the amount of future year contribution from U.S. elemental and particulate sources by multiplying the percentages in Table 4 by the estimated amount of RGM deposition to the watershed in 2010 (as estimated above in Section 3.3.1), thus:

$$[DEP_{2010\text{-}Wet}]_{US\text{-}elem} = (0.027)([DEP_{2010}]_{RGM}) = (0.027)(2.73 \text{ ug/m}^2\text{/yr}) = 0.0736 \text{ ug/m}^2\text{/yr}$$

and

$$[DEP_{2010\text{-}Wet}]_{particle} = (0.290)([DEP_{2010}]_{RGM}) = (0.290)(2.73 \text{ ug/m}^2\text{/yr}) = 0.7905 \text{ ug/m}^2\text{/yr}$$

and

$$[DEP_{2010\text{-}Dry}]_{particle} = (0.012)([DEP_{2010}]_{RGM}) = (0.012)(2.73 \text{ ug/m}^2\text{/yr}) = 0.0327 \text{ ug/m}^2\text{/yr} .$$

Once these estimated values for deposition of mercury to the Ohoopee River watershed from U.S. sources were calculated for 2010, the total mercury deposition to the Ohoopee River watershed, for this analysis, was determined by adding the projected deposition of RGM with projected deposition from U.S. sources and global mercury sources (Equation 8):

Projected Total Hg Deposition to Ohoopee River Watershed in 2010 =

$$[DEP_{2010}]_{RGM} + [DEP_{2010\text{-}Wet}]_{particle} + [DEP_{2010\text{-}Dry}]_{particle} + [DEP_{2010\text{-}Wet}]_{US\text{-}elem} + [DEP_{2010}]_{global} = \quad \textbf{(Equation 8)}$$

$$(2.726)_{RGM} + (0.791)_{[Wet]Particle} + (0.033)_{[Dry]Particle} + (0.074)_{[Wet]US\text{-}elem} + (6.605)_{Global}$$

$$= 10.23 \text{ ug/m}^2\text{/yr} .$$

Based on this methodology, for this analysis the projected annual deposition of total mercury to the Ohoopee River watershed for the year 2010 is estimated to be:
10.23 ug/m^2/yr (10.23 micrograms per square meter per year.)

As discussed in Section 2.1, the watershed covers an area of approximately 3,480 square kilometers. Thus, in this analysis, the projected annual deposition of total mercury in 2010 to the watershed is approximately 35.6 kilograms (79 pounds) per year.

3.4 Estimated Reductions in Future Deposition (2010) from the Baseline

Since the total deposition value is based on the relative deposition from different types of sources in the 50th percentile distribution of RELMAP modeled deposition, we conducted a

sensitivity analysis to determine the variability in the projected annual deposition of total mercury to the Ohoopee River watershed. Specifically, we evaluated the 10th percentile and 90th percentile results from the RELMAP analysis provided in Tables 5-5 and 5-6 of Volume III of *The Mercury Study*. Table 5, below, provides the projected 2010 deposition estimates for the 10th, 50th and 90th percentiles. (Also see Section 4.5 for additional discussion on using these percentiles.)

As can be seen below in Table 5, for the Stage 1 calculations, applying only promulgated standards, the estimated percent reductions for total mercury deposition for the Ohoopee River watershed range from **42 %** to **54 %** over the 15 year period. If we consider only the deposition of RGM over the 15 year period, Table 6, below, shows an estimated **72 %** reduction in RGM deposition. The lower estimated percent reduction for total mercury deposition is primarily a result of adding the deposition from the global sources (which we assumed to remain constant from the baseline period to 2010).

Table 5. Total Mercury Deposition Estimates

	Based on 10th Percentile	Based on 50th Percentile	Based on 90th Percentile
Baseline Total Hg Deposition in the Ohoopee River Watershed (µg/m^2/yr)	19.125	19.125	19.125
Projected 2010 Total Hg Deposition in the Ohoopee River Watershed (µg/m^2/yr)	11.054	10.227	8.770
Percent Reduction	42.20 %	46.53 %	54.14 %

Table 6. RGM Deposition Estimates

	Based on 10th Percentile	Based on 50th Percentile	Based on 90th Percentile
Baseline RGM Deposition in the Ohoopee River Watershed (µg/m^2/yr)	8.989	9.658	11.073
Projected 2010 RGM Deposition in the Ohoopee River Watershed (µg/m^2/yr)	2.536	2.726	3.125
Percent Reduction	71.78 %	71.78 %	71.78 %

4.0 DISCUSSION OF CONCEPTS AND UNCERTAINTIES

4.1 The RELMAP National Model of Atmospheric Deposition

This analysis of past and future deposition of mercury from the atmosphere depends heavily on the RELMAP modeling; the uncertainties inherent in that modeling remain a part of this process. The national inventory of emissions developed during the early 1990s included many first-time estimates for mercury emissions to the air from many of the individual facilities. During the preparation of the emission inventory data sets for the RELMAP modeling, EPA updated its estimated emissions for several source categories and individual sources, although the techniques to develop quantitative emission estimates remained somewhat limited. For the model calculations, the total emissions had to be allocated between the chemical/physical species of mercury, and this was dependent on limited studies in Europe, and a very few speciated-mercury emissions tests within the U.S.. *The Mercury Study* states that:

> *A wide variety of alternate emissions speciations have been simulated for important groups of atmospheric mercury sources in order to test the sensitivity of the RELMAP results to the speciation profiles used. [Bullock et al., 1997B]. This work showed that the RELMAP modeling results are very strongly dependent on the assumed emission speciations.* [Vol.III, p.4-4]

The constraint on modeling produced by limited test data on speciated mercury emissions continues to affect current modeling efforts. Thus the RELMAP results have no more uncertainty in this area than other models available at this time. This analysis utilizes the RELMAP data and results because the RELMAP work was widely reviewed and is considered to provide a useful overall analysis, as discussed in the second paragraph below.

Other aspects of the RELMAP modeling are also considered as contributing to uncertainty, such as the meteorological data and limits of Lagrangian type of computer models. For RELMAP, the meteorological data for the year 1989 were used, since the weather that year was fairly average over most of the U.S. The RELMAP representation of the mercury deposition from "background" was also limited by the constraints of that particular Lagrangian model. Background refers to elemental mercury which is transported internationally, thus the sources for it are "global". The background concentration of mercury in the air is fairly small but the available reservoir in the atmosphere is large. The elemental mercury is removed (deposited) from the atmosphere very slowly, but over a year's time the total deposition is significant. The RELMAP approach may have somewhat overestimated the deposition derived from "global" sources of elemental mercury because the atmospheric background concentration was assumed to remain available at a consistent level, rather than declining as air masses move across the U.S. Likewise, the atmospheric concentration of elemental mercury was not related to inputs into the modeling domain from different compass directions (i.e. across different U.S. borders). Depending on the altitudes and pathways for long-distance inputs of mercury, mixing and precipitation events, and atmospheric chemistry (especially in clouds), newer models using

updated atmospheric chemistry for mercury may provide a more refined estimate of deposition due to mercury transported internationally from global sources.

Notwithstanding the uncertainties noted in the two paragraphs above, EPA has confidence in the underlying studies that EPA used for this current analysis because scientists and interested parties provided detailed and extensive review of *The Mercury Study* and the RELMAP model results and analysis (including their uncertainties) prior to their publication. The background data, including the emissions inventory and the speciation profiles for mercury emissions and the RELMAP computer modeling, have generally been accepted as reasonable and useful to the understanding of atmospheric deposition of mercury in the continental United States.

Also, comparison of the RELMAP results for wet deposition with recent field data indicates that the model's predictions were reasonably correct. In *The Mercury Study*, the RELMAP results for deposition were compared to the available data (1996-1997) for monitored wet deposition of mercury. Since the study was published in 1997, the Mercury Deposition Network (MDN) has been expanded, so that now more data from actual measurements are available. In general, any one year's particular variations in weather (especially precipitation) has considerable influence on measured wet deposition of mercury; so making close comparisons of model results to only a few years' specific data has inherent limitations. In general, the MDN data correlate reasonably well with the RELMAP modeled wet deposition values over much of the U.S. For a detailed discussion of the RELMAP results and MDN measurements for the Ohoopee watershed see Section 4.4 below.

4.2 Other Atmospheric Computer Models or Direct Calculation

In conducting this analysis of deposition, EPA considered obtaining atmospheric models newer than RELMAP and preparing an updated emissions inventory, then using these tools to conduct specific modeling focused on the southeastern U.S., or particularly on an area of Georgia and Florida. Three models were considered: Industrial Source Complex Short Term, Version 3 (ISCST3) (for small areas, generally only 100 km across), and the national-scale models Regulatory Modeling System for Aerosols and Deposition (REMSAD) and Hybrid Single Particle Lagrangian Integrated Trajectory (HYSPLIT). However, the working versions currently available for all of these models have calculation routines for mercury chemistry and deposition that present limitations similar to those for RELMAP. The two national-scale models are undergoing updates to their mercury calculation routines; the improved versions of the models are expected to be available late in calendar year 2001 or in 2002. Because of the limitations of each of these other models currently available, EPA decided for this analysis to use the published and reviewed RELMAP modeling results and associated data on emissions. In addition, this analysis for the Ohoopee River watershed was prepared within a short time frame which would not allow time for the detailed work needed to develop updated emissions inventories and to test and run new versions of complex computer models.

EPA recognizes that the method of calculation used here, which focuses on reactive gaseous mercury (RGM) and derives an estimated deposition in the future by comparing ratios of RGM deposition to RGM emissions from local sources (those within the RGM airshed), is not equivalent to a full, computer modeling analysis. However, this approach does provide an estimate of future deposition based on considerations of both expected growth in activity and emissions by the sources, plus estimated reductions achieved through additional controls placed on emissions through the Clean Air Act. The estimated reduction percentages for specific source categories presented in Appendix I were taken directly from the supporting information for the MACT rule-making for each of these source categories. We recognize that we have used national averages for estimated reductions to be achieved by compliance with the MACT standards; these averages are based on the full range of processes and control options within a source category, across the nation. The actual level of reductions in emissions as controls are improved will vary for each source facility depending on the level of control already in place at the time the MACT standard becomes effective. A more in-depth analysis, including a source-by-source evaluation of facilities in the RGM airshed for the Ohoopee River, would be needed to obtain the details of changes in processes or controls and thus reductions in mercury emitted. Because this analysis was needed in a relatively short time, we used the national averages for reductions to be achieved under the new combustion rules. Evaluating each of individual facilities as to its present processes and control equipment and calculating its particular reductions after applying new controls would require more time and engineering analyses than were available for this first-phase analysis. Such a detailed source-by-source analysis may be developed in the future for further refinements of the emissions inventory and possible additional analyses or computer modeling.

