Technology and Mercury Impact Review

Periodic Evaluation

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Executive Summary

Mercury is a potent neurotoxin (a substance that is poisonous to the nervous system). It enters water bodies by wet and dry deposition where it is converted into methylmercury. Methylmercury accumulates in fish tissue where it finds its way into the food chain. Although mercury exists naturally in the earth's crust and can be released through natural activities like volcanic eruptions and wildfires, the majority of mercury is being emitted into the atmosphere through human (anthropogenic) activities. Coal-fired power plants are the largest source of anthropogenic mercury emissions in Georgia, and control of mercury emissions is important to reduce its toxic impact on human health.

In 2006, the Georgia Board of Natural Resources (DNR Board) adopted Georgia Rule 391-3-1-.02(sss) – "Multipollutant Control for Electric Utility Steam Generating Units", which required emissions controls for mercury (Hg), particulate matter (PM), nitrogen oxides (NO_x), and sulfur dioxide (SO_2) at specific coal-burning electric utility units in Georgia. These controls were required to be phased-in across the various coal-burning units from 2008 through 2018. The rule also required a *Technology and Mercury Impact Review – Periodic Evaluation* report (Georgia Rule 391-3-1-.02(sss)22.) to be submitted to the DNR Board by December 31, 2023. So that the reporting requirement could be met, an interdivisional partnership program, Georgia's Mercury in Fish Trend Program, was formed between the Environmental Protection Division's (EPD) Air Protection Branch (APB) and Watershed Protection Branch (WPB), the Wildlife Resource Division (WRD), and the Coastal Resources Division (CRD). This partnership allowed for the efficient collection of fish, the measurement of the mercury concentrations in the collected fish tissue, and the development of this report. Through Georgia's Mercury in Fish Trend Program, twenty-two fish collection sites across various water basins of Georgia were established along with field and lab resources. Of these sites, fifteen are in freshwater basins, three are in coastal water basins, and four in black water basins. The fish collection sites along with their water basins and exact locations have been included in this report. The project consisted of annual sampling and analysis of fish tissue. Sampling was conducted over a fifteen-year period, beginning in 2006 and continuing through 2020. The basic design criteria for the Georgia's Mercury in Fish Trend Program and the roles of each of the partner divisions are described in this report.

The water quality criterion for methylmercury in edible fish tissue is 0.3 milligrams of mercury per kilogram of fish tissue (mg/kg). Water quality criteria are developed to protect human health and aquatic life. When evaluating the sampling data, EPD noticed a number of trends. Over the course of the entire study, eleven sampling sites met the criterion at both the beginning of the study and continued to meet the criterion at the end of the study; three sampling sites failed to meet the criterion at the beginning of the study but did so by the end of the study; and seven sampling sites failed to meet the criterion at the beginning of the study and at the end of the study. There was only one sampling site that met the water quality criterion at the beginning of the study, but no longer met the criterion at the end of the study.

A distinct downward trend in mercury concentration in fish tissue was demonstrated through the years at some trend sites. This downward trend is quite prominent in the black water sites, which began the study with higher overall mercury concentrations in the fish tissue collected. Although, three of the four black water sites did not meet the water quality criterion at the beginning or end of the study, they all still showed a distinct downward trend.

This study looked at various sources of mercury emissions including air, water, and land point emission sources. No significant sources were found for land and water point sources. Coal-fired power plants were found to be the predominant source of anthropogenic mercury air emissions. In Georgia, there are only two remaining coal-fired power plants (with eight units) still operating, and all have installed mercury controls. Twenty-four coal-fired units in Georgia have either shut down or converted to firing natural gas since the beginning of this study, resulting in a 98.4% reduction of mercury emissions from coal-fired power plants between 2006 and 2020 in Georgia. In 2012, the United States Environmental Protection Agency (EPA) finalized the Mercury Air Toxics Standards (MATS), which required coal-fired power plants nationwide to reduce mercury emissions. EPA estimates that MATS resulted in an 86% reduction in mercury emissions from coal-fired power plants nationwide. The steady downward trend of mercury concentration in fish tissue at the black water sites shows that the mercury emissions reductions are benefiting the water bodies with the highest mercury concentrations.

EPD recommends that, as part of the fish consumption guideline monitoring program, the collection of fish samples from black water sites (Satilla River, Okefenokee Swamp, Ogeechee River, and Banks Lake) be taken every ten years and analyzed for mercury concentrations in fish tissue. In addition, other sites with average fish tissue mercury concentrations currently at or above 0.3 mg/kg (Savannah River at I-95, Flint River, Randy Pointer, Ocmulgee River Highway 96, Lake Andrews, and Savannah River at Highway 301) should also be monitored every ten years and analyzed for mercury concentrations. Results from this sampling will be included in the *Guidelines for Eating Fish From Georgia Waters* booklet.

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Glossary

APB	Air Protection Branch
CRD	Coastal Resources Division
CR	Chattahoochee River
DNR	Department of Natural Resources
EPA	Environmental Protection Agency
EPD	Environmental Protection Division
EGU	Electric Utility Steam Generating Unit
FGD	Flue Gas Desulfurization
Hg	Mercury
Hg(0)	Elemental Mercury
Hg(II)	Oxidized/Reactive Gaseous Mercury
MRL	Minimum Reporting Level
Hg(p)	Particulate Mercury
mg	Milligrams
kg	Kilograms
MRL	Minimum Reporting Level
ng/l	Nanogram per Liter
NPDES	National Pollutant Discharge Elimination System
NO_x	Nitrogen Oxides
PM	Particulate Matter
$PM_{2.5}$	Particulate Matter that has diameter of 2.5 micrometers or smaller
SCR	Selective Catalytic Reduction
SO_2	Sulfur Dioxide
SR	Savannah River
TMDL	Total Maximum Daily Load
TRI	Toxics Release Inventory
UGA	University of Georgia
WPB	Water Protection Branch
WPC	Water Pollution Control
WPCP	Water Pollution Control Plant
WLAs	Waste Load Allocations
WRD	Wildlife Resources Division

1.0 Introduction

Mercury is a trace metal of particular concern because it is a neurotoxin[1]. One of mercury's organic compound forms, methylmercury, is the most common organic mercury compound found in the environment and it is highly toxic. Although mercury occurs in the environment naturally, anthropogenic activities such as gold mining, coal burning, and waste incineration along with industrialization have increased mercury concentrations in the air, soil, and water.

In 2006, the Georgia Board of Natural Resources (DNR Board) adopted Georgia Rule 391-3-1-.02(sss) – "Multipollutant Control for Electric Utility Steam Generating Units" (Georgia Rule (sss)), which required emissions controls for mercury (Hg), particulate matter (PM), nitrogen oxides (NO_x), and sulfur dioxide (SO_2) at specific coal-burning electric utility steam generating units (EGUs) in Georgia. Georgia Rule 391-3-1-.02(sss) is provided in Appendix A. The controls were required to be phased-in across the various coal units from 2008 through 2018. All mercury emission controls required by Georgia Rule (sss) were operational by the end of calendar year 2017.

Georgia Rule 391-3-1-.02(sss)22. requires a *Technology and Mercury Impact Review – Periodic Evaluation* report to be submitted to the DNR Board by December 31, 2023. This report details the impact of mercury reductions from EGUs as a result of Georgia Rule (sss) with respect to mercury concentrations in fish tissue at twenty-two fish collection sites within Georgia. For this study, the Georgia Environmental Protection Division (EPD) worked with the Coastal Resources Division (CRD) and the Wildlife Resources Division (WRD) to collect fish, measure the mercury concentrations in fish tissue, and develop this report.

2.0 Background

Mercury, like any other naturally occurring element, has a complete life cycle of emission-deposition-emission, including phases of passage through sediment, air, water, and animals (Figure 1). Mercury can be found in many products such as fluorescent light bulbs, switches in older automobiles, and thermometers. It is also a natural component of many rocks, including coal. Burning coal releases the naturally occurring metal into the atmosphere. Coal-burning power plants are the largest source of anthropogenic mercury emissions.

Emissions from coal burning power plants contain varying percentages of three mercury species: particulate mercury (Hg(p)), oxidized/reactive mercury (Hg(II)), and elemental mercury (Hg(0)). Elemental mercury has a long atmospheric lifetime (six months to more than a year). Because of this, elemental mercury can spread across the globe and accumulate in rain clouds that eventually deposit the mercury back to land (deposition). Reactive mercury can combine with chlorine, sulfate, iron, and other elements to form inorganic salts and can undergo wet or dry deposition within a few days of being released in the atmosphere; therefore, ecosystems near the emitting point source could potentially have higher concentrations of mercury. These inorganic mercury salts can be transported in water and occur in soil.

[1] A neurotoxin is a substance that is poisonous to the nervous system.

