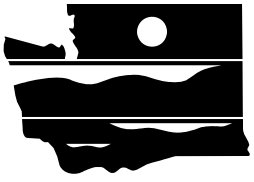
Addendum #1 to

Quality Assurance Project Plan: Depositional History of Mercury in Selected Washington Lakes Determined from Sediment Cores

May 2008

Publication Number 06-03-113ADD1



Publication Information

Addendum

This addendum is available on the Department of Ecology's website at
www.ecy.wa.gov/biblio/0603113ADD1.html

Original Publication

Quality Assurance Project Plan: Depositional History of Mercury in Selected Washington Lakes Determined from Sediment Cores

Publication No. 06-03-113

The Quality Assurance Project Plan is available on the Department of Ecology's website at
www.ecy.wa.gov/biblio/0603113.html

Authors of this Addendum

Callie Meredith and Chad Furl
Environmental Assessment Program
Washington State Department of Ecology
Olympia, Washington 98504-7710

DEPARTMENT OF ECOLOGY

Environmental Assessment Program

April 30, 2008

TO: Mike Gallagher, Project Lead
Solid Waste and Financial Assistance Program

Maria Peeler
Solid Waste and Financial Assistance Program

THROUGH: Will Kendra, Manager, Statewide Coordination Section
Environmental Assessment Program

Dale Norton, Supervisor, Toxics Studies Unit
Environmental Assessment Program

FROM: Callie Meredith, Environmental Assessment Program
Chad Furl, Environmental Assessment Program

SUBJECT: **ADDENDUM #1 TO QUALITY ASSURANCE PROJECT PLAN: DEPOSITIONAL HISTORY OF MERCURY IN SELECTED WASHINGTON LAKES DETERMINED FROM SEDIMENT CORES**

PROJECT CODE: 06-501-02-03
PUBLICATION NO: 06-03-113ADD1

In 2003, the first chemical action plan (CAP) was developed by the Washington State Department of Ecology (Ecology) and the state Department of Health (DOH) addressing the threat of mercury in Washington State (Peele, 2003). In 2006, a second CAP was presented addressing polybrominated diphenyl ethers (PBDEs) (Geller, 2006). The objectives of the CAPs are to reduce the threat of exposure to these chemicals and, where possible, eliminate inputs into the environment (Gallagher, 2007).

As a result of the mercury CAP, long-term mercury monitoring was initiated in 2006 to assess depositional patterns around the state through the use of age-dated sediment cores (Coots, 2006). Currently, Ecology and DOH are developing CAPs to address additional persistent, bioaccumulative, toxic chemicals (PBTs). The next CAPs scheduled are for lead in 2008 and polycyclic aromatic hydrocarbons (PAHs) in 2009 (Gallagher, 2007). This addendum outlines the addition of PAHs to the *Mercury in Sediment Cores Quality Assurance (QA) Project Plan* (Coots, 2006).

Experimental Design

Sediment cores are currently being retrieved from 3 lakes per year statewide to assess mercury and lead contaminant trends. A vertical sediment profile (35-50cm) is taken from a deep, flat area in each waterbody and sectioned into 1-cm slices. Selected 1-cm intervals are processed at Ecology headquarters by thoroughly homogenizing the sediment layer. Homogenized sediments are then split into subsamples and shipped to Manchester Environmental Laboratory (MEL) for mercury, lead, and total organic carbon (TOC) analysis. Aliquots from the homogenized sediments are also sent to a contract laboratory for 210-Pb analysis. Processing is done within 24 – 48 hours after sample collection.

Starting in 2008, PAHs will be added to the sediment core sample analyses. The selected 1-cm intervals will be collected and processed as described above, with the addition of a fifth subsample taken from the homogenized sediments. This subsample will be shipped to MEL for PAH analysis. PAH subsamples will be included in all sediment layers selected for analysis of mercury, lead, TOC, and 210-Pb.

The sediment layers selected for processing and analysis will represent recent and background conditions. A weighted sediment layer selection process will be used, with a higher density of intervals tested near the top, and spacing the selected layers farther apart moving down the core. The 210-Pb data will be used to assign sedimentation rates and ages to the sediment intervals providing a chronological history of mercury, lead, and PAH contamination in the sediment core. Sample collection and processing are described in detail in the *Mercury in Sediment Cores QA Project Plan* (Coots, 2006).

The selection criteria for the 2008 study sites will be modified from the Mercury in Sediment Cores QA Project Plan (Coots, 2006) to include proximity to potential PAH contamination. Lakes near urbanized areas will be given priority in the selection process to evaluate PAH deposition trends.

Analytical Laboratory

Samples for determination of PAHs will be sent to MEL. A list of the PAH compounds to be analyzed is included in the Appendix.

Intended Use

The data will be used to gather information on sources, concentrations, and trends of PAHs in lake sediments.

Organization, Schedule, and Laboratory Budget

Following are the organization of staff and the time schedule for this project.