4.3 The Airshed

The term and concept of an "airshed" is less well known than "watershed", and can be somewhat more difficult to define. Basically, an airshed is a geographic area that includes a variety of sources that emit a certain pollutant to the atmosphere, and where the area of the airshed includes all the sources whose emissions contribute to a significant loading or impact to a receptor, by way of atmospheric deposition. Typically the "receptor" can be a watershed (itself a geographic area) or the water surface of a large lake or estuary which receives wet and dry deposition of the pollutant of concern. Different types of pollutants vary considerably in characteristics such as: how long they persist in the air, how far they are transported (in typical weather patterns of a region), and the mechanisms by which they are removed from the air. For example, each chemical species of mercury in gaseous form has different patterns of transport and deposition, and various particles and aerosols with mercury adsorbed have still different patterns. A particular airshed generally surrounds the receptor (watershed or water body) that it affects, particularly in the eastern U.S. where wind directions often come from all compass directions when considered over a full year. The shape of an airshed depends on whether there is a predominant wind direction, and also on how precipitation relates to wind direction. The size of an airshed depends on how far the specific pollutant of concern is distributed from its emission

source, and upon defining some numeric level for "significant" deposition. Generally there is a gradient around each facility, where more deposition (per square meter) of the pollutant occurs fairly near the source and then declines as one moves farther away from the source. In some detailed computer models of atmospheric deposition, all the sources that can be "upwind" of the receptor (watershed) being studied are evaluated as to how far their emissions are transported. Sources situated so that only a small percentage of their emissions are likely to reach the watershed boundary are considered to be outside the airshed of that particular receptor (watershed.) Sources situated such that a significant percentage of their deposition does enter the watershed boundary are considered to be within the airshed of that particular watershed. The setting of "significant percentage" can be complex, but figures of 66% or 75% of emissions are commonly used in particular computer models to define an airshed. It must be understood that calculating or defining an airshed boundary, even with computer modeling, does not mean that there is some sudden change in the importance of sources as one crosses that boundary. Rather the airshed boundary represents an estimate of some degree of significance of contribution to deposition, as one moves along gradients away from the receptor area.

The RELMAP model and the REMSAD and HYSPLIT models, like other computer models that are useful in evaluating atmospheric deposition, do not calculate or define boundaries of specific airsheds to correspond to specific watersheds or water bodies. Generally they are used to model the atmosphere over a large geographic area, much larger than a specific airshed is likely to be, and include all the sources emitting the pollutant of concern. The model calculations incorporate all the emissions, their overall transport and atmospheric reactions, and the resultant deposition to all parts of the geographic area. (Generally the results are expressed as a numeric value for deposition within each square of a grid which is used to subdivide the geographic area.)

Here we are concerned with the specific pollutant, RGM or divalent mercury gas, and how near or far from a source it is deposited. This analysis for the Ohoopee River watershed is based on the RELMAP model, so defining the RGM airshed cannot be derived directly from the model. Rather the results of the model and other research results are consulted to estimate an area within which deposition of RGM can be considered significant. The RELMAP results indicate that significant deposition occurs within two grid squares (each about 40km across) around an individual facility or unit source with large annual emissions, with some deposition continuing into one adjacent grid square (thus to a distance of 80 to 120 km.) Various research publications on mercury, that discuss mercury's chemical species, give a range of significant deposition for RGM that varies from 50 or 60 km to as much as 200 km. For this analysis, the RGM airshed for the Ohoopee River watershed was set at a distance of 100 km around the watershed (and also includes the watershed area itself.) EPA chose 100 km because it is near the mid range of the various distances proposed for significant deposition of RGM. EPA's goal in defining the RGM airshed in this way was used to set a reasonable boundary within which to gather detailed information on sources, and evaluate current and probable future emissions.

In this study, the boundary of the RGM airshed in practical terms includes the boundaries of all the counties that have a portion of their area within 100 km radius of the Ohoopee River

watershed. The information provided by the RELMAP data bases on individual facilities includes the name of the county in which they are located, but not detailed locations. Therefore we did not estimate whether each facility was exactly within a strictly defined distance of 100km, but included all facilities in the County. This analysis does not assert that only those facilities within the RGM airshed are important for the deposition of RGM. Rather we consider that some RGM, and especially particulate and elemental mercury, emitted from sources within the U.S. but outside this particular airshed also will contribute in some measure to deposition of mercury within the Ohoopee River watershed. In addition, some deposition will come from mercury reaching the watershed by international transport; that is from "background" or global sources. In future years, possible additional analyses and computer modeling will probably evaluate emissions sources in a considerably larger area than just the watershed and 100 km distance around it.

Alternatively, the RGM airshed could be redefined to extend 200 km around the Ohoopee River watershed, a distance which reflects some research on transport of RGM. In that case, the analysis would encompass emissions from the urban areas of Atlanta, Albany and Valdosta, Georgia, plus Jacksonville, Florida, and Columbia, South Carolina, with the potentially large industrial and utility sources associated with urban areas. While sources in this larger area, and indeed within the entire southeastern U.S., may contribute to mercury deposition reaching the Ohoopee River watershed, absent additional modeling EPA cannot estimate their importance relative to sources within the RGM airshed based on 100 km.

In addition, if future analyses are pursued, EPA may develop detailed emissions data from individual sources within a study domain which would consider transport of all species of mercury, not just RGM Source-specific data may be gathered to account for process changes, installation of emissions control equipment or facility closures; such data may show even greater reductions in mercury emissions than EPA can estimate at this time. Speciation profiles for mercury in emissions are critical for modeling, but are not readily available for individual facilities or categories. At this time, measurements of speciated emissions are very limited from most source categories known to emit significant amounts of mercury. (Currently available techniques to measure mercury species quantitatively in emissions are expensive and difficult to apply.) However, the RELMAP estimates of speciated emissions by source category have been widely reviewed, and are used here to compare this analysis to that earlier, more comprehensive study and the published discussion of its results.

4.4 Comparing Monitor Data To Model Estimates.

Mercury in precipitation is monitored by routine collections and chemical analysis at numerous locations (monitoring sites) in the U.S., particularly in the eastern states. Much of this work is coordinated by the Mercury Deposition Network (MDN), a cooperative activity of federal, state, and local agencies, universities, and others, with central coordination through the Illinois State Water Survey. A basic, "transition" network began in 1995 with 13 sites, and in

1996 MDN became a sub-network of the well established National Atmospheric Deposition Program. In the year 2000, over 40 sites were active in the conterminous 48 states. Weekly samples are collected using clean procedures and are analyzed at a central laboratory, with appropriate field and laboratory quality assurance and validation protocols. Within the eight states of EPA's Region 4, for calendar years 1998, 1999, and 2000, data is available from 8 sites. Of these sites, three locations are relevant to south and middle Georgia: (1) central South Carolina (Congaree Swamp, in Richland County, near Columbia), (2) southeastern Georgia (Okefenokee National Wildlife Refuge in Charlton County), and (3) Gulf coast of Florida peninsula (Chassahowitzka. National Wildlife Refuge in Citrus County, north of Spring Hill.) The other sites in Region 4 states are: two locations in eastern North Carolina (Pettigrew State Park & Waccamaw State Park), and three locations in southeastern Florida, from Palm Beach County to Everglades National Park. The nearest sites outside Region 4 are in Louisiana, where three sites began providing data for1999. (See reference for MDN, 2001, for details.)

For the Okefenokee monitoring site, the following data are calculated as annual totals from the weekly data tables provided by the MDN: 1998 total rainfall = 1.414 m with Wet Deposition (total-Hg) = 16.70 ug/m^2 ; 1999 total rainfall = 1.036 m with Wet Deposition (total-Hg) = 12.00 ug/m^2 ; 2000 total rainfall = 0.907 m with Wet Deposition (total-Hg) = 9.56 ug/m^2. A simple average of these figures gives annual total rainfall of 1.12 m and annual wet deposition for total-mercury of 12.75 ug/m^2 (12.75 micrograms per square meter.)

Annual total wet deposition of mercury is generally correlated with total annual precipitation, at least for conditions within the southeastern U.S. The average MDN data for the Okefenokee, GA, site were compared to precipitation data from nearby weather stations, using total rainfall for 1989, the year of meteorological data used for the RELMAP modeling (because 1989 was an average year for weather across the U.S.) The1989 data for total rainfall from cities near Okefenokee N.W.R. are: 1.05 m/yr at Valdosta, GA (to the west), 1.12 m/yr at Waycross, GA (to the north), 1.17 m/yr at Brunswick, GA (to the east-northeast), 1.31 m/yr at Jacksonville, FL (to the east-southeast), and 0.92 m/yr at Live Oak, FL (to the south). Although a formal statistical or numeric analysis has not been done, EPA considers that the average data for 3 years at the MDN monitoring site at Okefenokee are sufficiently close to these meteorological data, that the MDN data can be used as an estimate for generally "average" conditions in south Georgia, and can be compared to the RELMAP modeling results.

However, when data is available for only one location, the question arises concerning what extent of area around that site should be considered to be represented by that location. Because of relative solubility of the various species of mercury found in the atmosphere, the "total-mercury" in precipitation is considered to be over 98% in the form of dissolved RGM (divalent mercury gas, dissolved in ionic form.) RGM also constitutes a similar percentage of dry deposition. Both wet and dry deposition of RGM is considered in this analysis to occur for the most part within 100 kilometers of an emission source. Thus the MDN monitor for wet deposition at Okefenokee would be influenced strongly by all sources (facilities or units) within a 100 kilometer distance, with some but lesser influence from other sources at greater distance in

the U.S. (especially up to 1000 km distant) plus a significant contribution from "global background" of elemental mercury which is gradually converted to RGM or divalent mercury. The nearest MDN sites are several hundred kilometers distant and provide essentially no assistance in resolving the locations of local sources whose emissions are impacting the MDN monitor at Okefenokee.

