SAVANNAH RIVER MERCURY TMDL
DATA REPORT

November 28, 2000

PREPARED BY:

Alan G. Auwarter
U.S. EPA, Region 4
Science and Ecosystems Support Division
Ecological Assessment Branch
Athens, Georgia

PREPARED FOR:

Tim Wool
U.S. EPA, Region 4
Water Management Division
Water Quality Planning and Assessment Branch
Atlanta, Georgia

TABLE OF CONTENTS

LITERATURE CITED

FIGURES

TABLES

1.0 INTRODUCTION

Point source discharges, surface water, pore water, sediment, soil and fish were sampled along the entire reach of the Savannah River system. Samples were analyzed for mercury, nutrients, sulfate, sulfide and other parameters (Table 1) needed by Region 4 Water Management Division to support development of a mercury total maximum daily load (TMDL) model for the Savannah River system.

2.0 FIELD SAMPLING PLAN

2.1 SAMPLING OBJECTIVES

The objective of this effort was to obtain environmental data necessary to provide input to a mercury TMDL model for the Savannah River watershed.

.

2.2 SAMPLE SITE LOCATIONS

The Savannah River is formed by the confluence of the Seneca and Tugaloo Rivers which is now under the waters of Lake Hartwell in northeast Georgia. Nineteen stations were targeted for sampling by the Water Management Division, from Lake Hartwell through Lakes Russell and Thurmond, to the tide gates near the mouth of the Savannah River (Figures 1-12). Additional influent and/or effluent samples were collected from 24 industrial and municipal dischargers along the river. These point source dischargers are listed in Table 2. Lake (Reservoir), River and tributary sample stations are listed in Table 3.

2.2.1 Reservoir Stations

One sample station was located in each of the reservoirs impounded along the river (Figures 1, 3 and 4): Hartwell (Figures 1 and 3), Russell (Figure 3) and Thurmond (Clark's Hill; Figures 1 and 4). At these stations, sediment was collected from the forebay. A soil sample was collected from the watershed area from a relatively undisturbed, nonurbanized location above the full pool level for each reservoir. Surface water, and pore water were collected from the tail-race area of each lake station. Total mercury data for fish was supplied by the Georgia Department of Natural Resources; no fish were collected from the reservoirs as part of this project.

2.2.2 River and Creek Stations

There were nine main stem sample stations (Figures 2 and 5-12). Samples of soil, sediment, surface water, pore water and fish were collected at each of these stations. One station was located in each of six tributaries along the Savannah River. The sampling teams collected fish and abiotic media in each tributary by approaching from the

Savannah River and proceeding upstream in the tributary a distance adequate to assure that samples collected were representative of the tributary itself rather than the mainstem or a mixing area. Fish were collected from Butler Creek upstream of Augusta's wastewater treatment plant outfall near the SR 56 (Doug Bernard Parkway) crossing.

2.3 SAMPLING PROCEDURES

In general, methods for sampling surface water, sediment and pore water followed those developed for the South Florida Ecosystem Assessment (US EPA 1998a). Additional information on sampling methods for surface water, sediments, soil and fish is provided in the following subsections. Samples were distributed among four laboratories for analysis. The analyses conducted on each environmental medium, the participating laboratory, container and preservative specifics, and holding times are summarized in Table 1.

2.3.1 Surface Water

Surface water samples were collected from the top foot of the water column. Analyses were performed on unfiltered water samples. For comparison with filtered samples, an extra sample of water was collected from the Thurmond Reservoir station and from main stem stations M-4 and M-8 and sent to Battelle Northwest Laboratories for filtration and analysis of total mercury and methyl mercury. Exposure of ambient water samples to airborne contaminants was prevented by using a specially designed vacuum chamber with a sampling wand and a hand pump. Surface water was siphoned through a Nitex pre-filter, via Teflon tubing (containing an in-line 0.45 um capsule filter) directly into a Teflon bottle. Point source samples were collected with a Teflon bucket. Sample collection and handling followed clean sampling techniques as described in Method 1669 Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels (US EPA 1996a).

