TOTAL MAXIMUM DAILY LOAD (TMDL)

For

Total Mercury in Fish Tissue Residue

In

Spring Creek (HUC 03150104)
Including Listed Segment

Etowah River Tributary (Floyd County, GA)

In compliance with the provisions of the Federal Clean Water Act, 33 U.S.C §1251 et.seq., as amended by the Water Quality Act of 1987, P.L. 400-4, the U.S Environmental Protection Agency is hereby establishing a Total Maximum Daily Load (TMDL) for Mercury for the entire segment of Spring Creek (Etowah River Tributary). Subsequent actions must be consistent with this TMDL.

James D. Giattina, Director Date

Water Management Division

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Total Mercury in Fish Tissue Residue

In the

In the Spring Creek 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 segment of Spring Creek in Georgia:

Etowah River Tributary (Floyd County, GA)

In order for this TMDL to be developed, the applicable water quality standard must be determined. The State of Georgia does not have a numeric water quality standard for the protection of public health from total mercury. EPA has determined that Georgia's numeric water quality standard for the protection of aquatic life of 12 nanograms per liter (ng/l), is not protective of human health. Therefore EPA does not regard the State's aquatic life criterion as the applicable water quality standard for this TMDL. Instead, EPA has derived a numeric interpretation of the State of Georgia's narrative water quality standard for toxic substances (Chapter 391-3-6-.03 Section (5)(e)) using EPA's Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health (USEPA, 2000). Using recommended national values, and site-specific data, EPA interpreted Georgia's narrative standard and has determined that the applicable water quality target for total mercury in the ambient water of the Spring Creek Basin is 2.2 ng/l (parts per trillion). At this concentration, or below, fish tissue residue concentrations of mercury will not exceed 0.3 mg/kg, which is protective of the general population from the consumption of freshwater fish. This interpretation of Georgia's water quality standard was based on site-specific data gathered for Spring Creek in 2002 specifically for the development of this TMDL. It does not apply to any other water in the State of Georgia.

The calculated allowable load of total mercury that may come into the identified segment of Spring Creek without exceeding the applicable water quality target of 2.2 ng/l in the ambient water is 0.1 kilograms per year (kg/year).

1. Introduction

The U.S. Environmental Protection Agency (EPA) Region 4 is establishing this Total Maximum Daily Load (TMDL) for total mercury for one listed segment of Spring Creek, a tributary to the Etowah River in Floyd County, Georgia. This stream was included on the State of Georgia's 2002 Section 303(d) list of impaired waters because mercury in one water column sample exceeded the freshwater aquatic life criteria of 0.012 ug/l (GADNR-EPD, 2000). However, EPA does not consider the State's aquatic life criterion to be protective of human health. In 2001, the State of Georgia provided EPA with a numeric interpretation of the Georgia narrative water quality standard for mercury (GADNR-EPD, 2001). The numeric interpretation, which provides that methylmercury in fish tissue is not to exceed 0.3 mg/kg, is consistent with EPA's recently adopted guidance value for mercury (USEPA, 2000; USEPA, 2001), and is considered to be more conservative and protective than the freshwater aquatic life criterion.

The State also provided EPA with a methodology for determining when a waterbody is impaired and is to be listed on the State's Section 303(d) lists, as well as a methodology for calculating the site-specific allowable water column concentration that will protect the general population from the accumulation of mercury in fish tissue. Using EPA's recently collected site-specific data for mercury and the State's methodology for calculating allowable mercury concentrations, this listed segment of Spring Creek is attaining the applicable water quality standard for mercury. However, the Consent Decree in the case of Sierra Club v. EPA, 1:94-cv-2501-MHS (N.D. Ga.) requires the State or EPA to develop TMDLs for all waterbodies on the State of Georgia's current 303(d) list. Although the listed segment of Spring Creek appears to be meeting the applicable water quality target for mercury, EPA is establishing this TMDL because the listed segment remains on the State's current 303(d) list.

TMDLs are required for waters on a state's 303(d) list by Section 303(d) of the Clean Water Act (CWA) and the associated regulations in 40 CFR § 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 wasteload allocations (WLAs) for point sources regulated by the National Pollutant Discharge Elimination System (NPDES) program and to load allocations (LAs) for all other sources. The WLAs and LAs in the TMDL provide a basis for states to limit the amount of pollution from both point and nonpoint sources to restore or protect a waterbody from exceeding the applicable water quality standard. This TMDL will provide the maximum average annual load of mercury that can enter the listed segment of Spring Creek without exceeding the applicable water quality standard. An allocation of the maximum annual load will be provided for both point sources and nonpoint sources. Any current of future point sources would be permitted through the State's reasonable potential procedures.