The Okefenokee monitor data represents actual, measured conditions of wet deposition and it differs from the predicted wet deposition from the RELMAP model analyses. The RELMAP results for estimated annual wet deposition to the Ohoopee watershed are 7.05 ug/m^2, averaging the appropriate grid squares. This result is considerably less than the MDN average for 3 years, namely 12.75 ug/m^2. (The difference is 5.70 ug/m^2, which is approximately 81 % of 7.05, or approximately 45% of 12.75 ug/m^2.) The RELMAP modeled estimates for wet deposition to other, nearby watersheds in south Georgia are near 6 ug/m^2, though for Ochlockonee and St. Mary's watersheds the value is close to 7 ug/m These differences between the MDN measurements and the RELMAP model estimates are among the more extreme differences noted in the southeastern states. For the eastern U.S. overall, the RELMAP model predictions for wet deposition have been reasonably close to most of the MDN monitored data for recent years. Thus the RELMAP model results are accepted as reasonably correct in general, though differences from measurements at specific locations can be expected. Because the MDN data are actual measurements in south Georgia, they have been used in all of our TMDL-related atmospheric deposition analyses for south Georgia watersheds and for the Ohoopee River watershed in middle Georgia. In addition, these TMDL analyses have made use of the RELMAP results which calculate annual dry deposition values very close to half of annual wet deposition for these watersheds. For our TMDL analyses dry deposition is calculated as half of the 12.75 ug/m^2, that is dry deposition is 6.375 ug/m^2.

When monitored data and modeled estimates differ, one considers first the likelihood that the emissions inventory data supplied to the model may be inaccurate or non-representative. One or several sources might be missing from the inventory, or might have actual emissions (here in 1998-2000) which are greater than reported to the emissions inventory (here for 1994-1996.) Also, one or several source categories may have a greater percentage of RGM in their emissions than the estimates used in the model; this would increase the local deposition impact of such sources. EPA has reviewed recent information on emissions sources with the state agencies, and compared the RELMAP emissions inventory (EI) to the 1996 National Toxics Inventory (NTI) and other data as available. This review has found a scattering of differences in emissions numbers provided for RELMAP and reported in other EIs, but no clear identification of missing or greatly under-reported sources which could account for the greater wet deposition at the MDN site. There have been no studies of speciated mercury emissions from the source categories of concern, except for a set of tests in 1999 at selected coal-fired electric utility boilers, nationwide. Because these analysis for the Georgia TMDLs were produced under limited time constraints, EPA has not evaluated the complex results from the 1999 Information Collection Request for speciated emissions from selected coal-fired utilities as applied to the specific power plants in the RGM airsheds for the south and middle Georgia watersheds.

Thus we consider that the emissions data can be improved (and probably will be as more attention is given to toxics emissions in coming years), but currently we cannot say where in the general area of southern Georgia and northern Florida the emissions for the RELMAP model may have been significantly underestimated. For example, if it were established that some facilities with considerably larger emissions than reported in the1994-EI were found to be located near the Atlantic coast – in southeastern Georgia, or in northern Florida and within 100 km of the Okefenokee MDN site – then the MDN site might be considered representative only for its three closest watersheds (St. Marys, Suwannee and Satilla), and less applicable to the more distant watersheds (Alapaha, Withlacoochee, Ochlockonee, and Ohoopee.) However, because we cannot now locate facilities with significantly larger emissions (or greater percent of RGM), then they may occur to the west or northwest of the MDN site, and thus be within 100 km of both the MDN monitor in Okefenokee and all of these seven watersheds. Therefore, EPA has considered it reasonable at this time to use the MDN data for wet deposition as the estimate for all six watersheds in south Georgia and for the Ohoopee watershed in middle Georgia.

Other influences have been suggested, beyond increased local emissions, which could result in monitored wet deposition being greater than the modeled estimate. These include: possible increases in oxidation chemistry in the atmosphere over the geographic area, or greater long-distance transport impacting the area. As a preliminary test of regional influences, a brief examination was made of data at MDN locations across the southeastern states (except for the southern tip of Florida) in comparison to RELMAP deposition estimates. Overall, without attempting to adjust for yearly variation, there was not an obvious pattern that the model underestimates the wet deposition values for all the southeastern MDN locations. So if there are atmospheric processes that increase deposition, they are not discernable across the southeastern coastal states from Louisiana to North Carolina, given the sparse monitoring distribution and few years of data available. Because Florida and southern Georgia are unusual in being close to both the Gulf coast and the Atlantic coast, there may be some marine-derived effects on atmospheric chemistry or transport which affect these areas more than other states. To evaluate such possible mechanisms will require additional atmospheric research and field monitoring, and improved atmospheric models, all of which are expected to become available in the next several years.

4.5 Relating Chemical/Physical Forms of Mercury to Deposition

The RELMAP computer modeling and subsequent analysis of its results provides information which can be used to estimate the how each of the several chemical/physical forms of mercury in emissions contribute to wet deposition and to dry deposition. In this discussion, below, “type” of mercury refers to the chemical species (elemental or divalent), “physical form” refers to its form as gas or particulate, and “source” refers to either U.S. emissions sources or background from “global sources”. (See Tables 1a and 1b in section 2.2 above, for the forms and sources of mercury, in the column headed “Deposition Variable”.) In the RELMAP modeling studies, separate computational runs were made for emissions of each form of mercury, and the modeled results for deposition in each grid square across the U.S. were mapped and

analyzed. For each type of mercury (e.g. elemental mercury from U.S. sources) the range of values of the calculated deposition per square meter were arranged into percentiles, analyzing wet deposition separately from dry deposition. In *The Mercury Study*, data for the 10th Percentile, the 50th Percentile, and the 90th Percentile for each type of mercury were presented for the U.S. as a whole, and also for the eastern portion of the U.S. (EPA, 1997, Vol.III, Tables 5-5 and 5-6.) This analysis for the Ohoopee River watershed uses the RELMAP results for the eastern U.S. as general estimators of the relative impacts on deposition of the various types of mercury, and applies some additional steps of logic beyond the RELMAP analysis.

This study, as presented above in sections 2.0 through 2.3, focuses on emissions and deposition of RGM, and then relates deposition from the other types of mercury to RGM. This study utilizes the RELMAP values for deposition at the 50th Percentile for each type of mercury to estimate the relative contribution of each type to total deposition. One assumption in this study is that the depositional values at the 50th Percentile of the various types of mercury can be taken as estimators of average deposition such that a sum of their values will provide an estimate of average total deposition of all forms of mercury (referred to as "total-mercury".) EPA considers this to be a reasonable assumption because the 50th percentile values result from a coordinated set of computer runs of the RELMAP model that used the same emissions inventory data and meteorology, and the same algorithms for atmospheric chemistry and processes of deposition. However, using these percentile values as estimators should be considered only a first approximation, used here because there are no other published values by which to compare the relative contribution to deposition which comes from each type of mercury released into the atmosphere.

A related question is whether to use the values (for the eastern U.S.) at the 50th percentiles to represent "average" influence of the types of mercury, rather than using some other set of percentile values. (Here, "average" is meant in the general sense, rather than as a statistical mean.) To check this approach EPA evaluated calculations using different percentiles. EPA examined the deposition values using both the 10th percentile and 90th percentile (shown in Tables 5-5 and 5-6 of Volume III of *The Mercury Study*) and found that they produce roughly similar percentage distributions among the deposition variables, with one exception. The global sources represent a slightly larger fraction of the total wet deposition at the 10th percentile, and a slightly smaller fraction of the total wet deposition at the 90th percentile.[5] With this corroboration, EPA decided that the use of the 50th percentile values provides an appropriate estimator of relative percent contribution to deposition from the various types of mercury emitted.

When estimating <u>future</u> deposition as percentage contributions coming from each type of mercury (e.g. particulate mercury from U.S. Sources), this analysis assumed the relative percentages among types of mercury would remain the same for 2010 as for the baseline period.

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[5] This observation is expected because in the RELMAP modeling the deposition from the global background was analyzed separately from U.S. mercury sources; its net deposition is influenced by precipitation.

That is, the same percentages based on RELMAP 50th percentiles were used for the baseline period and for 2010. This approach was taken because currently there are no analyses available which propose different balances of mercury types in the future atmosphere, and how such a balance of mercury species would influence deposition. Also, this document develops only a first phase analysis, so estimating effects of subtle changes which might occur in the future would need more complex analysis, such as computer modeling.

A related question regarding future estimations concerns the relative amounts of the speciated forms of mercury in emissions from sources. As new controls or changes in processes are put in place and the total amount of mercury emitted is reduced, the percentage of RGM emitted may change in relation to the other chemical species or physical types of mercury emitted. Where current engineering analysis for particular source categories has provided numeric estimates for speciated emissions when controls are added, such information was included in our calculations of future emissions. For source categories for which no current engineering estimates have been prepared, this analysis simply assumed the same percentage of RGM in emissions for the future year as was used for the RELMAP data bases for the baseline period. This approach was taken rather than make changes without known basis.

4.6 International Transport (Global Sources) and Reductions in the U.S.

The relative contribution to deposition in the U.S. from global sources of mercury remains controversial. Mercury which is transported in the atmosphere for long distances (internationally) is essentially all in the form of elemental mercury. Elemental mercury is transported globally because it is relatively insoluble in water, it is chemically quite inert, and it does not adsorb readily to most surfaces. Its removal from the air, by deposition, depends primarily on chemical reactions in the atmosphere which convert it to the divalent form (that is, to RGM which is soluble in precipitation) or by adsorption to particles. RELMAP and similar models consider that global sources (which includes current human activities, re-evaporation of previously deposited mercury, and natural releases) provide a low level but ubiquitous "background" of elemental mercury in the air. Current information on mercury's chemical reactions in the atmosphere indicates that conversion to RGM, and thus contribution to deposition, is rather slow under most conditions. However, the RELMAP model considers that the global "background" is always present and some conversion is always occurring. Thus the model calculates over a year's time a significant contribution to deposition comes from the global "background" (about 36% of total deposition to areas in eastern U.S. which receive average mercury deposition.) Research on atmospheric chemistry and transport, and improved national-scale computer modeling, may provide improved estimates of deposition from this "source" within a few years. Until that time, there will remain some uncertainty as to what deposition will be attributed to mercury from international transport, even as the U.S. achieves significant reductions in deposition from domestic sources by applying emissions controls and pollution prevention.