Organization

Name	Organization	Role	Phone No.
Mike Gallagher	SWFAP-HQ	Client	360-407-6868
Maria Peeler	HWTRP-HQ	Client	360-407-6704
Chad Furl	EAP-SCS-TSU	Project Lead	360-407-6060
Callie Meredith	EAP-SCS-TSU	EIM Data Engineer	360-407-6965
Dale Norton	EAP-SCS-TSU	Unit Supervisor	360-407-6765
Stuart Magoon	Manchester Lab	Lab Director	360-871-8801
Dean Momohara	Manchester Lab	Lab Unit Supervisor	360-871-8808
Nancy Rosenbower	Manchester Lab	Sample Scheduling/Receipt	360-871-8827
Bill Kammin	EAP	Quality Assurance Officer	360-407-6964

SWFAP-HQ = Solid Waste & Financial Assistance Program – Ecology Headquarters
HWTRP-HQ = Hazardous Waste & Toxics Reduction Program – Ecology Headquarters
EAP-SCS-TSU = Environmental Assessment Program – Statewide Coordination Section – Toxics Studies Unit

Schedule

Environmental Information System (EIM) Data Set	
EIM data engineer	Callie Meredith
EIM user study ID	CFUR0004
EIM study name	Depositional History of Mercury in Selected Washington Lakes Determined from Sediment Cores
EIM completion due	June 30, 2009
Final Report	
Report author lead	Chad Furl
Schedule	
Draft report due to supervisor	March 31, 2009
Draft report due to client/peer	April 30, 2009
Final report due	June 2009

EIM - Environmental Information Management system

Budget

The estimated annual laboratory costs for the addition of PAH analyses is listed in Table 1. The cost estimate reflects the MEL discount price for Ecology programs.

Table 1. Estimated Annual Laboratory Costs for PAH analyses.

Parameter	Cost per Sample	Number of Field Samples	Total Cost
PAHs	$315	33	$10,395

Quality Objectives

Measurement Quality Objectives

The measurement quality objectives and lowest concentration of interest for the PAH analyses are shown in Table 2. MEL will be expected to meet the quality objectives for accuracy, precision, and bias. Measurement quality objectives are comparable to other toxics studies' project plans for analysis of PAHs in sediments (Blakley, 2003). The lowest concentration of interest was selected based on analytical measurement limits.

Table 2. Measurement Quality Objectives for PAHs.

Parameter	Accuracy (% of true value)	Precision Duplicate RPD)	Bias (% of true value)	Lowest Concentration of Interest
PAHs	± 65% SRM	25%	± 20% LCS	40 µg/Kg dry weight

RPD = relative percent difference
SRM = standard reference material
LCS = laboratory control samples

Representativeness

An attempt will be made to collect the sediment cores from the deep areas of the lakes far away from the shoreline. Sediments from these areas are typically fine-grained sediments providing an undisturbed, representative sample and minimizing the effects of any single sediment source entering the lake.

Completeness

The completeness target for the field study is 100%.

Comparability

Sediment cores will be collected by experienced Ecology crew members adhering to the guidelines set forth in the Environmental Assessment Program's standard operating procedure for sediment core collection (Furl, 2008 in preparation).

Sampling and Measurement Procedures

Sampling Procedures

Sediment core samples will be collected using the protocol previously described in the *Mercury in Sediment QA Project Plan.* Containers, preservation, and holding times for the added sediment samples are listed in Table 3.

Table 3. Container, Preservation, and Holding Time for Sediment Samples.

Analysis	Container*	Preservation	Holding time
PAHs	8-oz. Glass, Teflon-lid Liner	Freeze, -18° C Cool to 4° C	1 Year 14 Days

* Containers will be obtained from MEL

Measurement Procedures

The measurement procedures for the PAH analyses are listed in Table 4. Samples will be analyzed at MEL using EPA Method 8270. The individual PAH compounds to be analyzed are included in MEL's standard PAH list. See the Appendix for the complete list of compounds to be analyzed.

Table 4. Expected Range of Results and Measurement Procedures for PAH analyses.

Analysis	Number of Samples	Expected Range of Results	Reporting Limit	Method Description	Analytical Method
PAHs	33	0.04-30,000 mg/Kg dw	40 µg/Kg dw*	Capillary GC/MS	EPA 8270

*Varies depending on moisture in sediment

A more sensitive method for PAH analysis was considered but was decided against due to the contamination levels expected. High concentrations are expected at some sites, which would necessitate dilution of the samples under the SIM-modified method and could lower accuracy of results.

Quality Control

Field

As stated in the *Mercury in Sediment Cores QA Project Plan,* this project will not include field quality control samples.

Laboratory

Laboratory quality control measures will be taken by MEL to evaluate precision and bias of the analyses. The laboratory quality control procedures for PAH analyses are listed in Table 5. The maximum batch size is 20 samples.

Table 5. Laboratory Quality Control Procedures for PAH Analyses.

