



**DOCUMENT TITLE: EPA-AO-021A – NTCRA for the River System SAP Supplement A (Resubmittal)**

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**SENT BY: Mike Houck**

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W – WITH ATTACHMENT  
 T – TRANSMITTAL ONLY  
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Document No. EPA-AO-021A

**Kingston Ash Recovery Project  
Non-Time-Critical Removal Action  
for the River System  
Sampling and Analysis Plan (SAP)  
Supplement A**

**Prepared by:  
Jacobs**

**for the Tennessee Valley Authority**

<b>Revision</b>	<b>Description</b>	<b>Date</b>
00	River SAP Supplement A for TVA Review	July 29, 2011
01	River SAP Supplement A for Regulatory Review	August 12, 2011
02	Revised to correct LCS and MS/MSD acceptance criteria in Tables E-8 and E-10	August 17, 2011

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## Attachments

- Attachment 1: Field Change Notices and Change Notices
- Attachment 2: Revised Sampling and Analysis Plan Appendices D and E

## List of Acronyms

CN	Change Notice
CRM	Clinch River Mile
EPA	U.S. Environmental Protection Agency
FCN	Field Change Notice
KIF	Kingston Fossil Plant
PCB	polychlorinated biphenyl
PLM	polarized light microscopy
PVC	polyvinyl chloride
SAP	Sampling and Analysis Plan
TVA	Tennessee Valley Authority

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## 1. BACKGROUND AND PURPOSE OF SUPPLEMENT A

### 1.1 BACKGROUND

In 2010, the *Kingston Ash Recovery Project Non-Time-Critical Removal Action for the River System Sampling and Analysis Plan (SAP)*, was reviewed and approved by the U.S. Environmental Protection Agency (EPA) and the Tennessee Department of Environment and Conservation. The SAP was released for public posting on May 24, 2010. The collection of biotic and abiotic media under the SAP has three primary objectives to support: a Preliminary Assessment of the Emory River and other river areas impacted by the spilled fly ash at the Tennessee Valley Authority (TVA) Kingston Fossil Plant (KIF) release in Roane County, Tennessee; an assessment of potential human health and ecological risks in the river; and decision-making for the restoration of impacted areas.

Due to funding constraints, all but one sampling task under the SAP were not initiated until the beginning of fiscal year 2011 in October 2010. The surface water sampling task was initiated on August 24, 2010 commensurate with the completion of all dredging activities in the Emory River.

### 1.2 PURPOSE OF SUPPLEMENT A

The purpose of this Supplement to the SAP is to document changes that have occurred since the SAP was implemented. Over the course of SAP implementation to date, a number of changes have been necessitated by field conditions, further consideration of the SAP objectives, and procurement of additional laboratories to accomplish the analyses specified in the SAP. In addition, further review in preparation for field implementation has identified a number of inconsistencies in Appendices D and E of the SAP. **It is noted that none of the changes or inconsistencies impact fulfillment of the Data Quality Objectives specified in the SAP. There have been no changes to the overall sampling design and procedures.**

The changes are described in two categories: Field Change Notices (FCNs)/Change Notices (CNs), and Errata. FCNs and CNs have been prepared to document changes necessitated by: field conditions (e.g., change in sample location due to inaccessibility); further review of sampling objectives and consideration of analytes; and, documentation in support of unspecified preservation methods and/or holding times for some biotic media. Errata include inadvertent omissions or incorrect citations, as well as references in the SAP that have been superseded by a revision to the *Quality Assurance Project Plan for the Tennessee Valley Authority Kingston Ash Recovery Project (TVA-KIF-QAPP)*. Errata are present in SAP Appendices D and E that summarize sample analyses, preservation, and holding times.

Section 2.0 summarizes the FCNs and CNs generated to date. Section 3.0 summarizes the Errata in Appendices D and E.

## 2. FIELD CHANGE NOTICES

Table 1 presents a listing of FCNs and CNs prepared to date. Copies of FCNs and CNs are provided in Attachment 1 of this Supplement to the SAP. Original signed FCNs and CNs are on file and recorded in the Kingston Ash Recovery Project Document Control office.