Some research studies have proposed that deposition in some areas of the U.S. which results from international transport (global sources) is more than the RELMAP estimate of 36% of total mercury deposition. Since reductions in emissions from sources in the U.S. will do little to reduce deposition of mercury from global sources, there may be a limit on overall reductions in deposition which national and local efforts can achieve. In contrast, some recent intensive studies in south Florida have indicated that local emissions, within 100 km of a receptor area, can account for most of the mercury deposition (70% or more) which reaches the Florida Everglades. These results suggest that reducing emissions in a local region will probably result in significant reductions in deposition, while deposition resulting from long range transport of elemental mercury has important but limited impact on the total loading to a watershed. [Dvonch, et al. 1999.] There are some encouraging data from recent studies in south Florida which indicate that reductions in mercury emissions to the air within the state and the U.S. do translate, after some years, into apparent responses within the aquatic ecosystem, including lower mercury levels in fish tissues. That is, reduced domestic emissions can benefit the environment in the U.S., even if global transport continues to contribute to the total deposition.

4.7 Deposition to the Watershed in Geographic Context

A comparison for the baseline period of the estimated value for RGM deposited in the Ohoopee River watershed (approximately 33.6 kg/yr) with the estimated RGM emissions from sources in the RGM airshed (approximately 1,389.9 kg/yr) might appear to indicate a rather small amount of net deposition to the area of concern. The ratio indicates that approximately 2.4 % of the calculated RGM emitted from the local sources in the RGM airshed deposits within the area of the watershed. One way to consider this ratio is to compare the area of the Ohoopee River watershed itself relative to the total area of the RGM airshed. As stated in Section 1.0, one of the basis tenants for our analysis is that the majority of RGM in emissions is expected to be deposited within 100 km of the source. The area of the watershed is approximately 3,480 km^2, while the area of the RGM airshed (including the watershed) is approximately 64,265 km^2. Thus the watershed area is approximately 5.4% of the RGM airshed area. Wind data from the airport at Waycross, GA, show that wind directions over a full year's time come from all compass directions, though somewhat more commonly from the southwesterly quadrant and from the northeast. It is likely that much of the RGM emitted from the sources that are located near the outer edge of the RGM airshed (that is, sources which lie nearly 100 km from the boundary of the watershed) will actually be deposited outside the RGM airshed. That is, winds will disperse some of the RGM from these sources in directions "away from" the watershed, out to distances up to 100 km beyond the RGM airshed. To estimate this larger area that will receive some deposition of RGM from sources that lie within the RGM airshed, a map was generated with an additional boundary "oval" at a distance of 200 km all around the Ohoopee River watershed. (See Figure 1.) The area within this larger "200 km oval" includes approximately 187,335 km^2. Thus the area within the watershed itself (near 3,480 km^2) is approximately 1.9 % of the entire area within the 200 km oval. Because the sources and the amount of mercury that each source emits are not evenly distributed, the deposition of RGM will not be evenly

distributed over the local area. Sources which are located in the watershed itself probably have a larger percentage of their RGM emissions deposited within the watershed than is the case for sources which are within the RGM airshed but some distance from the watershed. Therefore, it appears reasonable that approximately 2.4 % of the RGM emitted within the RGM airshed will be deposited within the area of the Ohoopee River watershed.

5.0 ONGOING AND FUTURE REDUCTIONS IN EMISSIONS

5.1 Introduction

As rules and standards pursuant to the Clean Air Act have been developed, proposed, and promulgated since 1990, compliance by emitting sources as well as actions taken voluntarily have already begun to reduce emissions of mercury to the air across the US. EPA expects a combination of ongoing activities will continue to reduce mercury emissions to the air over the next decade. EPA currently regulates emissions of mercury and other hazardous air pollutants under the maximum achievable control technology ("MACT") program of Section 112 of the Clean Air Act, and under a corresponding new source performance standard ("NSPS") program under Sections 111 and 129 of the Act. Section 112 authorizes EPA to address categories of major sources of hazardous air pollutants, including mercury, by issuing emissions standards that, for new sources, are at least as stringent as the emissions control achieved by the best performing similar source in the category, and, for existing sources, are at least as stringent as the average emission limitation achieved by the best performing top 12 percent (or 5 facilities whichever is greater) of similar sources. EPA may also apply these standards to smaller area sources, or choose to apply less stringent standards based on generally available control technologies ("GACT"). Sections 111 and 129 direct EPA to establish MACT-equivalent standards for each category of new and existing solid waste incineration units, regulating several specified air pollutants, including mercury. In addition, in 1996 the US eliminated the use of mercury in most batteries under the Mercury Containing and Rechargeable Battery Management Act. This action is reducing the mercury content of the waste stream which is further reducing mercury emissions from waste combustion. In addition, voluntary measures to reduce use of mercury containing products, such as the voluntary measures committed to by the American Hospital Association, also will contribute to reduced emissions from waste combustion.

5.2 Existing Standards

Based on the EPA's National Toxics Inventory, the highest emitters of mercury to the air include coal-burning electric utilities, municipal waste combustors, medical waste incinerators, chlor-alkali plants, and hazardous waste combustors. EPA has issued a number regulations under Sections 112 and 111 and 129 to reduce mercury pollution from several of these source categories. Relevant regulations that EPA has established to date under the Clean Air Act include, among others, those listed below.

- The source category of municipal waste combustion (MWC) emitted about 20 percent of total national mercury emissions into the air in 1990. EPA issued final regulations under Sections 111 and 129 for large MWCs on October 31, 1995. Large combustors or incinerators must comply with the rule by December, 2000. These regulations reduce mercury emissions from these facilities by about 90 percent from 1990 emission levels.

- Medical waste incinerators (MWIs) emitted about 24 percent of total national mercury emissions into the air in 1990. EPA issued emission standards under Sections 111 and 129 for MWIs on August 15, 1997. When fully implemented, in 2002, EPA's final rule will reduce mercury emissions from MWIs by about 94 percent from 1990 emission levels.

S Hazardous waste combustors (HWCs) emitted about 2.5 percent of total national mercury emissions in 1990. In September 1999, EPA issued emission standards under Section 112 for these facilities, which include incinerators, cement kilns, and light weight aggregate kilns that burn hazardous waste. When fully implemented, these standards will reduce mercury emissions from HWCs by more than 50 percent from 1990 emission levels. Note that on July 24, 2001, the U.S. Court of Appeals issued a decision vacating the MACT standards for HWCs. In accordance with the court action, EPA promulgated interim emissions standards on February 13, 2002, that temporarily replace the vacated standards until final standards are issued on or before June 14, 2005. The interim mercury emissions standards for hazardous waste incinerators (the only source category with facilities in the south Georgia airsheds) are unchanged from the vacated standards.

These promulgated regulations when fully implemented and considered together with actions discussed above that will reduce the mercury content of waste are expected to reduce national mercury emissions caused by human activities by about 50 percent from 1990 levels.

5.3 Possible Future Actions

While the expected reductions discussed above will reduce loadings to water bodies, additional air deposition reductions will be needed, in some cases, to achieve the TMDL goal of fishable waters. The National Academy of Science has stated that the benefits of eating fish require a long-term goal of reducing concentrations of methylmercury in fish. Reducing emissions of mercury from additional sources will be an important step toward achieving this goal. A review of active regulatory and related initiatives to reduce mercury emissions from many categories of sources is provided in Appendix II. Additional information on one of the more important sources, electric utilities, is discussed below.

As reported in the *Study of Hazardous Air Pollutant Emissions from Utility Steam Generating Units – Final Report to Congress* (*The Utility Study*, February 1998), electricity generating utility plants, primarily coal-fired units, emitted approximately 51 tons per year of

mercury nationwide in 1994. According to *The Mercury Study*, that amount was almost 1/3 of the human-generated mercury emissions in the United States for that year. A more recent estimate gives approximately 48 tons of mercury emitted per year, currently, from electric utilities nationwide.

In order to better understand the situation, EPA, in conjunction with the U.S. Department of Energy and other parties, carried out a formal Information Collection Request in 1999 to gather data nationwide on mercury in coal and in emissions from coal-fired utility plants. It was determined that coal-fired units have significant variations in the kind of coal burned, the configuration of the burner, and post-burner pollution control – and that the amount and type of mercury emitted is greatly affected by combinations of these design variations, as well as by other factors relating to combustion.

EPA has found that there are effective ways of controlling mercury emissions from power plants. Technologies available today and technologies expected to be available in the near future can eliminate most of the mercury from utility emissions in a cost-effective manner. As of late February 2002, however, regulatory requirements have not been defined for the reduction of mercury from the emissions of coal-fired power plants.

In response to this issue, EPA issued a regulatory finding on December 14, 2000, that regulation of HAP from coal and oil-fired electric utility steam generating units is appropriate and necessary. (It should be noted that regulation will not be necessary for units fueled by natural gas, with the exception of combustion turbines.) While this finding did not create regulations, EPA committed to develop and propose MACT regulations by December 15, 2003, with final regulations to follow in approximately one year and implementation an additional three years after that.

EPA expects that a combination of ongoing and future activities under the Clean Air Act will achieve reductions in air deposition of mercury that will enable achievement of water quality standards in the Ohoopee River basin. These activities include promulgated MACT standards, MACT standards under development, and co-benefits when controlling other air pollutants from electric utilities. The activities underway to address mercury are described further in Appendix II: “Emissions Reductions Programs and Initiatives.”

In addition, on February 14, 2002, President Bush proposed the Clear Skies Initiative which would result in reductions in emissions of mercury, sulfur dioxide, and nitrogen oxides from U.S. power plants, using a market based approach. Should this initiative be enacted into law, nationwide emissions of mercury from power plants would be reduced significantly from current conditions, thus contributing even more toward reduced deposition and attainment of water quality standards.

6.0 REFERENCES

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[NOTE: Additional citations to the Federal Register, and to Internet web pages are included in Appendix II.]