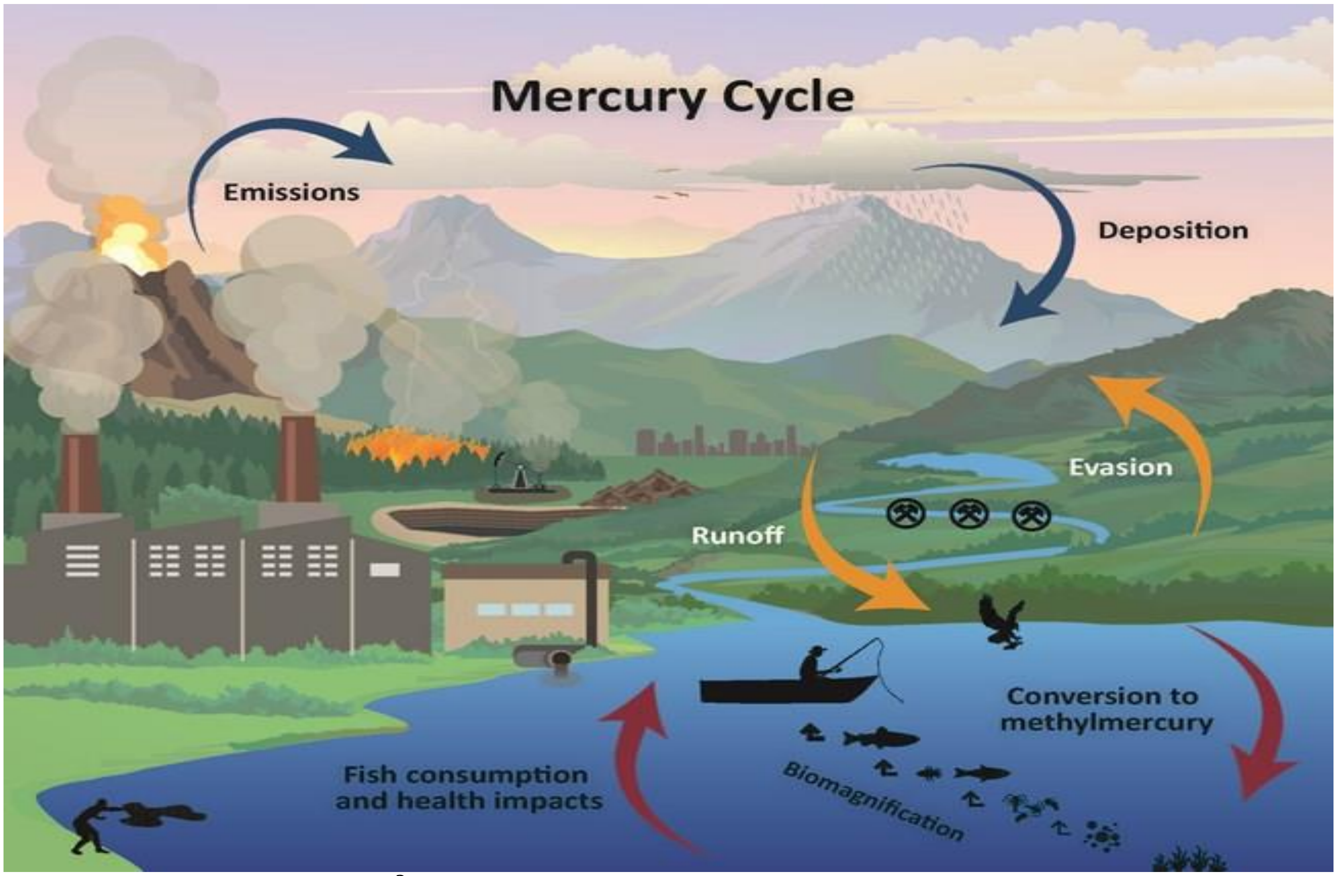

Figure 1. Mercury Life Cycle[2]

Mercury released into the atmosphere that is deposited on the land can undergo naturally occurring processes that convert it to methylmercury. Microscopic organisms combine mercury with carbon, converting it from an inorganic to organic form. Methylmercury is the most common organic mercury compound found in the environment and it is highly toxic. The rate of mercury methylation depends on numerous environmental factors, including temperature and the amounts of oxygen, organic matter, and sulfate present.[3] Methylmercury bioaccumulates in fish tissue where it finds its way into the food chain. The consumption of fish is the primary source of methylmercury exposure for humans.[4]

The conversion of mercury to methylmercury is often higher in wetlands where anoxic sediment promotes the microbial methylation of inorganic mercury to methylmercury. Water-level fluctuations also exacerbate mercury methylation. Water bodies located in the coastal plain are typically surrounded by wetlands that have limited dissolved oxygen levels and abundant organic matter. These areas generally have fish with higher methylmercury levels. Black waters are also found in the coastal plain and have naturally low dissolved oxygen levels and high dissolved organic carbon levels that are favorable environments for microorganisms to convert inorganic mercury to methylmercury.

[2] https://www.nps.gov/media/photo/gallery-item.htm?id=956eebdf-d21d-4683-89a3-e2e437d2e834&gid=2C4F50B9-10E2-4029-81F3-3FFC8D8FC8FE

[3] USGS circular 1395, The Quality of Our Nation's Waters Mercury in the Nation's Streams—Levels, Trends, and Implications. Dennis A. Wentz, Mark E. Brigham, Lia C. Chasar, Michelle A. Lutz, and David P. Krabbenhoft, U.S. Department of the Interior, U.S. Geological Survey

[4] https://www.who.int/news-room/fact-sheets/detail/mercury-and-health#:~:text=People%20may%20be%20exposed%20to,Cooking%20does%20not%20eliminate%20mercury

Mercury pollution is important on global as well as local levels. Changes to local mercury emissions can directly impact mercury concentrations in fish tissue of nearby water bodies, especially in blackwater rivers and water bodies located in the coastal plain that are surrounded by wetlands. Methylmercury production in wetlands and other aquatic ecosystems generally increases with increasing sulfate, which can be contributed by emissions from coal burning. Therefore, decreasing sulfate emissions can cause a decrease in methylmercury concentrations.

In 2012, the United States Environmental Protection Agency (EPA) finalized the Mercury Air Toxics Standards (MATS), which required EGUs nationwide to reduce mercury emissions. EPA estimates that MATS resulted in an 86% reduction in mercury emissions.[5] The controls required by Georgia Rule (sss) meant that Georgia utilities were, in most cases, already meeting the MATS emissions standards.

2.1 Georgia's Mercury in Fish Trend Program

Georgia's Mercury in Fish Trend Program is an interdivisional partnership of multiple Department of Natural Resources divisions: EPD (both the Air Protection Branch and the Watershed Protection Branch), WRD, and CRD.

Appendix B contains the Standard Operating Procedures for this project.

2.1.1 Basic Design Criteria of Georgia's Mercury in Fish Trend Program

Through this partnership, twenty-two fish collection sites were established along with field and laboratory resources. A commitment of annual fish sampling and analysis was made, and sampling occurred for a period of fifteen years, beginning in 2006 and ending in 2020. Listed below are the basic design criteria for the fish trend program followed by agency roles.

- Site locations were established in six WRD regions and one CRD region with each being responsible for their respective sites. Preference was given to pre-existing fish sampling locations.
- Selected sites were required to provide habitat for target species and boat access under all hydrologic conditions.
- Sites were located near coal-fired EGU air sheds, actionable and borderline mercury in fish Total Maximum Daily Load (TMDL) waters, and areas potentially impacted by out of state sources of mercury emissions.
- Target species were selected for each site.
- Ten target fish were sampled at each site annually, during site designated season.
- Samples were analyzed individually (skinless tissue and muscle only), with a Minimum Reporting Level (MRL) of 0.01 mg/kg.
- Target fish were between the ages of 2- and 3-years old. Exceptions were made when 2- and 3-year-old fish were inaccessible, then younger fish were targeted.
- Age of the fish was verified by analysis of scale and/or otolith and recorded.
- Sex of the fish was determined and recorded.

2.1.2 Agency roles under Georgia's Mercury in Fish Trend Program

The role of Wildlife Resources Division (WRD) and Coastal Resources Division (CRD) was to:

- Collect annual samples of fish, beginning in 2006 and continuing through 2020. Twenty-two collection site locations were established with CRD being responsible for collections at three (3)

[5] https://www.epa.gov/stationary-sources-air-pollution/mercury-and-air-toxics-standards

stations and WRD being responsible for collections at nineteen (19) stations. Tables 1-3 list the sites with their locations and sample collection season.

- Determine weight, length, age, and gender of each collected fish. The fish were then stored in freezers at WRD and CRD.

The role of Watershed Protection Branch (WPB) was to:

- Collect fish from WRD and CRD and send them to a University of Georgia (UGA) laboratory for analysis.
- Maintain and manage the contract with the laboratory at UGA.
- Parse out the data from the analyzed fish tissue obtained from the UGA lab and send relevant information to Air Protection Branch and partnering agencies (WRD and CRD).

The role of Air Protection Branch (APB) was to:

- Provide funding for the UGA laboratory analysis.
- Analyze the trends in mercury concentrations in fish tissue.
- Analyze the trends in mercury emissions from coal-fired EGUs and other sources.
- Study the relationship between mercury emissions and mercury concentrations in fish tissue.
- Share updated trend results with CRD, WRD, and WPB.
- Write and submit a periodic evaluation report to the DNR Board by December 31, 2023.

2.1.3 Fish Trend Stations of Georgia's Mercury in Fish Trend Program

Figure 2 shows the locations of the twenty-two fish collection sites along with their proximity to the ten coal-fired power plant sites that were required to install controls under Georgia Rule (sss).