2. Problem Definition

The listed segment of Spring Creek is on the State of Georgia's 2002 Section 303(d) list. Spring Creek was listed because mercury in one water column sample exceeded the freshwater aquatic life criteria established by the State of Georgia (GADNR- EPD, 2000).

The State of Georgia also uses Fish Consumption Guidelines (FCG) to 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 (GADNR, 2000). The Georgia Department of Natural Resources (GADNR) 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 of fish per day. Table 1 provides the recommended frequency of fish consumption for three different levels of contamination with mercury.

Table 1 Georgia Department of Natural Resources Fish Consumption Guidelines.

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 per 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. There are no FCG in place for Spring Creek.

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 of fish.

3. Applicable Water Quality Standard

TMDLs are established at levels necessary to attain and maintain the applicable narrative and numeric 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 yet include a numeric criterion for the protection of human health from methylmercury. Instead, the State's regulations provide the narrative water quality standard that waters are to be free from toxics. Since mercury can 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 TMDLs. 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 30, 2001 letter from the Environmental Protection Division of the Georgia Department of Natural Resources (GADNR- EPD) to USEPA Region 4 RE: Interim Mercury Criterion.) 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 entitled, "Water Quality Criterion for the Protection of Human Health: Methylmercury" (EPA, 2001). Using this methodology, which assumes that the general population is consuming 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 0.3 mg/kg methylmercury. The methodology uses a "weighted consumption" approach that assumes 10.2 grams per day (58.4%) of the total fish consumption is trophic level 3 fish (e.g., catfish and sunfish), and 7.3 grams per day (41.6%) are trophic level 4 fish (e.g., bass). See Equation 3-1 below.

Equation 3-1 Calculation of Weighted Fish Tissue Concentration to Determine Impairment

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

where:

Avg. Trophic 4 Concentration (mercury in fish tissue) = 0.24 mg/kg

Avg. Trophic Level 3 Concentration (mercury in fish tissue) = 0.08 mg/kg

In July 2002, EPA sampled 1 location in the listed segment of Spring Creek to collect site-specific data on ambient mercury in fish tissue and in the water. Using Equation 3-1, the site-specific fish tissue concentration data collected in Spring Creek yields a weighted fish tissue concentration of 0.15 mg/kg which is less than the State's current, applicable water quality criterion of 0.3 mg/kg.

4. TMDL Target

In order to establish the TMDL, the maximum allowable concentration of total mercury in the ambient water that will prevent accumulation of methylmercury in fish tissue greater than 0.3 mg/kg level must be determined. To determine this allowable ambient water concentration, EPA referred to the "Revisions to the Methodology for Deriving Ambient Water Quality Criteria for the Protection of Human Health" (also referred to as the "Human Health Methodology"; USEPA, 2000). The methodology is expressed below in Equation 4-1:

Equation 4-1 Calculation of the Water Quality Target

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

where:

WQT = target water quality concentration of total Mercury in ng/l
Reference Dose = 0.0001 mg/kg/day Methylmercury (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 = 1,340,193 (as calculated)
Fraction of the Total Mercury as Methylmercury = 0.10 (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 of fish per day (USEPA, 2000). For the other factors in the calculation, bioaccumulation and fraction methylmercury, EPA used site-specific data from the listed segment of Spring Creek collected in July of 2002. (See Section 5.2.) 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 measured fraction methylmercury of 0.10. **Using this approach, an allowable concentration of total mercury in the ambient water (WQT) in the listed segment of Spring Creek for the protection of human health is 2.2 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 in July 2002 was 1.1 ng/l.

5. Background

Spring Creek is located in northwestern Georgia (USGS Hydrologic Unit Code (HUC) 031501041603). The Spring Creek basin is presented in Figure 1.