Appendix I

RGM Airshed
Emissions Inventory

OHOOPEE AIRSHED Waste Incinerators

STATE/SOURCE	Facility Type	COUNTY	RGM AIRSHED Pre-MACT (1994/1996) Total Hg Emissions (kg/yr)	%Hg as RGM	RGM AIRSHED Pre-MACT (1994/1996) RGM Hg Emissions (kg/yr)	GROWTH Factor to 2010	Predicted % Reduction due to MACT (Year of MACT Compliance) 1998	Predicted Total Hg Emissions in 2010 (kg/yr)	Predicted RGM Emissions in 2010 (kg/yr)*
GEORGIA									
Savannah RRF	Municipal Waste Combustor	CHATHAM	207.56	60%	124.54	1.23	90% **	25.530372	0**
Baldwin County Hospital	Medical Waste Incinerator	BALDWIN	1.40	73%*	1.02	1.23	94%	Facility Closed	Facility Closed
Oconee Regional Medical Center	Medical Waste Incinerator	BALDWIN	5.07	73%*	3.70	1.23	94%	Facility Closed	Facility Closed
Coliseum Medical Center	Medical Waste Incinerator	BIBB	13.13	73%*	9.58	1.23	94%	Facility Closed	Facility Closed
HCA Colesium Hospital	Medical Waste Incinerator	BIBB	2.10	73%*	1.53	1.23	94%	Facility Closed	Facility Closed
Central State Hospital	Medical Waste Incinerator	BLECKLEY	12.26	73%*	8.95	1.23	94%	Facility Closed	Facility Closed
Corps of Engineers	Medical Waste Incinerator	BRYAN	2.10	73%*	1.53	1.23	94%	Facility Closed	Facility Closed
U.S. Army Hospital	Medical Waste Incinerator	BRYAN	2.90	73%*	2.12	1.23	94%	Facility Closed	Facility Closed
Bulloch Memorial Hospital	Medical Waste Incinerator	BULLOCH	0.61	73%*	0.44	1.23	94%	Facility Closed	Facility Closed
Dorminy Memorial Hospital	Medical Waste Incinerator	CHARLTON	1.74	73%*	1.27	1.23	94%	Facility Closed	Facility Closed
Candler General Hospital	Medical Waste Incinerator	CHATHAM	0.61	73%*	0.44	1.23	94%	Facility Closed	Facility Closed
Chatham County Health Department	Medical Waste Incinerator	CHATHAM	1.40	73%*	1.02	1.23	94%	Facility Closed	Facility Closed
Memorial Medical Center	Medical Waste Incinerator	CHATHAM	5.03	73%*	3.68	1.23	94%	Facility Closed	Facility Closed
St. Joseph Hospital	Medical Waste Incinerator	CHATHAM	4.20	73%*	3.06	1.23	94%	Facility Closed	Facility Closed
Clinch Memorial Hospital	Medical Waste Incinerator	CLINCH	0.70	73%*	0.51	1.23	94%	Facility Closed	Facility Closed
Dodge County Hospital	Medical Waste Incinerator	DODGE	1.79	73%*	1.31	1.23	94%	Facility Closed	Facility Closed
Effingham County Hospital	Medical Waste Incinerator	EFFINGHAM	0.70	73%*	0.51	1.23	94%	Facility Closed	Facility Closed
Emmanuel County Hospital	Medical Waste Incinerator	EMANUEL	0.29	73%*	0.21	1.23	94%	Facility Closed	Facility Closed
Evans Memorial Hospital	Medical Waste Incinerator	EVANS	1.26	73%*	0.92	1.23	94%	Facility Closed	Facility Closed
Glynn_Brunswick Memorial Hospital	Medical Waste Incinerator	GLYNN	10.77	73%*	7.86	1.23	94%	Facility Closed	Facility Closed
US Air Force Hospital Robins	Medical Waste Incinerator	HOUSTON	1.12	73%*	0.82	1.23	94%	Facility Closed	Facility Closed
Jeff Davis Hospital	Medical Waste Incinerator	JEFF DAVIS	1.96	73%*	1.43	1.23	94%	Facility Closed	Facility Closed
Jefferson Hospital	Medical Waste Incinerator	JEFFERSON	1.29	73%*	0.94	1.23	94%	Facility Closed	Facility Closed
Coliseum Psychiatric Hospital	Medical Waste Incinerator	JONES	3.22	73%*	2.35	1.23	94%	Facility Closed	Facility Closed
Medical Center of Central Georgia	Medical Waste Incinerator	JONES	108.75	73%*	79.39	1.23	94%	Facility Closed	Facility Closed
Mercer University	Medical Waste Incinerator	JONES	0.70	73%*	0.51	1.23	94%	Facility Closed	Facility Closed
Fairview Park Hospital	Medical Waste Incinerator	LAURENS	2.10	73%*	1.53	1.23	94%	Facility Closed	Facility Closed
V.A. Hospital	Medical Waste Incinerator	LAURENS	6.29	73%*	4.59	1.23	94%	Facility Closed	Facility Closed

V.A. Hospital	Medical Waste Incinerator	LAURENS	13.28	73%*	9.69	1.23	94%	Facility Closed	Facility Closed
Mc Duffie County Hospital	Medical Waste Incinerator	MCDUFFIE	3.50	73%*	2.55	1.23	94%	Facility Closed	Facility Closed
Monroe County Hospital	Medical Waste Incinerator	MONROE	0.29	73%*	0.21	1.23	94%	Facility Closed	Facility Closed
Newton General Hospital	Medical Waste Incinerator	NEWTON	2.10	73%*	1.53	1.23	94%	Facility Closed	Facility Closed
Peach County Hospital	Medical Waste Incinerator	PEACH	0.29	73%*	0.21	1.23	94%	Facility Closed	Facility Closed
Georgia Regional Hospital	Medical Waste Incinerator	RICHMOND	2.80	73%*	2.04	1.23	94%	Facility Closed	Facility Closed
Georgia Regional Hospital	Medical Waste Incinerator	RICHMOND	2.80	73%*	2.04	1.23	94%	Facility Closed	Facility Closed
Humana Hospital	Medical Waste Incinerator	RICHMOND	4.89	73%*	3.57	1.23	94%	Facility Closed	Facility Closed
Medical College of Georgia	Medical Waste Incinerator	RICHMOND	12.69	73%*	9.26	1.23	94%	Facility Closed	Facility Closed
St. Joseph Hospital	Medical Waste Incinerator	RICHMOND	12.05	73%*	8.80	1.23	94%	Facility Closed	Facility Closed
University Hospital	Medical Waste Incinerator	RICHMOND	44.95	73%*	32.81	1.23	94%	Facility Closed	Facility Closed
U.S. Army Hospital	Medical Waste Incinerator	RICHMOND	1.74	73%*	1.27	1.23	94%	Facility Closed	Facility Closed
Telfair County Hospital	Medical Waste Incinerator	TELFAIR	1.82	73%*	1.33	1.23	94%	Facility Closed	Facility Closed
Meadows Memorial Hospital	Medical Waste Incinerator	TOOMBS	1.79	73%*	1.31	1.23	94%	Facility Closed	Facility Closed
Satilla Regional Medical Center	Medical Waste Incinerator	WARE	4.02	73%*	2.94	1.23	94%	Facility Closed	Facility Closed
Wayne Memorial Hospital	Medical Waste Incinerator	WAYNE	4.30	73%*	3.14	1.23	94%	Facility Closed	Facility Closed
Wheeler County Hospital	Medical Waste Incinerator	WHEELER	1.40	73%*	1.02	1.23	94%	Facility Closed	Facility Closed
Wills Memorial Hospital	Medical Waste Incinerator	WILKES	1.40	73%*	1.02	1.23	94%	Facility Closed	Facility Closed
G.D. SEARLE AND CO.	Haz. Waste Incinerator	RICHMOND	0.89	8%	0.07	1	80%	0.18	0.01
		Georgia Totals	**518.01**		**350.58**			**25.71**	**0.01**
SOUTH CAROLINA									
Chambers Med. Tech. of SC.	Municipal Waste Combustor	HAMPTON	91.17	60%	54.70	1.14	90% **	10.39	0**
Chambers Med. Tech. of SC.	Medical Waste Incinerator	HAMPTON	239.26	73%*	174.66	1.14	94%	16.37	8.18
Chambers Med. Tech. of SC.	Medical Waste Incinerator	HAMPTON	239.26	73%*	174.66	1.14	94%	16.37	8.18
Chambers Med. Tech. of SC.	Medical Waste Incinerator	HAMPTON	239.26	73%*	174.66	1.14	94%	16.37	8.18
Aiken Regional Hospital	Medical Waste Incinerator	AIKEN	2.90	73%*	2.12	1.14	94%	0.20	0.10
US DOE Savanah River Site	Haz. Waste Incinerator	AIKEN	0.22	95%	0.21	1	80%	Facility Closed	Facility Closed
		South Carolina Totals	812.07		**581.00**			**59.69**	**24.65**
		GRAND TOTALS	***1330.07***		***931.58***			***85.40***	***24.66***

*For Medical Waste Incinerators the percent RGM is presumed to drop to 50% of the total released, after implementation of the MACT (See Table 4-2 in Volume III of *The Mercury Study*)

**After implementation of the MACT, municipal solid waste combutors are presumed to release no RGM (see Table 4-2 in Volume III of *The Mercury Study*)

OHOOPEE AIRSHED Fossil Fuel Electric Utility Boilers (Power Plants)