Analysis	Method Blanks	Check Std./LCS	Surrogate Spikes	Matrix Spike	Duplicates
PAHs	1/batch	1/batch	all samples	2/batch	1/batch

Surrogate spikes will be added to all samples. The compounds to be used as surrogates include 2-fluorobiphenyl, D-14 terphenyl, and D-10 pyrene.

Data Management Procedures

All data management procedures will follow those stated in the *Mercury in Sediment Cores QA Project Plan* (Coots, 2006).

Audits and Reports

In accordance with the *Mercury in Sediment Cores QA Project Plan,* MEL will be responsible for performance and system audits of laboratory procedures. Results of those audits are available upon request.

The project lead will complete a draft report of the study findings by February 2009 and a final report in May 2009. The following will be included in the final report, in addition to those sections already stated in the *Mercury in Sediment Cores QA Project Plan:*

- Results of the PAH analyses related to recommended standards.
- Graphical display and summary tables of the PAH data.
- Discussion of significant findings, PAH trends, and a comparison of concentrations between sites.
- Complete set of PAH data and MEL quality assurance review.

Data Verification

Data verification will be consistent with the *Mercury in Sediment Cores QA Project Plan.*

References

Blakley, N., 2003. Quality Assurance Project Plan: Little Squalicum Creek Biological Toxicity Assessment. Washington State Department of Ecology, Olympia, WA. Publication No. 03-03-110. www.ecy.wa.gov/pubs/0303110.pdf

Coots, R., 2006. Quality Assurance Project Plan: Depositional History of Mercury in Selected Washington Lakes Determined from Sediment Cores. Washington State Department of Ecology, Olympia, WA. Publication No. 06-03-113. www.ecy.wa.gov/pubs/0603113.pdf

Furl, C., 2008. Standard Operating Procedure for Obtaining Freshwater Sediment Core Samples. Washington State Department of Ecology, Olympia, WA. In preparation. www.ecy.wa.gov/programs/eap/quality.html

Gallagher, M., 2000. Proposed Strategy to Continually Reduce Persistent, Bioaccumulative Toxins (PBTs) in Washington State. Washington State Department of Ecology, Olympia, WA. Publication No. 00-03-054. www.ecy.wa.gov/pubs/0003054.pdf

Gallagher, M., 2007. Multiyear PBT Chemical Action Plan Schedule - Final. Washington State Department of Ecology, Olympia, WA. Publication No. 07-07-016. www.ecy.wa.gov/biblio/0707016.html

Geller, L., 2006. Washington State Polybrominated Diphenyl Ether (PBDE) Chemical Action Plan: Final Plan. Washington State Department of Ecology, Olympia, WA. Publication No. 05-07-048. www.ecy.wa.gov/biblio/0507048.html

Johnson, A., 2007. Quality Assurance Project Plan: A Trend Monitoring Component for Organic PBTs in the Washington State Toxics Monitoring Program. Washington State Department of Ecology, Olympia, WA. Publication No. 07-03-104. www.ecy.wa.gov/biblio/0703104.html

Johnson, A. and K. Seiders, 2005. Quality Assurance Project Plan: PBT Monitoring: Measuring PBDE Levels in Washington Rivers and Lakes. Washington State Department of Ecology, Olympia, WA. Publication No. 05-03-113. www.ecy.wa.gov/biblio/0503113.html

MEL, 2005. Manchester Environmental Laboratory Lab Users Manual, Eighth Edition. Washington State Department of Ecology, Manchester, WA.

Peele, C., 2003. Washington State Mercury Chemical Action Plan. Washington State Department of Ecology, Olympia, WA. Publication No. 03-03-001. www.ecy.wa.gov/biblio/0303001.html

Seiders, K., 2006. Quality Assurance Project Plan: Measuring Mercury Trends in Freshwater Fish in Washington State. Washington State Department of Ecology, Olympia, WA. Publication No. 06-03-103. www.ecy.wa.gov/biblio/0603103.html

cc: Carol Kraege, Solid Waste and Financial Assistance Program
Ken Zarker, Hazardous Waste and Toxics Reduction Program
Brandee Era-Miller, Environmental Assessment Program
Randy Coots, Environmental Assessment Program
Stuart Magoon, Manchester Environmental Laboratory
Bill Kammin, Ecology Quality Assurance Officer

Appendix. PAH compounds will be included in the sediment core analyses

Table A-1. PAH compounds to be included in the sediment core analyses.

Low-molecular weight PAHs	High-molecular weight PAHs	Substituted	Associated Compounds
Anthracene Acenaphthene Acenaphthylene Fluorene Naphthalene Phenanthrene	Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(ghi)perylene Benzo(k)fluoranthene Chrysene Dibenzo(a,h)anthracene Fluoranthene Indeno(1,2,3-cd)pyrene Pyrene	Retene 1-Methylnaphthalene 2-Chloronaphthalene 2-Methylnaphthalene	Carbazole Dibenzofuran