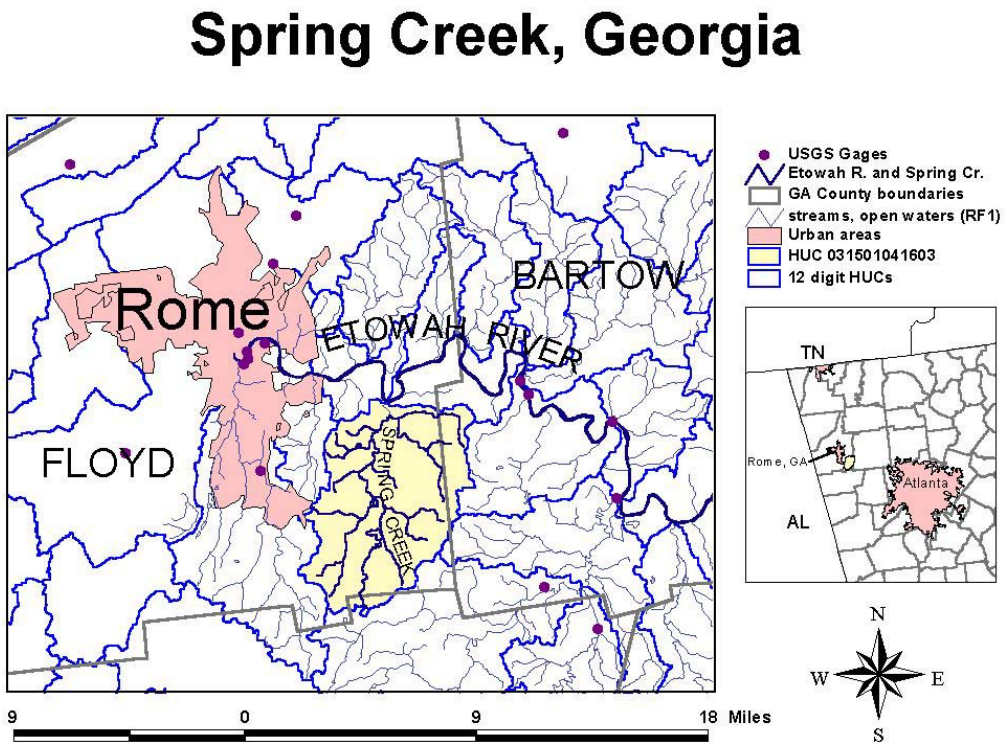

Figure 1 Map of the Spring Creek basin in northwestern Georgia.

5.1. Source Assessment

A TMDL evaluation examines the known potential sources of the pollutant in the watershed, including point sources, nonpoint sources, and background levels. There are no NPDES permitted facilities that discharge to the listed segment of Spring Creek. The primary nonpoint source of mercury is atmospheric deposition (USEPA, 1997).

5.2. Available Monitoring Data

EPA Region 4 sampled the listed segment of Spring Creek in July of 2002. Since even low concentrations of mercury in water can lead to significant accumulation of mercury in fish tissue, EPA sampled Spring Creek using the most sensitive sampling and analytical techniques. The samples were collected using the "clean hands" method (USEPA, 2000 and 1996), and analyzed using the ultra-trace level analytical technique, EPA Methods 1630/1631 (USEPA, 1998 and 1999). EPA adopted this method in June of 1999 for mercury in water for data gathering and compliance monitoring under the Clean Water Act and Safe Drinking Water Act. This method can reliably measure mercury to 0.5 ng/l (parts per trillion).

The purpose of this data collection effort was to generate data needed for the development of this mercury TMDL. Water column, fish, sediment and soil samples

(taken adjacent to the water column samples outside the flood plain) were collected on July 1, 2002 from one location within the listed segment of Spring Creek and used for this TMDL. The location for the water column samples is illustrated in Figure 2.