STATE/SOURCE	FUEL TYPE	COUNTY	RGM AIRSHED Pre-MACT (1994/1996) Total Hg Emissions (kg/yr)	%Hg as RGM*	RGM AIRSHED Pre-MACT (1994/1996) RGM Hg Emissions (kg/yr)	GROWTH Factor to 2010	Predicted % Reduction due to MACT	Predicted Total Hg Emissions in 2010 (kg/yr)	Predicted RGM Emissions in 2010 (kg/yr)
GEORGIA									
HARLLEE BRANCH	BIT COAL	Baldwin	41.09	30%	12.33	1.18	No MACT	48.48	14.54
HARLLEE BRANCH	BIT COAL	Baldwin	48.39	30%	14.52	1.18	No MACT	57.10	17.13
HARLLEE BRANCH	BIT COAL	Baldwin	73.72	30%	22.12	1.18	No MACT	86.99	26.10
HARLLEE BRANCH	BIT COAL	Baldwin	77.56	30%	23.27	1.18	No MACT	91.52	27.46
MCINTOSH (GA)	BIT COAL	Effingham	19.38	30%	5.81	1.18	No MACT	22.87	6.86
ARKWRIGHT	BIT COAL	Bibb/Jones	2.55	30%	0.77	1.18	No MACT	3.01	0.90
ARKWRIGHT	BIT COAL	Bibb/Jones	3.34	30%	1.00	1.18	No MACT	3.94	1.18
ARKWRIGHT	BIT COAL	Bibb/Jones	2.36	30%	0.71	1.18	No MACT	2.78	0.84
ARKWRIGHT	BIT COAL	Bibb/Jones	2.30	30%	0.69	1.18	No MACT	2.72	0.81
PORT WENTWORTH	BIT COAL	Chatham	4.53	30%	1.36	1.18	No MACT	5.35	1.60
PORT WENTWORTH	BIT COAL	Chatham	3.71	30%	1.11	1.18	No MACT	4.37	1.31
PORT WENTWORTH	BIT COAL	Chatham	10.64	30%	3.19	1.18	No MACT	12.55	3.77
SCHERER	BIT COAL	Monroe	123.75	30%	37.12	1.18	No MACT	146.02	43.81
SCHERER	BIT COAL	Monroe	62.16	30%	18.65	1.18	No MACT	73.35	22.01
SCHERER	BIT COAL	Monroe	45.37	30%	13.61	1.18	No MACT	53.53	16.06
SCHERER	BIT COAL	Monroe	37.32	30%	11.20	1.18	No MACT	44.04	13.21
MCMANUS 1	OIL FIRED	Glynn	0.05	30%	0.01	1.18	No MACT	0.06	0.02
MCMANUS 2	OIL FIRED	Glynn	0.09	30%	0.03	1.18	No MACT	0.11	0.03
PORT WENTWORTH 4	GAS FIRED	Chatham	0.00070	30%	0.00	1.18	No MACT	0.00083	0.00025
RIVERSIDE (GA) 8	GAS FIRED	Chatham	0.00001	30%	0.00	1.18	No MACT	0.00001	0.000003
Georgia Totals			**558.30**		**167.49**			**658.80**	**197.64**
SOUTH CAROLINA									
URQUHART	BIT COAL	Aiken	11.27	30%	3.38	1.18	No MACT	13.30332	3.990996
URQUHART	BIT COAL	Aiken	12.13	30%	3.64	1.18	No MACT	14.31446	4.294339
URQUHART	BIT COAL	Aiken	10.73	30%	3.22	1.18	No MACT	12.66140	3.798420
South Carolina Totals			**34.13**		**10.24**			**40.28**	**12.08**
	Grand Total		***592.44***		***177.73***			***699.08***	***209.72***

*** Tests of coal fired utility boilers have shown variability in the percentage of total mercury emissions that is RGM. An estimate of 30% RGM was presented in Table 4-2 of Volume III of the Mercury Study Report to Congress**

OHOOPEE AIRSHED Miscellaneous Sources

STATE/SOURCE	FACILITY TYPE	COUNTY	RGM AIRSHED Pre-MACT (1994/1996) Total Hg Emissions (kg/yr)	%Hg as RGM	RGM AIRSHED Pre-MACT (1994/1996) RGM Hg Emissions (kg/yr)	GROWTH Factor to 2010	Predicted % Reduction due to MACT ** see notes **	Predicted Total Hg Emissions in 2010 (kg/yr)	Predicted RGM Emissions in 2010 (kg/yr)
GEORGIA									
Olin	Chlor-alkali production	RICHMOND	597.38	30%	179.21	1.18	No MACT*	704.91	35.25
Savannah President ST, WPCP	Sewage Sludge Incinerator	CHATHAM	4.32	60%	2.59	1.23	No MACT	5.31	3.19
Savannah President ST, WPCP	Sewage Sludge Incinerator	CHATHAM	4.32	60%	2.59	1.23	No MACT	5.31	3.19
Riverwood Int'l Georgia	Pulp and Paper Recovery Furnace	BIBB	10.87	30%	3.26	1.18	No MACT	12.82	3.85
Gilman Paper Co.	Pulp and Paper Recovery Furnace	CAMDEN	2.95	30%	0.89	1.18	No MACT	3.49	1.05
Gilman Paper Co.	Pulp and Paper Recovery Furnace	CAMDEN	2.95	30%	0.89	1.18	No MACT	3.49	1.05
Gilman Paper Co.	Pulp and Paper Recovery Furnace	CAMDEN	5.91	30%	1.77	1.18	No MACT	6.97	2.09
Stone Savannah River	Pulp and Paper Recovery Furnace	CHATHAM	11.06	30%	3.32	1.18	No MACT	13.05	3.92
Union Camp Corporation	Pulp and Paper Recovery Furnace	CHATHAM	18.63	30%	5.59	1.18	No MACT	21.98	6.59
Union Camp Corporation	Pulp and Paper Recovery Furnace	CHATHAM	10.52	30%	3.16	1.18	No MACT	12.42	3.73
Georgia-Pacific Corp.	Pulp and Paper Recovery Furnace	GLYNN	14.90	30%	4.47	1.18	No MACT	17.58	5.28
Georgia-Pacific Corp.	Pulp and Paper Recovery Furnace	GLYNN	11.49	30%	3.45	1.18	No MACT	13.55	4.07
Interstate Paper	Pulp and Paper Recovery Furnace	LIBERTY	4.47	30%	1.34	1.18	No MACT	5.28	1.58
Federal Paper Board Co.	Pulp and Paper Recovery Furnace	RICHMOND	4.97	30%	1.49	1.18	No MACT	5.86	1.76
Federal Paper Board Co.	Pulp and Paper Recovery Furnace	RICHMOND	14.44	30%	4.33	1.18	No MACT	17.04	5.11
ITT-Rayonier, Inc.	Pulp and Paper Recovery Furnace	WAYNE	15.21	30%	4.56	1.18	No MACT	17.95	5.39
ITT-Rayonier, Inc.	Pulp and Paper Recovery Furnace	WAYNE	10.25	30%	3.07	1.18	No MACT	12.09	3.63
	Total		*744.64*		*225.98*			*879.11*	*90.69*

*** Based on recent emissions testing done to characterize mercury emissions from chlor-alkali facilities, the projected 2010 % RGM for the Olin facility was changed from 30% to 5%.**

OHOOPEE AIRSHED Residential/Industrial Boilers

STATE/SOURCE	FACILITY TYPE	RGM AIRSHED Pre-MACT (1994/1996) Total Hg Emissions (kg/yr)	%Hg as RGM	RGM AIRSHED Pre-MACT (1994/1996) RGM Hg Emissions (kg/yr)	GROWTH Factor to 2010	Predicted % Reduction due to MACT	Predicted Total Hg Emissions in 2010 (kg/yr)	Predicted RGM Emissions in 2010 (kg/yr)
GEORGIA COUNTY								
Appling	**Res/Ind Boilers**	**1.22**	**30%**	0.37	**1.23**	**No MACT**	1.50	0.45
Atkinson	**Res/Ind Boilers**	**0.48**	**30%**	0.14	**1.23**	**No MACT**	0.59	0.18
Bacon	**Res/Ind Boilers**	**0.739**	**30%**	0.22	**1.23**	**No MACT**	0.91	0.27
Baldwin	**Res/Ind Boilers**	**3.05**	**30%**	0.92	**1.23**	**No MACT**	3.75	1.13
Ben Hill	**Res/Ind Boilers**	**1.25**	**30%**	0.38	**1.23**	**No MACT**	1.54	0.46
Bibb	**Res/Ind Boilers**	**11.6**	**30%**	3.48	**1.23**	**No MACT**	14.27	4.28
Bleckley	**Res/Ind Boilers**	**0.806**	**30%**	0.24	**1.23**	**No MACT**	0.99	0.30
Brantley	**Res/Ind Boilers**	**0.856**	**30%**	0.26	**1.23**	**No MACT**	1.05	0.32
Bryan	**Res/Ind Boilers**	**1.19**	**30%**	0.36	**1.23**	**No MACT**	1.46	0.44
Bulloch	**Res/Ind Boilers**	**3.33**	**30%**	1.00	**1.23**	**No MACT**	4.10	1.23
Burke	**Res/Ind Boilers**	**1.59**	**30%**	0.48	**1.23**	**No MACT**	1.96	0.59
Butts	**Res/Ind Boilers**	**1.18**	**30%**	0.35	**1.23**	**No MACT**	1.45	0.44
Camden	**Res/Ind Boilers**	**2.33**	**30%**	0.70	**1.23**	**No MACT**	2.87	0.86
Candler	**Res/Ind Boilers**	**0.598**	**30%**	0.18	**1.23**	**No MACT**	0.74	0.22
Charlton	**Res/Ind Boilers**	**0.656**	**30%**	0.20	**1.23**	**No MACT**	0.81	0.24
Chatham	**Res/Ind Boilers**	**16.8**	**30%**	5.04	**1.23**	**No MACT**	20.66	6.20
Clinch	**Res/Ind Boilers**	**0.476**	**30%**	0.14	**1.23**	**No MACT**	0.59	0.18
Coffee	**Res/Ind Boilers**	**2.29**	**30%**	0.69	**1.23**	**No MACT**	2.82	0.85
Columbia	**Res/Ind Boilers**	**5.1**	**30%**	1.53	**1.23**	**No MACT**	6.27	1.88
Crawford	**Res/Ind Boilers**	**0.694**	**30%**	0.21	**1.23**	**No MACT**	0.85	0.26
Dodge	**Res/Ind Boilers**	**1.36**	**30%**	0.41	**1.23**	**No MACT**	1.67	0.50
Dooly	**Res/Ind Boilers**	**0.765**	**30%**	0.23	**1.23**	**No MACT**	0.94	0.28
Effingham	**Res/Ind Boilers**	**1.98**	**30%**	0.59	**1.23**	**No MACT**	2.44	0.73
Emanuel	**Res/Ind Boilers**	**1.59**	**30%**	0.48	**1.23**	**No MACT**	1.96	0.59
Evans	**Res/Ind Boilers**	**0.674**	**30%**	0.20	**1.23**	**No MACT**	0.83	0.25
Glascock	**Res/Ind Boilers**	**0.182**	**30%**	0.05	**1.23**	**No MACT**	0.22	0.07
Glynn	**Res/Ind Boilers**	**4.83**	**30%**	1.45	**1.23**	**No MACT**	5.94	1.78
Greene	**Res/Ind Boilers**	**0.911**	**30%**	0.27	**1.23**	**No MACT**	1.12	0.34
Hancock	**Res/Ind Boilers**	**0.688**	**30%**	0.21	**1.23**	**No MACT**	0.85	0.25
Houston	**Res/Ind Boilers**	**6.89**	**30%**	2.07	**1.23**	**No MACT**	8.47	2.54
Irwin	**Res/Ind Boilers**	**0.668**	**30%**	0.20	**1.23**	**No MACT**	0.82	0.25
Jasper	**Res/Ind Boilers**	**0.653**	**30%**	0.20	**1.23**	**No MACT**	0.80	0.24
Jeff Davis	**Res/Ind Boilers**	**0.929**	**30%**	0.28	**1.23**	**No MACT**	1.14	0.34
Jefferson	**Res/Ind Boilers**	**1.34**	**30%**	0.40	**1.23**	**No MACT**	1.65	0.49
Jenkins	**Res/Ind Boilers**	**0.637**	**30%**	0.19	**1.23**	**No MACT**	0.78	0.24
Johnson	**Res/Ind Boilers**	**0.643**	**30%**	0.19	**1.23**	**No MACT**	0.79	0.24
Jones	**Res/Ind Boilers**	**1.6**	**30%**	0.48	**1.23**	**No MACT**	1.97	0.59
Laurens	**Res/Ind Boilers**	**3.09**	**30%**	0.93	**1.23**	**No MACT**	3.80	1.14
Liberty	**Res/Ind Boilers**	**4.07**	**30%**	1.22	**1.23**	**No MACT**	5.01	1.50
Lincoln	**Res/Ind Boilers**	**0.575**	**30%**	0.17	**1.23**	**No MACT**	0.71	0.21
Long	**Res/Ind Boilers**	**0.479**	**30%**	0.14	**1.23**	**No MACT**	0.59	0.18
McDuffie	**Res/Ind Boilers**	**1.55**	**30%**	0.47	**1.23**	**No MACT**	1.91	0.57
McIntosh	**Res/Ind Boilers**	**0.667**	**30%**	0.20	**1.23**	**No MACT**	0.82	0.25
Monroe	**Res/Ind Boilers**	**1.32**	**30%**	0.40	**1.23**	**No MACT**	1.62	0.49
Montgomery	**Res/Ind Boilers**	**0.553**	**30%**	0.17	**1.23**	**No MACT**	0.68	0.20
Morgan	**Res/Ind Boilers**	**0.995**	**30%**	0.30	**1.23**	**No MACT**	1.22	0.37
Newton	**Res/Ind Boilers**	**3.23**	**30%**	0.97	**1.23**	**No MACT**	3.97	1.19