Ambient water quality parameters including pH, conductivity, dissolved oxygen, and temperature were measured using a Hydrolab® multi-parameter instrument. Calibration and use of the instrument was performed in accordance with EPA's guidelines (US EPA 1996b) and the manufacturer's instructions.

2.3.2 Sediment

Sediment was collected using a petite ponar dredge, homogenized, and divided among sample containers (US EPA 1996b).

2.3.3 Soil

The top four inches of surficial soils were sampled with a clean stainless steel spoon, homogenized in a glass pan and distributed among sample containers (US EPA 1996b).

2.3.4 Fish

Scientific Collection Permits were obtained from the Georgia Department of Natural Resources, Wildlife Resources Division for collecting fish. Fish were collected using boat-mounted electrofishing equipment for all stations other than Butler Creek where backpack electrofishing equipment was used. Collection, processing, preservation, and transport of samples was conducted in accordance with Ecological Assessment Branch Standard Operating Procedures (EABSOP, US EPA 2000a) and Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Second Edition (US EPA 1995).

Since the TMDL was related to human exposure to mercury via fish consumption, legal sized largemouth bass were targeted for collection. Where largemouth bass were not obtainable for any reason, other predatory species high on the food chain and/or commonly caught for human consumption, such as bowfin, chain pickerel, grass pickerel or striped bass, were collected.

Immediately after collection, fish were chilled on wet ice, shipped or driven to the Region 4 laboratory in Athens, GA, fileted and frozen within 48 hours of collection. Filets were homogenized using dry ice at the SESD laboratory (US EPA 2000a). Fish samples were shipped on dry ice to Battelle Laboratories, Inc. for analysis of total mercury and percent moisture. Skinless filets from five individual fish were analyzed for total mercury from each station.

2.4 SAMPLING EQUIPMENT DECONTAMINATION

Sampling and processing equipment were laboratory cleaned and wrapped and/or sealed prior to sampling activities. Decontamination of field sampling materials followed this ordered procedure:

1. non-phosphate Lacunas Detergent wash
2. potable water rinse
3. organic free water rinse
4. solvent rinse (isopropanol)
5. organic free water rinse

3.0 QUALITY ASSURANCE PROJECT PLAN

This section identifies the individuals/organizations participating in the project and discusses specific roles and responsibilities of personnel. Also discussed are quality objectives for measurement and data acquisition.

3.1 PROJECT MANAGEMENT

The environmental field sampling effort shall be managed through the Ecological Assessment Branch with the support of the Water Quality Planning and Assessment Branch, Water Management Division.

3.1.1 Project/Task Organization

- The Science and Ecosystems Support Division (SESD) provided eleven biologists/samplers to conduct field sampling activities including onsite measurements, sample collection, sample processing, sample packaging, and sample shipment/transportation.

- The Water Quality Planning and Assessment Branch provided three biologists to assist with sampling and other project needs.

- Four laboratories analyzed samples as per Table 1 distribution.

- The Office of Quality Assurance at SESD provided expedited quality assurance review of data generated outside of SESD.

3.1.2 Special Training Requirements/Certification

Safety training and certification requirements for personnel are described in the project Safety Plan. In addition, field biologists are trained and experienced in how to perform the environmental studies which they are conducting, including sampling surface water for ultra-trace level mercury analysis and collecting and processing fish for chemical analysis. Participating staff were familiar with boat handling and with project Float Plans.

3.1.3 Documentation and Records

Sample collection and documentation were planned and executed in accordance with EABSOP (US EPA 2000a), Sampling Ambient Water for Trace Metals (US EPA 1996a) and EIBSOPQAM (US EPA 1996b). Sample tracking (chain of custody), containers, sample quantities, and preservatives are given in Table 1 and follow guidelines presented in ASBOQCM (US EPA 1997).