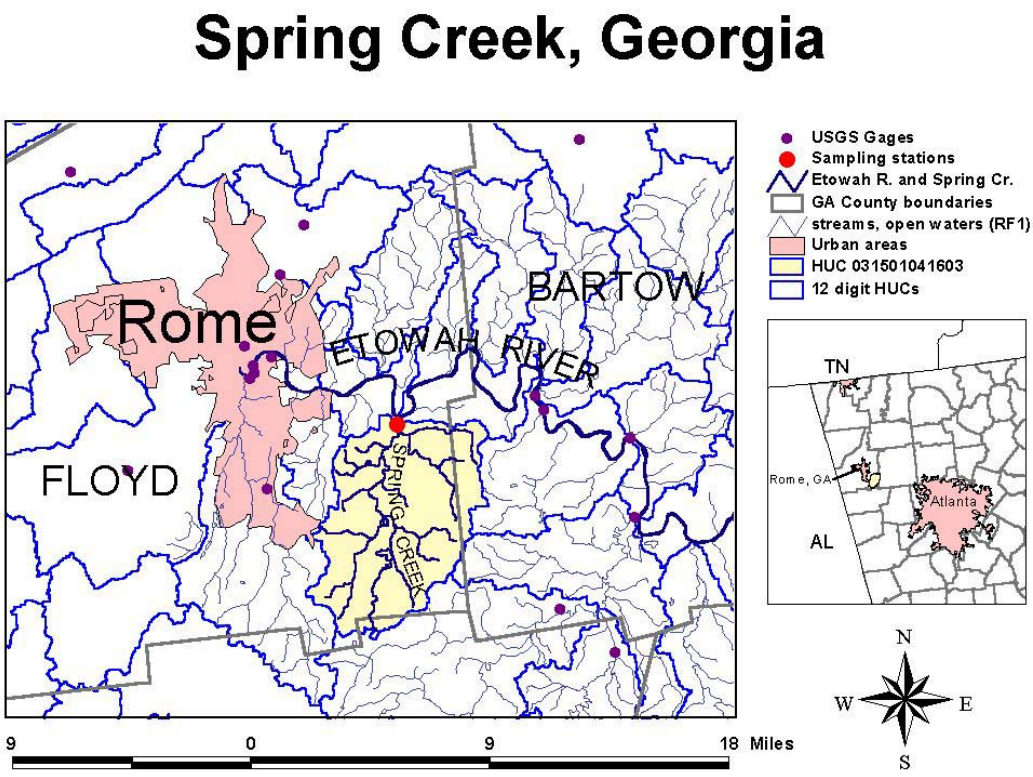

Figure 2 Location of the Spring Creek sampling station in Georgia.

The fish collection on July 1 and 2, 2002 consisted of 10 fish, of which 5 were trophic level 3 fish (sunfish, catfish) and 5 were considered trophic level 4 (bass).

The following sections provide the results of the field sampling for mercury.

5.2.1. Water Column Data

Water column samples were collected 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 quantification level 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 2 provides the measured mercury concentrations in the water column of the listed segment of Spring Creek.

Table 2 Water Column Mercury Concentrations in Spring Creek, Georgia, July 2002.

Station	Waterbody	Mercury, Total (THg, ng/L)	Mercury, Methyl (MeHg, ng/L)	Fraction MeHg
SC	Spring Creek	1.1	0.11	0.10

5.2.2. Fish Tissue Data

Samples of fish were taken from the listed segment of Spring Creek within the same area as the water column and sediment samples. Trophic level three (sunfish, catfish) and trophic level four fish (bass) were targeted in the collection because they represent the fish that are caught and kept by anglers and consumed as a source of food. The fish filets obtained during EPA's sampling effort were analyzed for total mercury (THg). Table 3 provides the individual fish data.

Table 3 Fish Tissue Mercury Data for Spring Creek, Georgia, July 2002.

Station	Waterbody	Trophic Level	Species	Total Length (mm)	Whole Wt (gm)	Filet Wt (gm)	THg, (mg/kg) Wet Weight
SC	Spring Creek	4	Redeye Bass	260	224	67	0.38[DA]
SC	Spring Creek	4	Redeye Bass	260	197	62	0.30[A]
SC	Spring Creek	4	Spotted Bass	225	129	53	0.32
SC	Spring Creek	4	Spotted Bass	215	96	32	0.15
SC	Spring Creek	4	Shadow Bass	190	143	44	0.16
SC	Spring Creek	3	Bluegill Sunfish	180	124	45	0.31
SC	Spring Creek	3	Green Sunfish	146	68	24	0.08
SC	Spring Creek	3	Green Sunfish	150	67	24	0.05[A]
SC	Spring Creek	3	Green Sunfish	130	41	14	0.05 [A]
SC	Spring Creek	3	Channel Catfish	275	175	51	0.04

Table 4 shows the weighted fish tissue concentration calculated by applying Equation 3-1 to the July 2002 data. A weighted fish tissue concentration exceeding 0.3 mg/kg would indicate impairment.

Table 4 Weighted Average Fish Tissue Concentration in Spring Creek, Georgia, July 2002.

Trophic Level	Avg. Conc. Total Hg mg/kg	Max. Conc. Total Hg mg/kg	Min. Conc. Total Hg mg/kg	Count	Length	Total Hg mg/kg Geomean
4	0.3	0.4	0.2	5	230	0.24
3	0.1	0.3	0.04	5	176	0.08

Applying Equation 3-1 to the trophic level geometric mean concentrations yields a weighted average fish tissue concentration of 0.15 mg/kg.