Oconee	**Res/Ind Boilers**	**1.36**	**30%**	0.41	**1.23**	**No MACT**	1.67	0.50
Oglethorpe	**Res/Ind Boilers**	**0.754**	**30%**	0.23	**1.23**	**No MACT**	0.93	0.28
Peach	**Res/Ind Boilers**	**1.64**	**30%**	0.49	**1.23**	**No MACT**	2.02	0.61
Pierce	**Res/Ind Boilers**	**1.03**	**30%**	0.31	**1.23**	**No MACT**	1.27	0.38
Pulaski	**Res/Ind Boilers**	**0.626**	**30%**	0.19	**1.23**	**No MACT**	0.77	0.23
Putnam	**Res/Ind Boilers**	1.09	**30%**	0.33	**1.23**	**No MACT**	1.34	0.40
Richmond	**Res/Ind Boilers**	14.70	**30%**	4.41	**1.23**	**No MACT**	18.08	5.42
Screven	**Res/Ind Boilers**	1.07	**30%**	0.32	**1.23**	**No MACT**	1.32	0.39
Taliaferro	**Res/Ind Boilers**	0.15	**30%**	0.04	**1.23**	**No MACT**	0.18	0.05
Tattnall	**Res/Ind Boilers**	1.37	**30%**	0.41	**1.23**	**No MACT**	1.69	0.51
Telfair	**Res/Ind Boilers**	0.85	**30%**	0.26	**1.23**	**No MACT**	1.05	0.31
Toombs	**Res/Ind Boilers**	1.86	**30%**	0.56	**1.23**	**No MACT**	2.29	0.69
Treutlen	**Res/Ind Boilers**	0.46	**30%**	0.14	**1.23**	**No MACT**	0.57	0.17
Twiggs	**Res/Ind Boilers**	0.76	**30%**	0.23	**1.23**	**No MACT**	0.93	0.28
Ware	**Res/Ind Boilers**	2.74	**30%**	0.82	**1.23**	**No MACT**	3.37	1.01
Warren	**Res/Ind Boilers**	0.47	**30%**	0.14	**1.23**	**No MACT**	0.58	0.17
Washington	**Res/Ind Boilers**	1.48	**30%**	0.44	**1.23**	**No MACT**	1.82	0.55
Wayne	**Res/Ind Boilers**	1.73	**30%**	0.52	**1.23**	**No MACT**	2.13	0.64
Wheeler	**Res/Ind Boilers**	0.38	**30%**	0.11	**1.23**	**No MACT**	0.47	0.14
Wilcox	**Res/Ind Boilers**	0.54	**30%**	0.16	**1.23**	**No MACT**	0.67	0.20
Wilkes	**Res/Ind Boilers**	0.82	**30%**	0.25	**1.23**	**No MACT**	1.01	0.30
Wilkinson	**Res/Ind Boilers**	0.79	**30%**	0.24	**1.23**	**No MACT**	0.97	0.29
SOUTH CAROLINA COUNTY								
Aiken	**Res/Ind Boilers**	18.60	**30%**	5.58	**1.23**	**No MACT**	22.88	6.86
Allendale	**Res/Ind Boilers**	1.80	**30%**	0.54	**1.23**	**No MACT**	2.21	0.66
Barnwell	**Res/Ind Boilers**	3.12	**30%**	0.94	**1.23**	**No MACT**	3.84	1.15
Beaufort	**Res/Ind Boilers**	13.30	**30%**	3.99	**1.23**	**No MACT**	16.36	4.91
Edgefield	**Res/Ind Boilers**	2.82	**30%**	0.85	**1.23**	**No MACT**	3.47	1.04
Hampton	**Res/Ind Boilers**	2.79	**30%**	0.84	**1.23**	**No MACT**	3.43	1.03
Jasper	**Res/Ind Boilers**	2.38	**30%**	0.71	**1.23**	**No MACT**	2.93	0.88
McCormick	**Res/Ind Boilers**	1.36	**30%**	0.41	**1.23**	**No MACT**	1.67	0.50
	Grand Total	***181.94***		***54.58***			***223.79***	***67.14***

Appendix II

Emissions Reductions Programs and Initiatives

Appendix II
Emissions Reductions Programs and Initiatives

Air Standards and Programs Impacting
Hazardous Air Pollutant Emissions/Deposition to Watersheds

This Appendix summarizes the hazardous air pollutant (HAP) related standards and programs (including time-frames) that will impact emissions and ultimately air deposition into watersheds. The descriptive text and Table II.1. are based on EPA's document, the *Air-Water Interface Work Plan*, which can be accessed on the World Wide Web at http://www.epa.gov/ttn/oarpg/t3/reports/combined.pdf. Additional information on these programs can be found in EPA's *Deposition of Air Pollutants to the Great Waters, Third Report to Congress* (EPA-453/R-00-005, June 2000) which can be accessed on the World Wide Web at http://www.epa.gov/oar/oaqps/gr8water. This Appendix is only a summary of many diverse and dynamic activities, and should be viewed as informational, subject to change as programs and activities continue to develop.

1. ***National Technology-Based Standards*** - Under Section 112 (d) of the Clean Air Act as amended in 1990 (CAA), EPA is required to regulate stationary sources of 188 listed hazardous air pollutants (HAPs). On July 16, 1992, EPA published a list of 174 industry groups (known as source categories) that emit one or more of these air toxics. For listed categories of "major" sources (those that emit, or have the potential to emit, 10 tons/year or more of a HAP or 25 tons/year or more of a combination of HAPs), the CAA requires EPA to develop standards that require the application of air pollution reduction measures known as maximum achievable control technology, or MACT standards. During the process of developing standards for "major sources," EPA also determined that for some source categories MACT standards would be needed for both major and area sources. Otherwise, area sources are to be regulated under less stringent generally available control technology, or GACT standards. Area sources are defined as stationary sources which emit, or have the potential to emit less than10 tons per year of one HAP and less than 25 tons per year of multiple HAPs. Thus far, EPA has developed 49 stationary source standards, addressing 85 different types of sources.

The CAA provided a 10-year schedule in which to promulgate these MACT standards with a certain percentage of these standards being promulgated within 2, 4, 7 and 10-years. Some of the 10-year standards such as those for refractory manufacturing (many sources emit POM), and commercial industrial boilers (sources emit mercury, cadmium, lead) are still under development. EPA intends to address all the originally listed source

categories by May 15, 2002.

2. ***Solid Waste Combustion Standards*** - Section 129 of the CAA directs EPA to establish new source performance standards, or NSPS, and emission guidelines under section 111 of the Act to limit emissions of dioxins and furans, cadmium, lead, mercury, and NOX, as well as particulate matter, opacity, sulfur dioxide, carbon monoxide, and hydrogen chloride from solid waste incineration units burning nonhazardous solid waste. These standards are essentially equivalent to MACT standards and apply to all subject solid waste incineration units without regard to "major" or "area" status. EPA has issued final standards and guidelines for large municipal waste combustors (MWCs), small MWCs, hospital/medical/infectious waste incinerators (HMIWIs) and commercial and industrial solid waste incinerators (CISWI). MWCs and HMIWIs account for 30 percent of the national mercury emissions to the air. By the time these rules for MWCs and HMIWIs are fully implemented, they will reduce mercury emissions from these sources by about 90 percent from baseline levels, and will reduce dioxin/furan emissions from these sources by more than 95 percent from baseline levels.

3. ***Residual Risk Standards*** - The residual risk standards program, required under sections 112(f) and 129(h)(3) of the CAA is designed to assess the risk from source categories after MACT standards and NSPS for solid waste incinerators are implemented. It is in the residual risk phase of the air toxics program that EPA determines the adequacy of the MACT standards already in place. Within 8 years of the promulgation of the MACT standard, EPA is required to assess whether further standards are needed to provide an ample margin of safety to protect public health, or to prevent (after considering costs, energy, safety and other factors) an adverse environmental effect. If EPA concludes that existing technology-based standards are not sufficient to meet these risk-based goals, EPA is required to promulgate additional regulations.