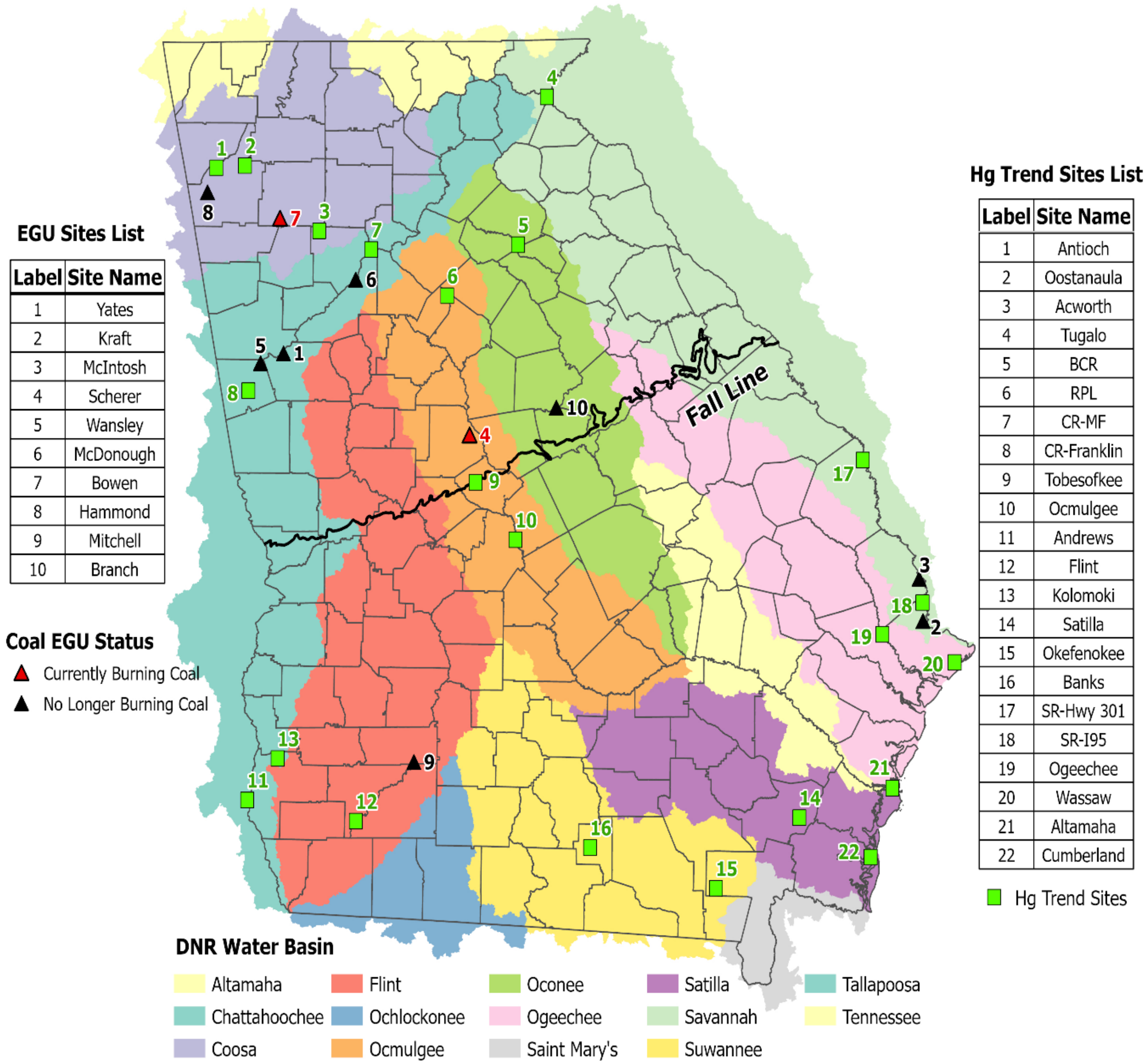

Figure 2. Georgia Water Basins, Coal-fired EGUs, and Fish Tissue Trend Site Locations

3.0 Technology and Mercury Impact Review – Periodic Evaluation

Georgia Rule 391-3-1-.02(2)(sss) "Multipollutant Control for Electric Utility Steam Generating Units" requires that the EPD Director submit a *Technology and Mercury Impact Review – Periodic Evaluation* to the DNR Board by December 31, 2023.

The report must include an "evaluation of available and relevant information to determine if additional reductions of mercury emissions from electric utility steam generating units are necessary or appropriate," and an additional evaluation that includes the following information:

1. Mercury concentrations in fish tissue water bodies in the State and any changes or trends of such concentrations over time;
2. The sources of mercury (including air, land, and water sources) that might influence in-state mercury concentrations in fish tissue;
3. The state of the science regarding the relationship among sources of mercury, mercury speciation and mercury concentrations in fish tissue in water bodies in the State;
4. The health impact of mercury contamination in fish tissue;
5. Technically and economically feasible controls for the reduction of mercury emissions from coal-fired EGUs or other sources;
6. Whether additional reductions of mercury from coal-fired electric utility steam generating units or other sources and/or whether additional time or study is appropriate and necessary in light of items 1 through 5 (subparagraphs (i) through (v) of Georgia Rule (sss));
7. Recommendations for any necessary revisions to Paragraph (sss) or other actions as needed to address other sources;
8. Recommendations for an appropriate timeline for the development of any such additional regulations; provided, however, that implementation and operation of any such additional controls shall be required no earlier than January 1, 2027.

Each of these eight requirements are addressed below.

3.1 Requirement 1: Mercury concentrations in fish tissue in water bodies in the State and any changes or trends of such concentrations over time

The Air Protection Branch completed a mercury in fish tissue trend analysis to show the impact of mercury emission controls on methylmercury accumulation in the fish tissue at various trend sites. Trend sites were grouped into fresh, coastal, or black water depending on the characteristics of the water basins. The fish tissue trends were compared to the water quality criterion for mercury in fish tissue. The water quality criterion for mercury in fish tissue is 0.3 milligrams of mercury per kilogram of fish tissue (mg/kg).[6] Water quality criteria are developed to protect human health and aquatic life.

[6] https://www.epa.gov/wqc/national-recommended-water-quality-criteria-human-health-criteria-table

3.1.1 River Basins

A river basin is the portion of land drained by a river and its tributaries. It encompasses all the land surface dissected and drained by many streams and creeks. River basins in Georgia include freshwater river basins, coastal water river basins, and black water river basins.

- Fresh water river basins consist of fast-moving water with a low concentration of dissolved salts and solids.
- Coastal water river basins are estuaries of river water flowing into the sea, they are partially enclosed bodies of water temporarily or permanently open to the sea, the water has high saline content but not as high as sea water.
- Black water river basins are slow moving water bodies that move through forested swamp or wetlands, their sandy soils lack the ability to retain dissolved organic matter from vegetation, making the water tea colored; hence, the name "Black Water."

Freshwater River Basin Sites

Fifteen of the sites in the study are in Georgia's freshwater river basins, of which six are located in the coastal plain. Table 1 lists each site, the location of the site, which species of fish was collected, when the fish were collected, and which agency was responsible for the site.

Table 1. Trend Sites at Various Freshwater River Basins in Georgia

Station Site Description	Latitude (N)	Longitude (W)	Species (Common)	Collection Season	Responsible Agency
Antioch Lake (East & West) at Rocky Mountain	34.367208	85.292776	Largemouth Bass	Spring (late April to May)	WRD
Oostanaula River at Georgia Highway 140	34.379075	85.124605	Spotted Bass	Fall	WRD
Lake Acworth	34.058234	84.688863	Largemouth Bass	Fall	WRD
Lake Tugalo	34.715917	83.352894	Largemouth Bass	Fall	WRD
Bear Creek Reservoir	33.990347	83.522065	Largemouth Bass	Spring (late April to May)	WRD
Randy Pointer Lake (Black Shoals; Big Haynes Reservoir)	33.740258	83.937685	Largemouth Bass	Fall	WRD
Chattahoochee River below Morgan Falls Dam/Bull Sluice Lake	33.966122	84.383374	Largemouth Bass	Fall (October) or Spring (April)	WRD
Chattahoochee River below Franklin and above West Point Lake	33.273768	85.104859	Largemouth Bass	Spring (late April to May)	WRD
Lake Tobesofkee	32.824016	83.771388	Largemouth Bass	Fall	WRD
Savannah River at Highway 301	32.932892	81.498949	Largemouth Bass	Fall	WRD

Station Site Description	Latitude (N)	Longitude (W)	Species (Common)	Collection Season	Responsible Agency
Savannah River at I-95	32.233758	81.148398	Largemouth Bass	Fall	WRD
Ocmulgee River below Macon at Ga. Highway. 96	32.542062	83.537461	Largemouth Bass	Fall	WRD
Lake Andrews	31.264515	85.111836	Largemouth Bass	Summer	WRD
Flint River below junction with Ichawaynochaway Creek	31.160831	84.473830	Largemouth Bass	Fall	WRD
Lake Kolomoki (or Yohola) at Kolomoki State Park	31.468577	84.932817	Largemouth Bass	Summer	WRD

Each of the sites listed in Table 1 were evaluated for nearby impacts and mercury trends. The information for each site is summarized below.

Antioch Lake

This lake is a part of Coosa Freshwater River Basin in Georgia. Georgia Power Plant Hammond and Plant Bowen are the closest EGUs to this trend site. Mercury emission controls were installed at Plant Hammond in 2008. Plant Hammond was retired in 2019. Mercury emission controls were installed at Plant Bowen in 2008, 2009, and 2010. This freshwater site has consistently shown mercury concentrations in fish tissue to be under 0.3 mg/kg.

Oostanaula River

This river is a part of Coosa Freshwater River Basin in Georgia. Georgia Power Plant Hammond and Plant Bowen are the closest EGUs to this trend site. Mercury emission controls were installed at Plant Hammond in 2008. Plant Hammond was retired in 2019. Mercury emission controls were installed at Plant Bowen in 2008, 2009, and 2010. This freshwater site has consistently shown mercury concentrations in fish tissue to be under 0.3 mg/kg.

Lake Acworth

This lake is a part of the Coosa Freshwater River Basin in Georgia. Georgia Power Plant Bowen and Plant McDonough are the closest EGUs to this trend site. Plant McDonough retired its coal-fired units in 2011 and 2012, and three natural gas combined cycle units began operation in 2012. Mercury emission controls were installed at Plant Bowen in 2008, 2009, and 2010. This freshwater site has consistently shown mercury concentrations in fish tissue to be under 0.3 mg/kg.