3.2 MEASUREMENT/DATA ACQUISITION

3.2.1 Sampling Process Design

The rationale for the design, type of samples to be collected, and sampling locations are specified in Sections 2.1 and 2.2.

3.2.2 Sampling Methods Requirements

Samples and *in situ* data for this project were collected in accordance with Sampling Ambient Water for Trace Metals (US EPA 1996a), EABSOP (US EPA 2000a), and EIBSOPQAM (US EPA 1996b).

3.2.3 Sample Handling and Custody Requirements

Handling, and custody of samples followed guidelines described in the *Ecological Assessment Branch Laboratory Operations and Quality Assurance Manual* (EABLOQAM, US EPA 2000b). Sample shipping followed guidelines described in the *Analytical Support Branch Operations and Quality Control Manual* (ASBOQCM, US EPA 1997) and *Environmental Investigations Branch Standard Operating Procedures and Quality Assurance Manual* (EISOPQAM, US EPA 1996b).

3.2.4 Sample Preservation, Containers, and Holding Times

Sample preservatives, containers, and holding time requirements are included in Table 1.

Water quality parameters including pH, conductivity, dissolved oxygen, and temperature were measured *in situ* using a Hydrolab® multi-parameter instrument and did not require handling or preservation of a sample.

3.2.5 Analytical Methods Requirements

.

Water samples were analyzed for dissolved total mercury (Method 1631, US EPA 1999), dissolved methyl mercury (Method 1630, US EPA 1998b), total organic carbon (Method 415.1, US EPA 1983), and total suspended solids (Method 160.3, US EPA 1983). . Laboratory analysis of surface water for TOC and TSS were performed using with EPA Methods 415.1 and 160.3, respectively (US EPA 1983). Sulfide was measured in water using the Hach Methylene Blue Method 8131 (Hach 1994). Surface water was also sampled and analyzed for sulfate and nutrients (US EPA 1983). Method 1631 (US EPA 1999, modified for microwave digestion for fish tissue) was followed for fish tissue total mercury analysis.

3.2.6 Quality Control Requirements

Quality control (QC) procedures were used in the field and laboratory to ensure that reliable data were obtained. When performing this field sampling effort, precaution was taken to prevent the cross-contamination of sampling equipment, sample bottles, and other equipment that could compromise sample integrity.

3.2.6.1 Field Quality Control. Field QC samples were collected as part of the sampling effort include field duplicate, field equipment rinse blanks and ambient air field blanks as described below:

- Field duplicate samples provide an indication of field and analytical system precision. At least one field duplicate sample was collected for every 10 samples that were collected and submitted to the laboratory. The location of duplicate samples was determined by the field team leader.

- Field equipment rinse blanks demonstrate that the equipment is free from contamination. At least one field equipment blank was collected for every 10 samples that were collected and submitted to the laboratory.

- Ambient air field blanks measure the concentration of contaminants that are being deposited or entrained from the air during the process of collecting samples of abiotic media. An ambient air field blank was collected during the process of collecting effluent and influent samples at each point source visited for this project as well for every ten or fewer collections of ambient abiotic media.

- Unopened trip blanks were taken into the field. These were analyzed along with samples to measure contaminants that could be attributed to laboratory-supplied field materials and to ambient exposure during the sampling period.

3.2.6.2 Laboratory Quality Control. The QC samples prepared and analyzed by the laboratory included blanks, duplicates, and spikes, as described below:

- Laboratory method blanks provide an indication of potential contamination introduced to the laboratory during sample preparation and analysis.

- Duplicates are typically used as an indication of precision associated with the analytical process.

- Spikes provide an indication of preparation and analysis method accuracy by adding a known amount of material to a sample (matrix spike) or blank (laboratory control sample) and calculating percent recovery.