   In analyzing residual risk, EPA will conduct risk assessments consistent with the Agency's human health and ecosystem risk assessment technical guidance and policies. The EPA will use a tiered approach, usually first conducting a screening level assessment for a source category, and move to a refined assessment only where the risks identified in the screening assessment appear unacceptable. Depending on the characteristics of the hazardous air pollutants, these assessments will address single or multiple pathways of exposure (e.g., inhalation, consumption of contaminated fish) as well as human and ecological endpoints (e.g., terrestrial wildlife, fish-eating wildlife).

4. ***Area Source Standards*** - Under the urban air toxics program required under Section 112 (k) of the CAA, EPA must list at least 30 "area source" HAPs and then ensure that 90 percent of the area source emissions of the area source HAPs are regulated. The 30 HAPs were listed in the Integrated Urban Air Toxics Strategy (Strategy) published in the Federal Register on July 19, 1999. In order to begin meeting the 90 percent goal in the Strategy, EPA identified 13 new categories of smaller commercial and industrial operations or so-called "area" sources for regulation. Examples of area sources are dry cleaners, gasoline service stations, and public owned treatment works.

The EPA plans to finalize regulations for the recently listed 13 new area source categories by 2004. In addition, the EPA has completed or nearly completed regulations on an additional 16 area source categories. By 2003, EPA will have listed enough additional source categories for regulation in order to meet the requirement to regulate 90 percent of the area source emissions from all area source HAPs.

5. ***Seven Specific Pollutants*** - Section 112(c)(6) of the CAA lists seven specific pollutants (alkylated lead compounds, POM, hexachlorobenzene, mercury, PCBs, dioxins and furans) for special attention by EPA. The Act requires that EPA assure that stationary sources accounting for 90 percent of the emissions of these air toxics are subject to regulation. EPA published a list of source categories for regulation in the Federal Register in April 1998. Most of these source categories are already being regulated under the MACT program described in #1 above. An example of an area source category being regulated under this requirement is mercury cell chlor alkali plants (which emit mercury) and are a part of the chlorine manufacturing source category. EPA plans to complete these standards by 2003.

6. ***Utility Determination and Actions*** - As reported in the Mercury Report to Congress in 1997, utility plants (primarily coal-fired plants) emitted approximately 52 tons per year of mercury nationwide in 1994, which is almost 1/3 of the human made mercury emissions in the United States. During 1999 EPA gathered data through an Information Collection Request on mercury emissions from coal-fired electric utility power generation plants to evaluate the need for regulation of toxic air pollutants from these sources. The EPA, in conjunction with the U.S. Department of Energy and other parties, continues to assess the effectiveness and costs of various mercury pollution control technologies and pollution prevention options. Through an agreement with EPA, the National Academy of Sciences (NAS) recently completed a review of the available data on the health impacts associated with exposure to mercury. On December 14, 2000, EPA announced that it will regulate emissions of mercury and other air toxics from coal- and oil-fired electric utility steam generating units. EPA will propose MACT regulations by December 15, 2003 and issue final regulations by December 15, 2004.

7. ***Mobile Source Standards*** - While the toxic reductions from EPA's mobile source emission standards have been large, prior to 1990 EPA had no specific directions from Congress for a planned program to control air toxic emissions from mobile sources. However, in 1990 Congress amended the CAA adding a formal requirement to consider motor vehicle air toxics controls. Section 202(l) requires the Agency to complete a study of motor vehicle-related air toxics, and promulgate requirements for the control of air toxics from motor vehicles. The EPA completed the required study in 1993, and has recently updated the emissions and analyses. EPA proposed a rule to address the requirements of section 202(l) in July 2000 and issued a final rule on March 29, 2001. The March 2001 final rule identifies 21 mobile source air toxics and sets new gasoline toxic emission performance standards. It also sets out a Technical Analysis Plan to continue research and analysis on mobile source air toxics. Based on the results of that research, EPA will conduct a future rulemaking, to be completed no later than July 1,

2004, which will revisit the feasibility and need for additional controls for nonroad and highway engines and vehicles and their fuels. In addition, EPA has discretionary authority under CAA section 213(a)(4) to regulate HAP emissions from non-road mobile sources, which the Agency has not yet exercised.

Table II.1.: Office of Air Standard Setting Timeline for Standards Related to Toxics

National Technology-Based Standards		
Standards required by the Act in 1992 and 1994 (2&4-year)	Promulgate the 2&4 year air toxics standards.	Done
Standards required by the Act in 1997 (7-year)	Promulgate remaining 7-year air toxics standards.	Done
Standards required by the Act in 2000 (10-year)	Develop 10-year air toxics standards.	May 2002
Combustion standards	Promulgate remaining combustion standards.	November 2002
Residual Risk (RR) Program		
Residual risk	Propose any additional standards needed for coke ovens.	Under Development
	Propose any necessary residual risk standards for 2- and 4-year technology based standards.	2002-2004
Area Source Category Listing and Standards		
Update area source category list	Complete the area source list.	December 2003
Develop area source standards	Promulgate 13 area source standards.	2004
	Promulgate additional area source standards.	2006
	Promulgate last group of area source standards.	2009
Seven Specific Pollutants - Source Category List and Standards		
Standards for seven specific pollutants	Promulgate any standards necessary to meet requirement that sources accounting for 90% of emissions are subject to regulation for seven specific pollutants (to the extent not already achieved through the 2,4,7 and 10-	2003

Utilities Determination and Actions		
Information collection	Collect information from the utility industry, conduct analysis of potential control technologies.	Completed December 2000
Regulatory Decision/Action	Make regulatory determination for air toxics emissions (including mercury) from electric utilities.	Positive determination made December 2000
	Develop MACT regulation for utilities.	2001-2004
Office of Transportation and Air Quality(OTAQ) -Related Activities		
Section 202(l) rule	Final Rule identifies mobile source air toxics and sets new gasoline toxic emission performance standards. Also commits to further research.	Final Rule issued on March 29, 2001
Assessment activities	Final diesel health assessment document.	Under Development
	Propose re-assessment of mobile source HAP controls.	2003/2004

Table II.2. Status of Clean Air Act Standards Related to Control of Mercury By Source Category

Source Category	Status	Federal Register Citation
Electric Utility Boilers: coal combustion, oil, and natural gas http://www.epa.gov/ttn/atw/combust/utiltox/utoxpg.html	Proposal scheduled for Dec. 2003 and Final by Dec. 2004	12/20/2000, 65 FR 79825 - Regulatory Finding on the Emissions of Hazardous Air Pollutants from Electric Utility Steam Generating Units
Municipal waste combustion (small) http://www.epa.gov/ttn/atw/129/mwc/rimwc2.html	Final rules and guidelines complete	12/06/2000 65 FR 76349 - Subpart AAAA of 40 CFR Part 60 - New Source Performance Standards for Small Municipal Waste Combustion Units 12/06/2000 65 FR 76377 - Subpart BBBB of 40 CFR Part 60 - Emission Guidelines for Small Municipal Waste Combustion Units
Municipal waste combustion (large) http://www.epa.gov/ttn/uatw/129/mwc/rimwc.html	Final rule and guidelines complete Fed plan complete	12/19/1995 60 FR 65387 - Subpart Eb of 40 CFR Part 60 - NSPS for Large Municipal Waste Combustors constructed after September 20, 1994 Subpart Cb - Emission Guidelines for Large Municipal Waste Combustors constructed on or before September 20, 1994 11/12/1998 63FR63191 - Federal Plan Requirements for Large Municipal Waste Combustors Constructed On or Before September 20, 1994

Source Category	Status	Federal Register Citation
Medical waste incineration http://www.epa.gov/ttn/atw/129/hmiwi/rihmiwi.html#RULE	Final rule and guidelines complete Fed plan complete	09/15/1997 62FR48348 - Subpart Ec of 40 CFR Part 60 - NSPS for Hospital/Medical/Infectious Waste Incinerators constructed after June 20, 1996 Subpart Ce - Emission Guidelines for Hospital/Medical/Infectious Waste Incinerators constructed on or before June 20, 1996 08/15/2000 65FR49739 - 40 CFR Part 62 - Federal Plan Requirements for Hospital/Medical/Infectious Waste Incinerators Constructed On or Before June 20, 1996
Chlor-alkali production	Under development	
Hazardous waste combustors http://www.epa.gov/hwcmact/	Rule promulgated Interim Standards Final Rule	09/30/1999 64 FR 52827 - 40 CFR Parts 60, 63, 261, and 270 - Part 63 Subpart EEE - NESHAP for Hazardous Air Pollutants for Hazardous Waste Combustors. [Note: On July 24, 2001, the U.S. Court of Appeals issued a decision vacating the HWC MACT standards.] 02/13/2002 67 FR 6791 - 40 CFR Parts 63, 264, 265, 266, 270, 271 - NESHAP: Interim Standards for Hazardous Air Pollutants for Hazardous Waste Combustors (Interim Standards Rule)
Portland cement, excluding hazardous waste fired http://www.epa.gov/ttn/atw/pcem/pcempg.html	Rule promulgated	06/14/1999 64 FR 31898 - 40 CFR Part 63 National Emission Standards for Hazardous Air Pollutants for Source Categories; Portland Cement Manufacturing Industry

Source Category	Status	Federal Register Citation
Commercial/Industrial boilers: coal and oil http://www.epa.gov/ttn/atw/combust/boiler/boilerpg.html	Under development	
Pulp and paper manufacturing cluster http://www.epa.gov/ttn/atw/pulp/pulppg.html	Rule promulgated	01/12/2001 66 FR 3180 - 40 CFR Part 63 Subpart S - NESHAP for Kraft Chemical Recovery Combustion Sources at Kraft, Soda, Sulfite, and Stand-Alone Semichemical Pulp Mills
Commercial and Industrial Solid Waste Incinerators http://www.epa.gov/ttn/atw/129/ciwi/ciwipg.html	Final rule and guidelines complete	12/01/2000 65 FR 75337- Subpart CCCC of 40 CFR Part 60 - NSPS for Commercial/Industrial Solid Waste Incinerators constructed after November 30, 1999 Subpart DDDD of 40 CFR Part 60 - Emission Guidelines for Commercial/Industrial Solid Waste Incinerators constructed on or before November 30, 1999