Lake Tugalo

This lake is a part of the Savannah Freshwater River Basin in Georgia. There are no power plants in the vicinity of this trend site. This freshwater site has shown fluctuating mercury concentrations in fish tissue with the highest being 0.377 mg/kg in 2009 (above the water quality criterion) and lowest being 0.214 mg/kg in 2019 (below the water quality criterion).

Bear Creek Reservoir

This reserve is a part of Oconee Freshwater River Basin in Georgia. There are no power plants in the vicinity of this trend site. This freshwater site has shown a downward trend of mercury concentrations in fish tissue since 2008. Mercury concentrations were below the water quality criterion in the last three sampling years.

Randy Pointer Lake

This lake is a part of the Ocmulgee Freshwater River Basin in Georgia. Georgia Power Plant McDonough is in the vicinity of this trend site. Plant McDonough retired its coal-fired units in 2011 and 2012, and three natural gas combined cycle units began operation in 2012. This freshwater site has always shown fluctuating mercury concentrations in fish tissue with the highest being 0.589 mg/kg in 2006 and lowest being 0.279 mg/kg in 2013. During the fifteen years of this study, the mercury concentration in the fish tissue at this site has dropped from 0.589 mg/kg in 2006 to 0.447 mg/kg in 2020, although 2013 was the only year that this site was below the water quality criterion.

Chattahoochee River Below Morgan Falls

This trend site is a part of Chattahoochee Freshwater River Basin in Georgia. Georgia Power Plant McDonough is the closest EGU to this trend site. Plant McDonough retired its coal-fired units in 2011 and 2012, and three natural gas combined cycle units began operation in 2012. This freshwater site has always shown mercury concentrations in fish tissue to be under 0.3 mg/kg.

Chattahoochee River Below Franklin

This trend site is a part of Chattahoochee Freshwater River Basin in Georgia. Georgia Power Plant Yates and Plant Wansley are the closest EGUs to this trend site. In 2015, five of the seven coal-fired units at Plant Yates retired and two remaining units were converted to natural gas. Plant Wansley installed mercury emission controls in 2008 and 2009 and was retired in 2022. This freshwater site has always shown mercury concentrations in fish tissue to be under 0.3 mg/kg.

Lake Tobesofkee

This trend site is a part of Ocmulgee Freshwater River Basin in Georgia. Georgia Power Plant Scherer is the closest EGU to this trend site. Mercury emission controls were installed at Plant Scherer in 2009-2014. This freshwater site has always shown mercury concentrations in fish tissue to be under 0.3 mg/kg.

Savannah River at Highway 301

This trend site is a part of the Savannah Freshwater River Basin in Georgia and is located in the coastal plain. There are no EGUs in the vicinity of this trend site. This freshwater site has shown a fluctuating yet downward trend in mercury concentrations in fish tissue with the highest being 0.765 mg/kg in 2006 (above the water quality criterion) and lowest being 0.240 mg/kg in 2011 (below the water quality criterion).

Savannah River at I-95

This trend site is a part of the Savannah River Basin in Georgia and is located in the coastal plain. Georgia Power Plant Kraft and Plant McIntosh are the EGUs in the vicinity of this trend site. Plant Kraft and Plant McIntosh were retired in 2015 and 2019, respectively. This water site has shown a downward trend in mercury concentrations in fish tissue since 2017. The site was at the water quality criterion of 0.3 mg/kg.

Ocmulgee River below Macon

This trend site is a part of Ocmulgee Freshwater River Basin in Georgia. There are no power plants in the vicinity of this site. This freshwater site has consistently shown mercury concentrations in fish tissue to be slightly above 0.3 mg/kg. The 2020 mercury concentration was 0.334 mg/kg.

Lake Andrews

This trend site is a part of Chattahoochee Freshwater River Basin in Georgia and is located in the coastal plain. There are no power plants in the vicinity of this trend site. Mercury concentrations in fish tissue at this site at the beginning of the study were above the water quality criterion at 0.341 mg/kg and slightly higher at the end of the study at 0.459 mg/kg in 2020.

Flint River

This trend site is a part of Flint Freshwater River Basin in Georgia and is located in the coastal plain. Georgia Power Plant Mitchell is closest to this trend site, which was retired in 2016. Mercury concentrations in fish tissue at this site at the beginning of the study were below the water quality criterion at 0.260 mg/kg, but slightly above the water quality criterion at 0.320 mg/kg in 2020.

Lake Kolomoki

This trend site is a part of Flint Freshwater River Basin in Georgia and is located in the coastal plain. There are no power plants in the vicinity to this trend site. Mercury concentrations in fish tissue at this site have shown a fluctuating trend but a clear downward trajectory that can be seen from 2018 through 2020. Mercury fish tissue concentration at Lake Kolomoki went from 0.325 mg/kg in 2018 (above the water quality criterion) to 0.273 mg/kg in 2020 (below the water quality criterion).

Coastal Water Sites

Three sites in the study are in Georgia's coastal water river basins. Table 2 lists each site, the location of the site, which species of fish was collected, when the fish were collected, and which agency was responsible for the site.

Table 2. List of Trend Sites in Coastal Water River Basins in Georgia

Station Site Description	Latitude (N)	Longitude (W)	Species (Common)	Collection Season	Responsible Agency
Wassaw Sound, (Wilmington & Bull River Estuary in Sound), Savannah, GA	31.940002	80.959382	Spotted Seatrout	Fall	CRD
Altamaha River Delta and Sound	31.323051	81.325018	Spotted Seatrout	Fall	CRD
Cumberland/St. Andrew Sound	30.984192	81.452494	Spotted Seatrout	Fall	CRD

Each of the sites listed in Table 2 were evaluated for nearby impacts and mercury trends. The information for each site is summarized below.

Wassaw Sound

This water trend site is a part of the Ogeechee River Basin in Georgia. Georgia Power Plant Kraft and Plant McIntosh are the EGUs in the vicinity of this trend site. Plant Kraft and Plant McIntosh were retired in 2015 and 2019, respectively. This water site has consistently shown mercury concentrations in fish tissue to be under 0.3 mg/kg.

Altamaha River Delta and Sound

This water trend site is a part of the Ogeechee River Basin in Georgia. There are no power plants in the vicinity to this trend site. This water site has consistently shown mercury concentrations in fish tissue to be under 0.3 mg/kg.

Cumberland/St. Andrew Sound
This water trend site is a part of the Satilla River Basin in Georgia. There are no power plants in the vicinity to this trend site. This water site has consistently shown mercury concentrations in fish tissue to be under 0.3 mg/kg. From 2014-2018, the CRD was unable to collect fish samples from this site. In 2019-2020, fish samples were collected and delivered to EPD, but mercury concentrations were not reported.

Black Water Sites

Four sites in the study are in Georgia's black water river basins. Table 3 lists each site, the location of the site, which species of fish was collected, when the fish were collected, and which agency was responsible for the site.

Table 3. List of Trend Sites in Black Water River Basins in Georgia

Station Site Description	Latitude (N)	Longitude (W)	Species (Common)	Collection Season	Responsible Agency
Satilla River below U.S. Highway 82, near Atkinson, GA.	31.178319	81.870872	Largemouth Bass	Spring	WRD
Okefenokee Swamp National Wildlife Refuge at Billy's Lake	30.831800	82.360972	Chain Pickerel	Late Fall/Early Winter (December-January)	WRD
Ogeechee River at Ga. Highway 204	32.078603	81.383927	Largemouth Bass	Fall	WRD
Banks Lake National Wildlife Refuge	31.031399	83.099377	Largemouth Bass	Late Fall/Early Winter (December-January)	WRD

Each of the sites listed in Table 3 were evaluated for nearby impacts and mercury trends. The information for each site is summarized below.

Satilla River
This water trend site is a part of the Satilla River Basin in Georgia. There are no power plants in the vicinity to this trend site. This water site has shown a fluctuating downward trend in mercury concentrations in fish tissue since 2006 with a sharp decline from 2018 through 2020. Mercury concentration in the Satilla River fish tissue samples has dropped from 1.728 mg/kg in 2007 to 0.653 mg/kg in 2020, which is still above the water quality criterion.

Okefenokee Swamp National Wildlife Refuge
This water trend site is a part of the Suwanee River Basin in Georgia. There are no power plants in the vicinity to this trend site. This water site has shown a fluctuating trend in mercury concentrations in fish tissue since 2006, although a strong downward trend is seen from 2015 through 2020. Mercury concentrations in Okefenokee swamp have dropped from its all-time high of 1.275 mg/kg in 2007 to 0.389 mg/kg in 2020, which is still above the water quality criterion. It is important to mention that in spring of

2007 there was a huge wildfire in the Okefenokee Swamp.[7] Wildfires can mobilize[8] mercury from soil and vegetation into the atmosphere.

Ogeechee River

This water trend site is a part of the Ogeechee River Basin in Georgia. Georgia Power Plants Kraft and McIntosh are in the vicinity to this trend site. Plant Kraft and Plant McIntosh were retired in 2015 and 2019, respectively. This water site has shown a fluctuating but downward trend in mercury concentrations in fish tissue since 2006. Mercury concentrations in the Ogeechee River fish tissue samples have dropped from its all-time high of 1.761 mg/kg in 2007 to 0.898 mg/kg in 2020, which is still above the water quality criterion.

Banks Lake National Wildlife Refuge

This water trend site is a part of the Suwanee River Basin in Georgia. There are no power plants in the vicinity to this trend site. This water site has shown a strong downward trend in mercury concentrations in fish tissue since 2006 and in 2020 its mercury concentrations were below 0.3 mg/kg. Mercury concentration in the Banks Lake fish tissue has dropped from 1.068 mg/kg in 2006 to 0.254 mg/kg in 2020.