3.2.7 Instrument Calibration and Maintenance Requirements

All field screening and analytical instruments were calibrated and maintained in accordance with EABSOP (US EPA 2000a), EIBSOPQAM (US EPA 1996b), ASBOQCM (US EPA 1997) and the manufacturer's instructions. The results from all instrument calibration and maintenance activities were recorded in a bound logbook in accordance with the procedures outlined in EABSOP (US EPA 2000a).

3.2.8 Sample Management

Data collected during field sampling activities were managed and stored by the sampling team members. Upon completion of sampling activities, all documents/records obtained during the field investigation were delivered to the project leader who organized, labeled, and maintained them during preparation of the data report. Upon completion of the report, project records will be submitted to the Science and Ecosystem Support Division Records Room. All original analytical data and supporting documentation, e.g., chromatograms, QA/QC records, calculations, etc., will be maintained by the ASB laboratory according to their ASBOQCM (US EPA 1997). Access of analytical results for this project shall be available to EPA project team members through the Region 4 Laboratory Information Management System (R4LIMS). Where necessary, electronic or hard copies have been and will be provided to interested parties pending approval of the Project Manager.

3.3 DATA VALIDATION AND USABILITY

Sample data were reviewed to ensure that analyses were performed and reported as requested.

3.4 STANDARD OPERATING PROCEDURES

Sampling activities including collection, documentation, handling, analysis and QA/QC were performed in accordance with the US EPA standard operating procedures and guidance documents as discussed in Section 2.2. A site specific Safety Plan and Float Plans were developed and approved prior to commencement of field activities.

3.5 WASTE DISPOSAL

Samples collected for chemical analysis will be maintained for 60 days after the issuance of chemical results/final report. If no additional testing has been requested at the end of the 60 days, with the approval and concurrence of the Project Manager, arrangements will be made for disposal through the US EPA laboratory waste disposal system.

4.0 PROJECT MANAGEMENT AND REPORTING

EPA will make every effort to provide the data needed to support this mercury TMDL modeling effort for the Savannah River system. Parties that have been consulted or involved with this sampling effort and/or that assisted in the production of this data report are:

Tim Wool	USEPA, R4, WMD, WQPAB -- Project Manager
Alan Auwarter	USEPA, R4, SESD, EAB – Field Team Leader
Phyllis Meyer	USEPA, R4, SESD, EAB – Assistant Field Team Leader
Lonnie Dorn	USEPA, R4, SESD, EAB - Assistant Field Team Leader
Tom Cavinder	USEPA, R4, SESD, EAB - Field Team Member
Phil Murphy	USEPA, R4, SESD, EAB - Field Team Member
Pete Kalla	USEPA, R4, SESD, EAB - Field Team Member
Chris Decker	USEPA, R4, SESD, EAB – Field Team Member
Leslie Cagle	USEPA, R4, SESD, EAB - Field Team Member
Candace Halbrook	USEPA, R4, SESD, EAB - Field Team Member
Louis Salguero	USEPA, R4, SESD, EIB - Field Team Member
Joe Compton	USEPA, R4, SESD, EIB - Field Team Member
Ed Decker	USEPA, R4, WMD, WQPAB - Field Team Member
Morris Flexner	USEPA, R4, WMD, WQPAB - Field Team Member
Dave Melgaard	USEPA, R4, WMD, WQPAB - Field Team Member
Gail Mitchell	USEPA, R4, WMD, WQPAB
Jerry Stober	USEPA, R4, SESD, EAB
Mike Wasko	USEPA, R4, SESD, ASB
Jenny Scifres	USEPA, R4, SESD, ASB, Chief, ICS
Antonio Quinones	USEPA, R4, SESD, Chief, EAB
Anne Keller	USEPA, R4, SESD, EAB, Chief, BTES
Bill Cosgrove	USEPA, R4, SESD

5.0 PROJECT SCHEDULE, DELIVERABLES, AND TASKS

The field work for this project was conducted between July 24 and September 13, 2000. Four laboratories participated. Because of the quick response nature of this project, the Project

Manager was given verbal status reports and electronic and hard copy reports as soon as data became available. This permitted preliminary modeling work to begin so court deadlines could be met. Once data validation was completed, final data were provided to the Project Manager.