6. Total Maximum Daily Load (TMDL)

The TMDL is the total amount of a pollutant that can be assimilated by the receiving waterbody without exceeding the applicable water quality target. The TMDL for the listed segment of Spring Creek is 0.1 kg/year to prevent signficant accumulation of mercury in fish tissue. This TMDL determines the maximum load of total mercury that can enter Spring Creek within a year without exceeding 0.3 mg/kg in fish tissue residue as calculated in Section 3.

6.1. Critical Condition Determination

The annual average flow and annual average loading represent the critical conditions for this TMDL. Annual average flow and annual average loading are appropriate for several reasons. First, EPA's Human Health methodology, which has been used to derive an appropriate numeric interpretation of Georgia's narrative water quality standard for toxic substances for this TMDL, assumes that health effects due to mercury occur as a result of long-term exposure to mercury in fish tissue through consumption of contaminated fish. The bioaccumulation of methylmercury in fish tissue is a long-term, multi-year, process. The State applies their human health criteria at a flow equivalent to the annual average flow (Georgia Rules and Regulations for Water Quality Control, Chapter 391-3-6-.03(5)(e)(iv) which requires the application of annual average load in the TMDL.

6.2. Seasonal Variation

Mercury is expected to fluctuate based on the amount and distribution of rainfall, and on variable emissions from local and distant atmospheric sources. Since wet deposition is greatest in the spring and winter seasons, loadings of mercury are highest during these times of the year. However, these seasonal impacts or other short-term variability in loadings are damped out by the biotic response of bioaccumulation, which as discussed above, is a long-term process. Because of this, and because the load is expressed on an average annual basis, seasonal variations are not important in this TMDL.

6.3. 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 may be expressed in conservative assumptions used to develop the TMDL. A MOS is incorporated into this TMDL in that the maximum load is based upon a conservative representation of mercury entering Spring Creek and the TMDL calculation does not take into account reduction/volatilization. In addition, that increment of mercury loading between the current annual loading and the total amount of mercury the River can receive without exceeding the water quality standard is reserved as an additional MOS. This MOS reflects EPA's recognition that mercury is a persistent, bioaccumulative pollutant that appears on EPA's list of priority toxic pollutants.

6.4. TMDL Determination

To determine the total maximum load of total mercury to Spring Creek, a conservative mass balance calculation is used. The annual average flow and the water quality target as calculated in Equation 4-1 is used to determine the maximum load of mercury to the waterbody as not to exceed a water column concentration of 2.2 ng/l. (See Equation 6-1.)

Equation 6-1 TMDL Determination

$$TMDL = \frac{WQT(ng/l) * Annual\ Average\ Flow * Number\ of\ Seconds/Year * 1000}{Number\ of\ ng/g}$$

where:

Water Quality Target= 2.2 ng/l
Annual Average Flow in Waterbody = 1.4 cubic meters/second
Number of Seconds/Year = 31536000
Number of ng per gram = 1E9

The annual average flow of Spring Creek was estimated using a drainage-area ratio method. This method involves calculating the flow per square mile of drainage area for a similar gaged watershed and then multiplying that ratio by the drainage area of the ungaged watershed for which a flow estimate is needed. The USGS gage 02394950 on Hills Creek was chosen because the stream is near Spring Creek, has similar types and proportions of landuses, and drains a comparable area. Since the TMDL is expressed on an annual basis to only one significant figure, the flow estimate could vary by as much as 50% and still result in the same calculated load. **The TMDL load is calculated as 0.1 kg/year total mercury for Spring Creek**.

7. 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 and as a Wasteload Allocation (WLA) to the point-source facilities in Georgia with an NPDES permit.

The calculated allowable load of mercury that can come into Spring Creek without exceeding the water quality target of 2.2 ng/l is 0.1 kg/year. Because this assessment indicates that the allowable load can be maintained without reducing the current loads received by the stream, nonpoint sources will be assigned allocations equal to current loads. The remainder of the loading capacity is assigned to the MOS. Any future point sources will be permitted through Georgia EPD's reasonable potential procedures, which are based on Georgia's Rules and Regulations for Water Quality Control, Chapter 391-3-6.06(4)(d)5. These procedures involve determining whether a discharge causes, has the potential to cause, or contributes to an instream excursion above a narrative or numeric criteria within a State water and are required by 40 CFR § 122.4(d).

8. References

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