3.1.2 Trend Sites by Year

The mercury concentrations at each of the trend sites have been compared to the water quality criterion (0.3 mg/kg) and how they have fluctuated over the last fifteen years. Table 4 lists fish tissue concentrations for each trend site by the year. Over the course of the project, WRD or CRD were sometimes unable to collect fish samples at some sites due to low water levels or storms. In other cases, power outages due to storms destroyed samples (lack of refrigeration) which had already been collected. More details for each site can be found in Appendix C and Appendix D. Appendix C contains trend charts for each site showing mercury fish tissue concentrations from 2006 through 2020, wind roses[9] based on five years (2014-2019) of meteorological data showing predominant wind direction, and a map showing the location of the trend site along with any nearby EGUs. Appendix D contains box and whisker plots of mercury fish tissue concentration data for each site. Box and whisker plots provide average and median points for a data set, they also show the maximum and minimum value in the data set and provide the first quartile (25 percentile) and third quartile (75 percentile) of the set. Figure 3 shows the trends in mercury concentration in fish tissue for all the three types of water basins, compared to the water quality criterion for mercury in Georgia. A distinct downward trend in mercury concentration in fish tissue was demonstrated at the black water sites, which began the study with higher overall mercury concentrations in the fish tissue collected.

[7] https://gatrees.org/reflections-on-the-big-fire-of-2007/
[8] https://www.usgs.gov/news/featured-story/comprehensive-study-finds-widespread-mercury-contamination-across-western-north
[9] https://www.epa.gov/sites/default/files/2019-01/documents/how_to_read_a_wind_rose.pdf

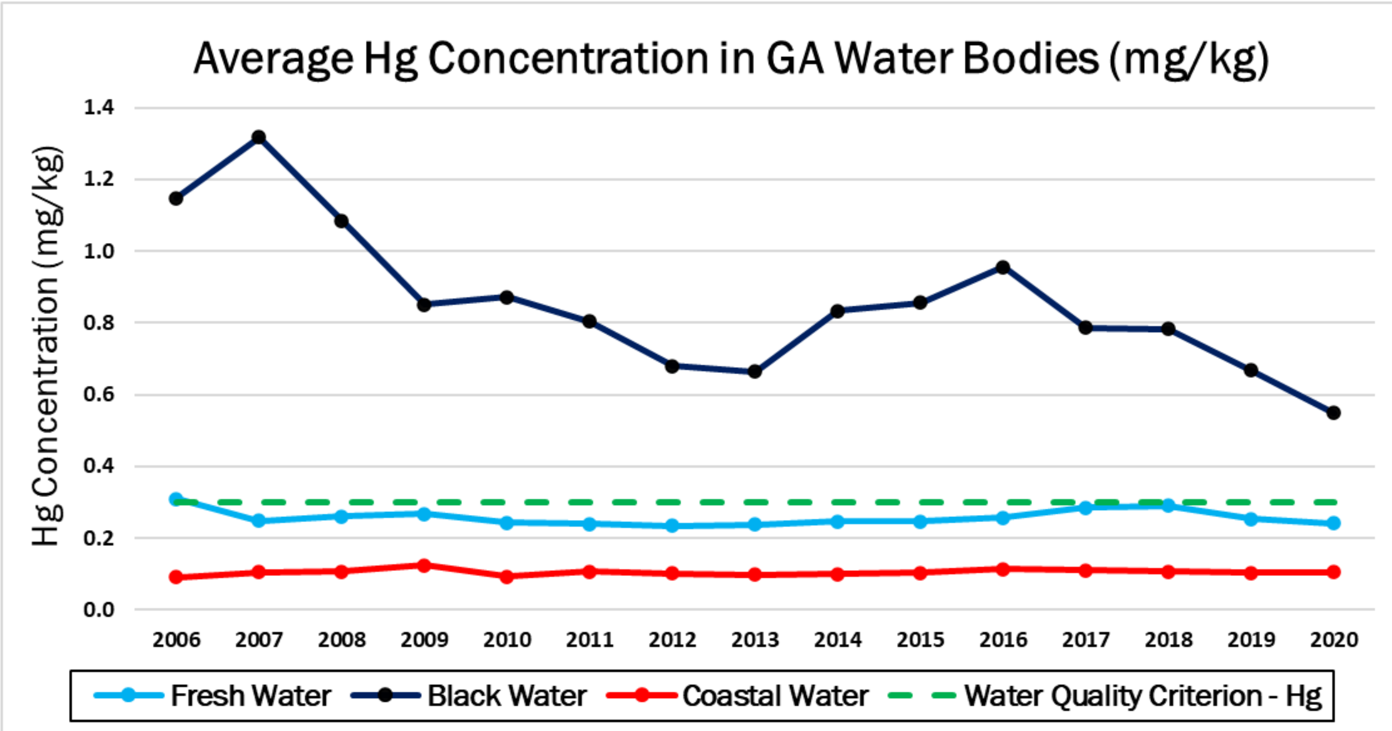

Figure 3. Average Hg Concentration in GA Water Bodies

Table 4. Mercury Concentration for Fish Tissue for Each Trend Site by The Year

Trend Site Location	Mercury Concentration in Fish Tissue (mg/kg)														
Year	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Fresh Water Bodies															
Antioch		0.058	0.077	0.084		0.044		0.039		0.030	0.057	0.060	0.070	0.040	0.040
Oostanaula	0.171	0.138	0.163	0.097	0.172	0.126	0.182	0.161		0.109	0.117	0.131	0.237	0.126	0.131
Lake Acworth	0.184	0.169	0.144		0.166	0.113	0.125	0.085		0.105	0.109	0.092	0.108	0.104	0.105
Lake Tugalo	0.365	0.313	0.364	0.377	0.237			0.355			0.389	0.353	0.309	0.214	0.276
Bear Creek Reservoir		0.298	0.397									0.182		0.126	0.101
Randy Pointer Lake	0.589	0.359	0.360	0.405		0.388		0.279			0.543	0.378	0.528	0.357	0.447
Chattahoochee River (Morgan Falls)		0.089	0.069	0.070	0.129								0.283	0.209	0.116
Chattahoochee River (Franklin)		0.259			0.181			0.173		0.189	0.088	0.153	0.183	0.131	0.148
Lake Tobesofkee	0.196	0.153		0.276	0.154	0.196	0.088	0.102	0.138	0.163	0.176	0.109	0.142	0.171	0.140
Savannah River at Highway 301	0.765	0.285			0.353	0.240	0.274				0.295	0.817	0.463	0.479	0.310
Savannah River at I-95	0.493	0.302			0.336	0.398	0.231			0.608	0.290	0.456	0.410	0.360	0.300
Ocmulgee River Highway 96	0.351	0.348			0.347	0.321	0.296	0.352	0.470	0.340		0.397		0.437	0.336
Lake Andrews	0.341	0.325			0.282								0.366		0.459
Flint River	0.260	0.210	0.189	0.284									0.490		0.320
Lake Kolomoki	0.287	0.410	0.382	0.381	0.243								0.325		0.273
Coastal Water Bodies															
Wassaw	0.099		0.121	0.099	0.081	0.088							0.105	0.100	
Altamaha River Delta and Sound	0.087		0.100	0.113	0.080	0.112							0.103	0.099	
Cumberland/St. Andrews	0.086		0.100	0.160	0.117	0.119		0.092							
Black Water Bodies															
Satilla		1.728			1.094	1.428	0.973		1.018	0.900	1.121	1.127	1.157	0.884	0.653
Okefenokee	0.786	1.275	0.986	0.480	0.817	1.067	0.562	0.491		1.025	0.796	0.506		0.525	0.389
Ogeechee River	1.351	1.761		0.886	1.010	0.642	0.908			0.981	1.450	1.140	1.078	0.875	0.898
Banks	1.068	0.663	0.478	0.776	0.528	0.488	0.339	0.403	0.502	0.520	0.458	0.371	0.381	0.388	0.254

3.2 Requirement 2: The sources of mercury (including air, land, and water sources) that might influence in-state mercury concentrations in fish tissue

3.2.1 Air Sources of Mercury

Impairment of water basins by mercury is predominantly due to air deposition.[10] Anthropogenic sources of mercury air emissions in Georgia include coal-fired power plants and other coal burning processes. Coal-fired power plants are the largest emitters of mercury into the air. Table 5 compares the number of mercury-emitting sources in Georgia in 2006 to those operating in 2023. Only a few non-power plant facilities exist in Georgia that are currently permitted to burn coal in boilers or kilns: Imperial-Savannah, L.P, Mount Vernon Mills, Caraustar Industries, Georgia-Pacific Cedar Springs, Georgia-Pacific Savannah River, Cemex Southeast, and Graphic Packaging International, LLC - Augusta Mill. Although the non-EGU facilities listed in Table 5 are permitted to burn coal, the air-based mercury emissions are considerably below the EPA reporting threshold of 10 pounds per year.

Table 5. Comparison of Current Mercury Sources in Georgia to Mercury Sources in 2006

Sources of Mercury	Total Number in 2006	Total Number in 2023
Coal-Fired EGUs	10 facilities (34 units)	2 facilities (8 units)
Other Coal Burning Equipment	10	7

Figure 4 shows that the mercury emissions controls required by Georgia Rule (sss), combined with the retirement or conversion of 25 EGUs, resulted in a 4118 pounds (98.4%) reduction of mercury emissions from power plants between 2006 and 2020. The two power plants that are currently permitted to burn coal as of 2023 are Georgia Power Plant Bowen (4 units) and Georgia Power Plant Scherer (4 units). The controls installed on each of these units are discussed in further detail in Requirement 5.