6.0 RESULTS

Point sources sampled along the river are listed in Table 2, along with the total mercury and methyl mercury results from their effluents, and influents where collected. Coordinates for river water sampling locations are listed in Table 3. Sediments were typically sampled from the same location as the water sample. If sediments could not be sampled there, they were collected from a nearby depositional area. *In situ* water quality data are provided in Table 4.

Fish were sampled near the water and sediment sampling locations. Fish stations (Figures 5-12) were comprised of river or creek reaches along which shocking runs were made in water shallow enough for electrofishing to be effective. Each station location was centered on the coordinates provided in the figures. Fish species, length, weight, and total mercury content of the filets from individual fish (on both a wet- and dry-weight basis) are provided in Table 5.

Results of sulfide analyses for surface water and sediment samples are in Table 6. Pore water was extracted from sediments *in situ*, preserved and analyzed for sulfides in the laboratory. Results of nutrients and classical analyses in sediment and soil samples can be found in Table 7. Analyses conducted on sediment and/or soil included nitrate-nitrite nitrogen, sulfate, total Kjeldahl nitrogen, total phosphorous, percent moisture and percent volatile residue in addition to total and methyl mercury. Ambient water nutrient and classical analytical results are in Table 8. These analyses include total Kjeldahl nitrogen, total phosphorous, total suspended solids, sulfate and total organic carbon. The results of methyl mercury and total mercury analyses for ambient water samples are in Table 9 and for sediment and soil samples in Table 10.

LITERATURE CITED

Hatch Procedures Manual. 1994. DREL/2000 Advanced Water Quality Laboratory. Hach Company, Second Edition. August 1, 1994.

US EPA. 2000a. *Ecological Assessment Branch Standard Operating Procedures*. U.S. Environmental Protection Agency, Region 4, Science and Ecosystems Support Division, Ecological Assessment Branch, Athens, GA.

US EPA 2000b. *Ecological Assessment Branch Laboratory Operations and Quality Assurance Manual.* U.S. Environmental Protection Agency, Region 4, Science and Ecosystems Support Division, Ecological Assessment Branch, Athens, GA.

US EPA. 1999. *Method 1631, Revision B: Mercury in Water by Oxidation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry.* U.S. Environmental Protection Agency, Office of Water, Washington, DC.

US EPA. 1998a. *South Florida Ecosystem Assessment. Volumes I and II.* US Environmental Protection Agency, Region 4, Science and Ecosystem Support Division and Office of Research and Development

.

US EPA. 1998b. *Method 1630 Methyl Mercury in Water by Distillation, Aqueous Ethylation, Purge and Trap, and Cold Vapor Atomic Fluorescence Spectrometry*. U.S. Environmental Protection Agency, Office of Water, Washington, DC.
US EPA. 1997. *Analytical Support Branch Operations and Quality Control Manual.* US Environmental Protection Agency, Region 4, Science and Ecosystem Support Division, Athens, GA.

US EPA 1996a. *Method 1669 Sampling Ambient Water for Trace Metals at EPA Water Quality Criteria Levels*. U.S. Environmental Protection Agency, Office of Water, Engineering and Analysis Division (4303), Washington, DC.

US EPA 1996b. *Environmental Investigations Branch Standard Operating Procedures and Quality Assurance Manual*. U.S. Environmental Protection Agency, Region 4, Science and Ecosystems Support Division, Environmental Investigations Branch, Athens, GA.

US EPA. 1995. *Guidance for Assessing Chemical Contaminant Data for Use in Fish Advisories, Second Edition*. Office of Science and Technology, Office of Water, Washington, DC.

US EPA. 1983. *Methods for Chemical Analysis of Water and Wastes*. U.S. Environmental Protection Agency, Environmental Monitoring and Support Laboratory, Office of Research and Development, Cincinnati, OH.

FIGURES

TABLES