Figure 5 shows the reduction of mercury emissions from power plants in Georgia as well as reductions from neighboring states due to MATS. Mercury emissions from power plants were obtained from the Toxic Release Inventory Program (TRI) maintained by the U.S. Environmental Protection Agency (EPA). Power plants from neighboring states were included based on the vicinity of the facility to the trend site locations and the extent of its emissions. If a facility was within 100 kilometers of a trend site location and had mercury emissions of more than 10 pounds per year (lb/yr), which is the mercury emissions reporting threshold for TRI, then that facility was included in the study. As a result, approximately two-thirds of the Florida EGUs and half of the North Carolina EGUs are included in Figure 5.

Other potential air sources of mercury emissions could also include wildfires and prescribed fires since they could mobilize mercury from soil and vegetation into the atmosphere. Higher mercury concentrations in fish tissue analyzed in 2007 for the Okefenokee Swamp site could be due to the wildfires at the swamp during April of that year.

[10] https://epi.dph.ncdhhs.gov/oee/mercury/in_fish.html

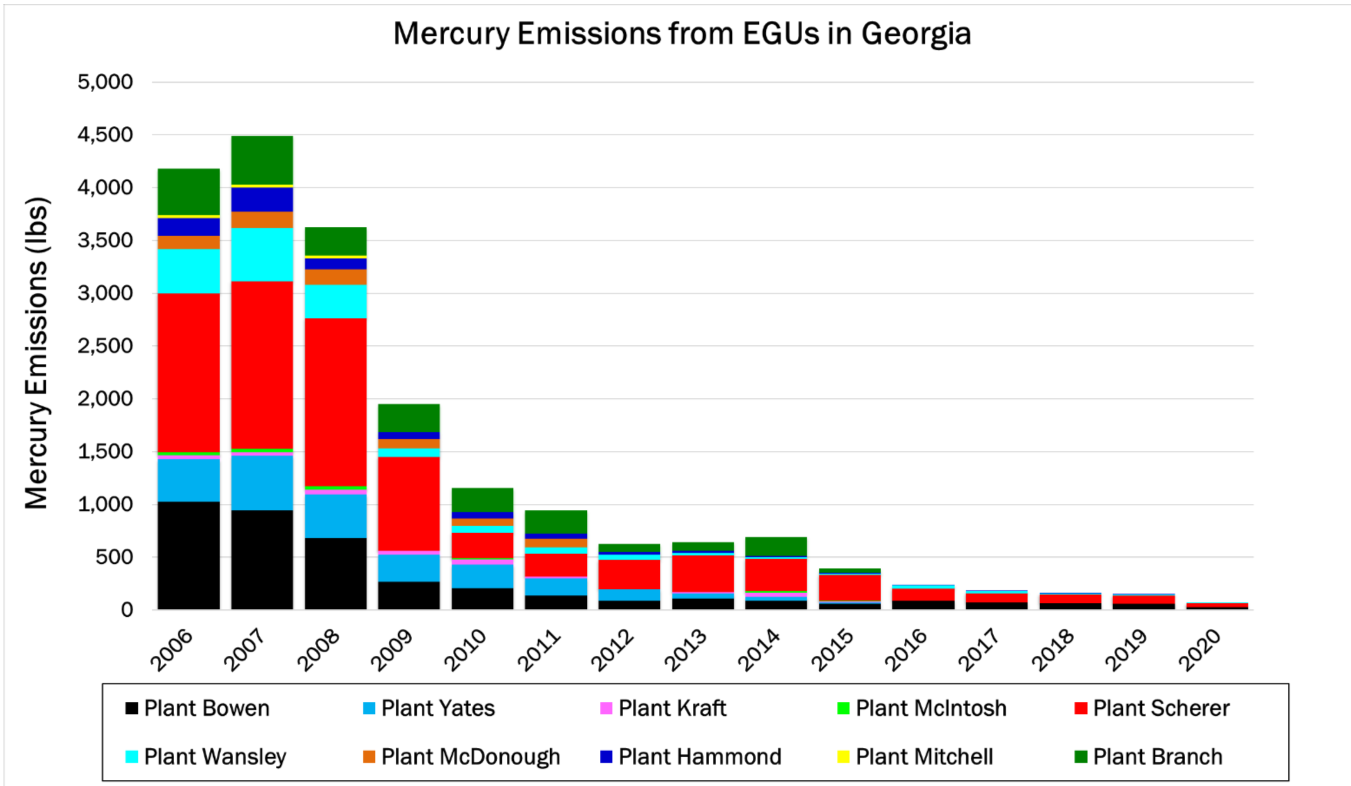

Figure 4. Annual Mercury Emissions from EGUs in Georgia

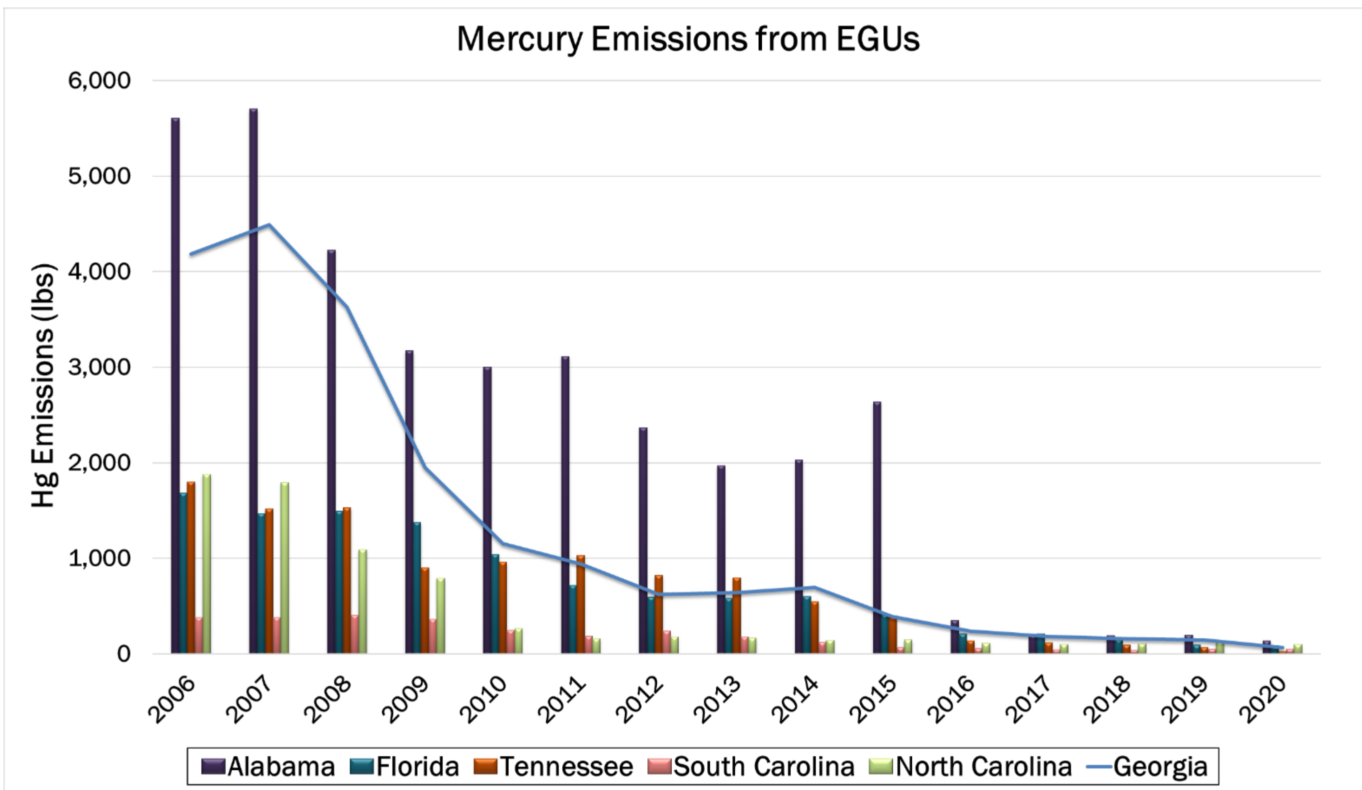

Figure 5. Annual Mercury Emissions from EGUs in Georgia and Neighboring States

3.2.2 Water Sources of Mercury

When a waterbody does not meet the water quality criteria and is placed in Category 5 of section 305(b)/303(d) of the Clean Water Act, a Total Maximum Daily Load (TMDL) is developed for that waterbody. In the early 2000's, EPA proposed TMDL's for total mercury for various river basins in Georgia. Based on TMDL's, waste load allocations (WLAs) are given to sources regulated by the National Pollutant Discharge Elimination System (NPDES) program. The WLAs in the TMDL provided a basis for states to reduce pollution from both point and nonpoint sources and provide a path to restoration of the quality of the impaired waterbody. Table 6 shows the list of the water point sources that were provided with WLAs for mercury, the associated river basin, and the applicable water quality target.

Although EPA provided WLAs to the point source facilities listed in Table 6 which were incorporated in the EPD NPDES permits, they stated that "the impairment of the listed waterbodies by mercury was due predominantly to air deposition, complete elimination or significant reduction of mercury from water point source discharges would produce little benefit in the quality of the river."[11]

3.2.3 Land Sources of Mercury

There are no specific land point sources of mercury emissions identified, but potential land point sources could include coal ash ponds and leachate from municipal solid waste landfills.

[11] https://epd.georgia.gov/satilla-river-basin-tmdl-reports

Table 6. Point Source Facilities with WLAs for Mercury and the Associated River Basin [12, 13, 14, 15]

Point Source Facilities with WLAs for Hg	River Basin	Applicable Water Quality Target (ng Hg/l water)
Augusta – Butler Creek Municipal Facility	Savannah	2.8
Columbia County – Crawford Creek Municipal Facility	Savannah	2.8
Columbia County-Reed Creek Municipal Facility	Savannah	2.8
Columbia County-Little River Municipal Facility	Savannah	2.8
Garden City WPCP	Savannah	2.8
Richmond County – Spirit Creek Municipal Facility	Savannah	2.8
Savannah Crossroads Municipal Facility	Savannah	2.8
Savannah President Street Municipal Facility	Savannah	2.8
Savannah -Wilshire/Windsor Municipal Facility	Savannah	2.8
Savannah Travis Field Municipal Facility	Savannah	2.8
Sylvania WPCP	Savannah	2.8
Tybee Island Municipal Facility	Savannah	2.8
Waynesboro Municipal Facility	Savannah	2.8
DSM Chemicals Augusta	Savannah	2.8
Fort James	Savannah	2.8
Georgia Power Vogtle	Savannah	2.8
International Paper Company	Savannah	2.8
Kemira	Savannah	2.8
PCS Nitrogen Fertilizer	Savannah	2.8
Savannah Electric Effingham	Savannah	2.8
Stone Container	Savannah	2.8
USA Fort Gordon	Savannah	2.8
Union Camp Corporation	Savannah	2.8
USA Hunter AFB STP	Savannah	2.8
DHR Gracewood School Rec WPCP	Savannah	2.8
DHR Gracewood Hospital	Savannah	2.8
Olin Corporation Augusta	Savannah	2.8
Citgo Asphalt	Savannah	2.8
Brockway Standard, Inc.	Suwanee	2.8
DNR Stephen C Foster	Suwanee	2.8
Homerville Ind Park	Suwanee	2.8
Homerville WPCP	Suwanee	2.8
Kingsland St. Marys WPCP	St. Marys	1.9
Durango Paper St. Marys*	St. Marys	1.9
Brunswick Academy Cr	Satilla	2.5
Douglas Southeast	Satilla	2.5
Georgia Pacific Brunswick	Satilla	2.5
Jekyll Island WPCP	Satilla	2.5
St. Simons Island	Satilla	2.5
Waycross WPCP	Satilla	2.5

*Durango Paper in St. Marys shutdown in 2002.

[12] https://epd.georgia.gov/suwannee-river-basin-tmdl-reports
[13] https://epd.georgia.gov/savannah-river-basin-tmdl-reports
[14] https://epd.georgia.gov/st-marys-river-basin-tmdl-reports
[15] https://epd.georgia.gov/satilla-river-basin-tmdl-reports

3.3 Requirement 3: The state of the science regarding the relationship among sources of mercury, mercury speciation and mercury concentrations in fish tissue in water bodies in the State

Mercury occurs naturally in the earth's crust. It is released into the environment from volcanic activity, weathering of rocks, wildfires, and anthropogenic activity. Anthropogenic activity is the main cause of mercury releases, particularly coal-fired power plants, residential coal burning units, industrial processes, waste incinerators and mining for mercury, gold, and other metals.

Emissions from coal burning power plants contain varying percentages of three mercury species: particulate mercury (Hg(p)), oxidized/reactive mercury (Hg(II)), and elemental mercury (Hg(0)). Elemental mercury has a long atmospheric lifetime (six months to more than a year). Because of this, elemental mercury can spread across the globe and accumulate in the rain clouds that eventually deposits the mercury back to land (deposition). Reactive mercury can combine with chlorine, sulfate, iron, and other elements to form inorganic salts and can undergo wet or dry deposition within a few days of being released in the atmosphere; therefore, ecosystems near the emitting point source could potentially have higher concentrations of mercury. These inorganic mercury salts can be transported in water and occur in soil.

Mercury released into the atmosphere that is deposited on the land can undergo naturally occurring processes that convert it to methylmercury. Microscopic organisms combine mercury with carbon, converting it from an inorganic to organic form. Methylmercury is the most common organic mercury compound found in the environment and it is highly toxic.[16] The rate of mercury methylation varies greatly in time and space, and depends on numerous environmental factors, including temperature and the amounts of oxygen, organic matter, and sulfate present.[17] Methylmercury bioaccumulates in fish tissue where it finds its way into the food chain.[18] Bioaccumulation occurs when an organism contains higher concentrations of the substance than do the surroundings. Methylmercury also biomagnifies. For example, large fish are more likely to have high levels of mercury because of eating many smaller fish that have acquired mercury through ingestion of plankton or other smaller fish. Bioaccumulated methylmercury is the primary source of methylmercury exposure for humans, due to human consumption of contaminated fish tissue.

Methylmercury concentrations in fish correlate strongly with wetland abundance in a stream's watershed. The conversion of mercury to methylmercury occurs in wetlands where anoxic sediment, especially surface sediment, promotes the microbial methylation of inorganic mercury to methylmercury. Water-level fluctuations, including drying and wetting of soil and aquatic sediment, also exacerbate mercury methylation. Water bodies located in the coastal plain are typically surrounded by wetlands that have limited dissolved oxygen levels and abundant organic matter. These water bodies generally have fish with higher methylmercury levels.

Black waters are also found in the coastal plain and have favorable environments for microorganisms to convert inorganic mercury to methylmercury. Methylation is greatly enhanced in black water systems that have anoxic sedimentation (i.e., low oxygen concentrations), high sulfate content, low pH, and high organic matter due to slow moving water. Hence, methylmercury accumulation in black water basins is considerably

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[16] https://www.epa.gov/mercury/basic-information-about-mercury

[17] USGS circular 1395, The Quality of Our Nation's Waters Mercury in the Nation's Streams—Levels, Trends, and Implications. Dennis A. Wentz, Mark E. Brigham, Lia C. Chasar, Michelle A. Lutz, and David P. Krabbenhoft, U.S. Department of the Interior, U.S. Geological Survey

[18] https://www.who.int/news-room/fact-sheets/detail/mercury-and-health#:~:text=People%20may%20be%20exposed%20to,Cooking%20does%20not%20eliminate%20mercury

higher than in fresh or coastal water basins. This is consistent to what was observed in Georgia water bodies in this study.

Changes to local mercury emissions can directly impact mercury concentrations in fish tissue of nearby water bodies, especially in black water rivers and water bodies located in the coastal plain that are surrounded by wetlands. Methylmercury production in wetlands and other aquatic ecosystems generally increases with increasing sulfate, which can be contributed by emissions from coal burning. Therefore, decreasing sulfate emissions can cause a decrease in methylmercury concentrations.

3.4 Requirement 4: The health impact of mercury contamination in fish tissue

For many communities, fish is the main source of protein. Methylmercury tends to bioaccumulate in fish tissue, and consumption of fish and shellfish contaminated with methylmercury is usually the cause of human exposure to mercury.

Two groups are primarily more sensitive to the neurotoxicity caused by mercury:

- Fetuses are the first group identified as a group sensitive to mercury. They are most susceptible to developmental effects due to mercury. Methylmercury exposure in the womb can result from a mother's consumption of fish and shellfish. Methylmercury can adversely affect a baby's growing brain and nervous system. The primary health effect of methylmercury is impaired neurological development. Therefore, cognitive thinking, memory, attention, language, and fine motor and visual spatial skills may be affected in children who were exposed to methylmercury as fetuses.[19]

- The second group is people who are regularly exposed (chronic exposure) to high levels of mercury (such as populations that rely on subsistence fishing). Among selected subsistence fishing populations, between 1.5 to 17 children out of a thousand showed cognitive impairment (mild intellectual disabilities) caused by the consumption of fish containing mercury.[16]

Recent studies are looking into possible relationship between mercury toxicity and diseases of the cardiovascular system. These studies were based on the hypothesis that the neurotoxic effects of mercury might also impact cardiac autonomic function since heart rhythm and function are under autonomic nervous system control. One of these studies strongly correlated mercury toxicity with hypertension, coronary heart disease, myocardial infarction, cardiac arrhythmias, carotid artery obstruction, cerebrovascular accident, and generalized atherosclerosis.[20]

Research is ongoing concerning dietary intake of mercury and cancers. Some studies have associated a high intake of dietary mercury with an increased risk of colorectal cancer.[21]

3.5 Requirement 5: Technically and economically feasible controls for the reduction of mercury emissions from coal-fired power plants or other sources

Flue gas from coal combustion units contains varying percentages of three mercury species: particulate mercury, oxidized/reactive mercury, and elemental mercury. Control of mercury emissions from coal-fired boilers is currently achieved via existing controls that remove particulate matter (PM), sulfur dioxide (SO_2), and nitrogen oxides (NOx).

[19] https://www.who.int/news-room/fact-sheets/detail/mercury-and-health
[20] https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5295325/
[21] https://pubmed.ncbi.nlm.nih.gov/31522783/

3.5.1 PM

Particulate mercury is captured with PM control equipment. A typical coal-fired power plant can be equipped with Electrostatic Precipitators for primary control and capture of fly ash but is not used for the collection of mercury particles (Hg(p)). Instead, the plant may have a baghouse installed for the purpose of removing mercury particles. The use of a baghouse and carbon injection will remove particulate mercury, along with any remaining fly ash, with a collection efficiency of 80% - 90% for units burning low-sulfur bituminous coal, subbituminous, or lignite coal.[22]

3.5.2 SO_2 and NOx

For SO_2, facilities in Georgia use wet flue gas desulfurization (FGD) systems to capture the soluble reactive mercury compounds. Baghouses can be used prior to the FGD systems as a polishing system to remove additional mercury prior to the scrubber using activated carbon and filtering it out through the bags. Selective catalytic reduction (SCR) for NOx control enhances oxidation of elemental mercury in flue gas to Hg(II), which results in increased mercury removal in the wet FGD system.[23]

A facility may choose to use existing SO_2 and NOx controls such as the combination of a wet (FGD)/scrubber and a SCR. This method has demonstrated Hg (II) removal in the range of 70% to 90% in plants burning high sulfur bituminous coal[23].[17] The high removal rate is due to the SCR assisting in the conversion of the mercury into an activated state that is now soluble in water for capture in a wet scrubber.

3.5.3 Georgia Power Plant Controls

Controls that have been applied to coal-fired power plants in Georgia are listed in Table 7 below. These controls are technically and economically feasible, and include wet scrubbers, baghouses, selective catalytic reduction, conversion to burning natural gas, or retirement of the coal-fired units.

[22] https://www.nescaum.org/documents/hg-control-and-measurement-techs-at-us-pps_201007.pdf
[23] https://www3.epa.gov/airtoxics/utility/hgwhitepaperfinal.pdf

Table 7. Mercury Controls Applied by Coal-Fired EGUs in Georgia

Plant	Unit	Year NOx Controls Installed	Year SO_2 Controls Installed	Year Baghouse Controls Installed	Year Retired
Yates	**1**		1992		2015
Yates	**2**				2015
Yates	**3**				2015
Yates	**4**				2015
Yates	**5**				2015
Yates	**6**				Converted to Natural Gas in 2015
Yates	**7**				Converted to Natural Gas in 2015
Kraft	**1**				2015
Kraft	**2**				2015
Kraft	**3**				2015
McIntosh	**1**				2019
Scherer	**1**	2013	2014	2010	
Scherer	**2**	2013	2013	2009	
Scherer	**3**	2010	2011	2009	
Scherer	**4**	2012	2012	2010	
Wansley	**1**	2003	2008		2022
Wansley	**2**	2003	2009		2022
McDonough	**1**				2012
McDonough	**2**				2011
Bowen	**1**	2001	2010		
Bowen	**2**	2001	2009		
Bowen	**3**	2003	2008	2016	
Bowen	**4**	2003	2008	2016	
Hammond	**1**		2008		2019
Hammond	**2**		2008		2019
Hammond	**3**		2008		2019
Hammond	**4**	2002	2008		2019
Mitchell	**3**				2016
Branch	**1**				2015
Branch	**2**				2013
Branch	**3**				2015
Branch	**4**				2015

3.5.4 Remaining Coal-fired EGUs

Of the remaining coal-fired EGUs, Georgia Power Plant Bowen Units 1 and 2 rely on the SCR and FGD system for removal of mercury from the gas stream. Georgia Power Plant Scherer Units 1-4 and Bowen Units 3 and 4 all utilize SCR and FGD systems along with baghouses for additional mercury removal.

3.6 Requirement 6: Whether additional reductions of mercury from coal-fired electric utility steam generating units or other sources and/or whether additional time or study is appropriate and necessary in light of requirements 1 through 5

As shown in Table 7, coal-fired power plants in Georgia have either retired or have installed mercury controls. Figures 3 and 4 document the sharp decline in mercury emissions from coal-fired electric utility steam generating units in Georgia and surrounding states. Figure 6 shows the change in mercury emissions from coal-fired EGUs between 2006 and 2020.

Georgia does have non-power plant sources that have coal burning equipment; however, those sources do not emit significant amount of mercury into the atmosphere. With reduced mercury in the water and lower bioaccumulation in fish tissue, further reductions in mercury emissions from coal-fired power plants or other sources are not required.

3.7 Requirement 7: Recommendations for any necessary revisions to Paragraph (sss) or other actions as needed to address other sources.

EPD did not identify any other significant sources of mercury emissions in Georgia and does not recommend any further revisions to Georgia Rule (sss), or any other actions to address mercury emissions from other sources. However, decreasing sulfate emissions can cause a decrease in methylmercury concentrations.

3.8 Requirement 8: Recommendations for an appropriate timeline for the development of any such additional regulations; provided, however, that implementation and operation of any such additional controls shall be required no earlier than January 1, 2027.

Controls imposed by the requirements of Georgia Rule (sss), paired with the changing landscape of coal-fired power industry in Georgia and EPA's MATS rule, have resulted in a decrease in mercury concentrations in the fish tissue sampled over the last fifteen years. Therefore, EPD does not recommend any additional regulations.

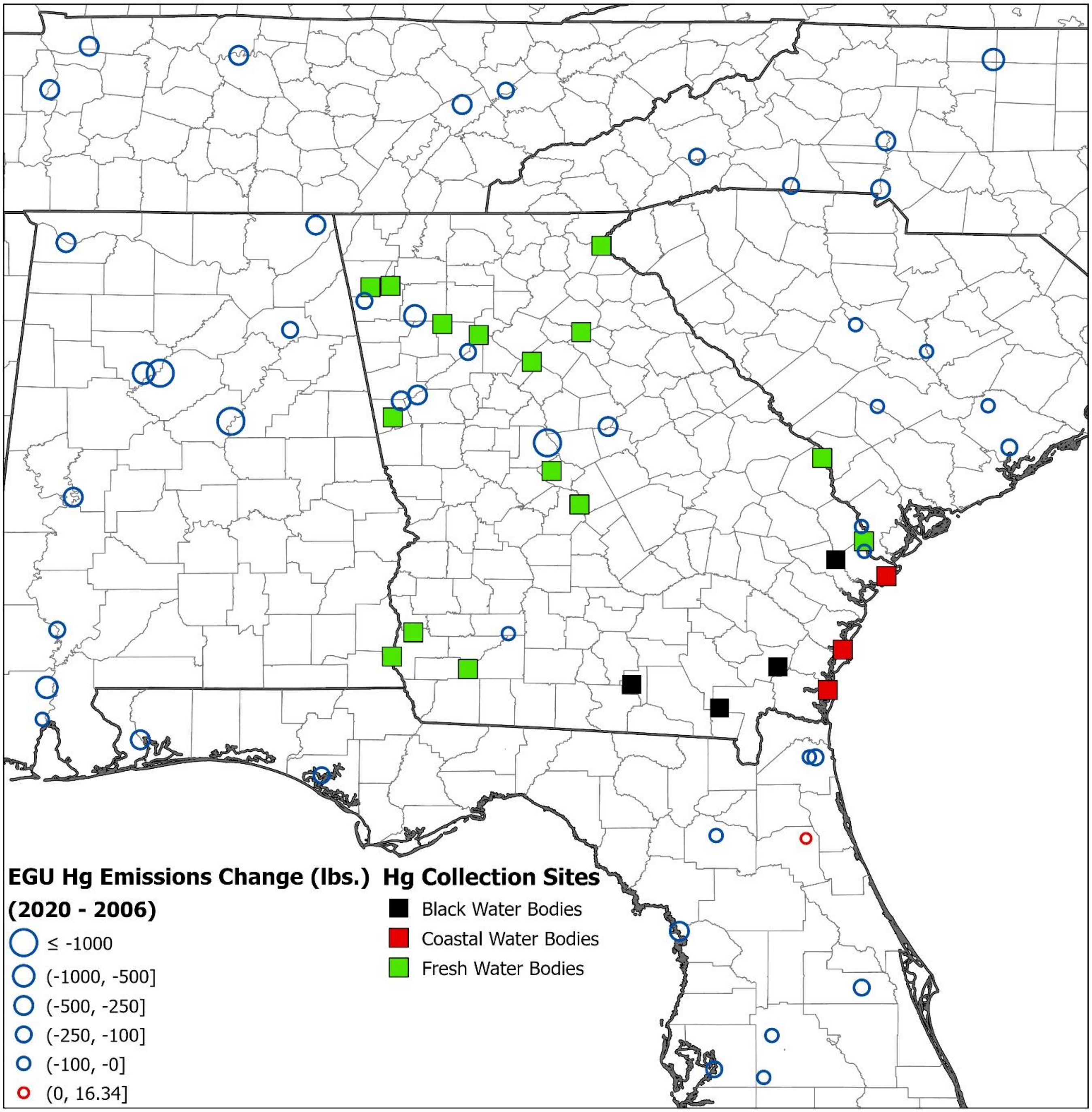

Figure 6. Mercury Emissions from Coal-Fired Electric Utility Steam Generating Units

4.0 Conclusion

Coal-fired power plants are the predominant source of reactive mercury emissions in Georgia. Mercury emission controls and technologies applied by the power industry in Georgia has resulted in reduced amounts of reactive mercury available for methylation and subsequently bioaccumulation of methylmercury in fish. Only two coal-fired power plants (8 units) remain in operation. Both have installed mercury controls. Twenty-four coal-fired units that were operating at the beginning of this study have either been retired or have converted to natural gas. EPD does not recommend any further regulations. A distinct downward trend of mercury concentrations has been observed in the fish tissue which can be contributed to mercury emission controls installed on the remaining coal-fired power plants, combined with coal-fired power plant retirements. This downward trend is apparent in a number of water basins in Georgia, with a strong downward trend visible in black water systems.

EPD recommends that, as part of the fish consumption guideline monitoring program, the collection of fish samples from black water sites (Satilla River, Okefenokee Swamp, Ogeechee River, and Banks Lake) be taken every ten years and analyzed for mercury concentrations in fish tissue. In addition, other sites with average fish tissue mercury concentrations currently at or above 0.3 mg/kg (Savannah River at I-95, Flint River, Randy Pointer, Ocmulgee River Highway 96, Lake Andrews, and Savannah River at Highway 301) should also be monitored every ten years and analyzed for mercury concentrations. Results from this sampling will be included in the *Guidelines for Eating Fish From Georgia Waters* booklet.