**Table 1. Field Change Notice and Change Notice as of July 25, 2011**

<b>FCN/CN #</b>	<b>Date</b>	<b>Title</b>	<b>Change</b>
FCN-001	04/28/10	Soil Metals Analysis from Well Borings	Addition of metals analysis to the soil borings collected at GW-01, GW-02, TWP-04, TWP-05, TWP-06.
FCN-002	06/8/10	Leaching Test – Hydraulic Conductivity Testing	Addition of Hydraulic Conductivity testing to ash and lime treated ash.
FCN-003	07/20/10	Bedrock Well Construction	Wells TWP-24, TWP-25, and TWP-26 will be installed using rotosonic drilling and rock coring techniques rather than hollow stem auger.
FCN-004	07/20/10	Surface Water Level Measurement Locations	Addition of 35 more locations for water level measurements to better refine the boundary conditions for the model.
FCN-005	07/27/10	Equipment Rinsate	Allowance for up to 2 additional equipment blanks for additional equipment types during GW drilling operations
FCN-006	03/11/10	Lime Addition – In Situ Application	Approval to add lime at a rate no greater than 6% dry weight to reduce the moisture of the ash.
FCN-006A	08/20/10	PVC Outer Casing For GW-01 and GW-03	Change well casing for GW-01 and GW-03 from metal to PVC.
FCN-007	08/10/10	Changes to Geoprobe Scope	Several planned Geoprobe locations eliminated due to inadequacy to seal off alluvium from overlying ash porewater and safety concerns.
FCN-008	10/10/10	Heron Colony Locations	Heron eggs unable to be collected from CRM 2.5 as the colony was inactive in 2010.
FCN-009	10/10/10	Egg Shell Analysis	A subset of tree swallow eggs will be selected for analysis of the egg shell, including eggs from 13 locations from potentially impacted areas and 7 reference sites.
FCN-010	06/8/10	Tree Swallow Nest Box Locations	Correct inconsistencies with tree swallow nest box locations between Section 3.9, Figure 3-16, and Appendix A.
FCN-011	10/10/10	Addition of Strontium to All SAP Media Analyses	Strontium added to list of requested metals analyzed in all sample media to support ongoing ecological studies.
FCN-012	10/10/10	Arsenic Speciation Reduction in Shad	Reduction from 100 to 25% of shad samples for arsenic speciation.
FCN-013	12/3/10	Chromium VI and Mercury Speciation Elimination	Elimination of chromium VI and mercury speciation in surface water samples.
FCN-014	01/10/11	Justification for 12-week Holding Time for Sediment Toxicity Testing Samples	Holding time extension from 8 weeks to 12 weeks for sediment toxicity testing.

**Table 1. Field Change Notice and Change Notice Status as of July 25, 2011**  
(continued)

FCN/CN #	Date	Title	Change
FCN-015	10/10/10	Chemical Analysis of Water for Toxicity Tests	Addition of chemical analyses of the surface water used for toxicity testing.
FCN-016	01/25/11	Elimination of Aroclor 1262 and 1268	Elimination of Aroclor 1262 and 1268 from sediment sampling MAG.
FCN-018	01/31/11	Use of Compositing for Analysis of Fish Fillets Samples for Selected Constituents	Due to sample size limitations of the bluegill specimens, compositing of filets will be implemented for Pest, PCB, and radiological analyses.
FCN-019	01/31/11	Change in Holding Time for Fish Fillet Samples	Change in fish fillet holding times for frozen samples to one year.
FCN-020	01/25/11	Addition of PLM on Submerged Sediments sent for Toxicity Testing and Porewater Extraction	Addition of PLM to submerged sediments sent for toxicity testing and porewater extraction.
FCN-021	01/27/11	Addition of Metals Analysis on Composited Porewater-Extracted Sediments	Addition of metals analysis to composited porewater-extracted sediments
KRP-CN-001	04/19/11	Well Installation Materials and Equipment Changes	Allows for the use of decontaminated stainless steel split spoons, a fluid rotary rig, and use of longer screens (20 ft).
KRP-CN-002	03/29/11	Additional Laboratory PLM Analyses In VibeCore Sediment Samples from the Clinch, Emory, and Tennessee Rivers	Adds laboratory confirmation of all PLM samples with field PLM results >50%.
KRP-CN-003	07/13/11	Groundwater Sampling	Update Table 2 of GW sampling SOP TVA-KIF-SOP-02 with currently used field form "Preliminary Groundwater Data Field Worksheet".
KRP-CN-004	07/13/11	Periphyton Sampling	Update TVA-KIF-SOP-59 for Periphyton Sampling to reflect actual sampling in the boat, rather than transporting the periphytometers back to a location on shore for sampling.
KRP-CN-005	06/27/11	Radionuclide and Metals Speciation Holding Times Changes (fish) and Various other Edits to Appendices D and E of the SAP	Extend frozen fish holding times for radionuclides and metals speciation to one year, and various other edits and updates to SAP Appendices D and E.

**Note:** For definitions, see the List of Acronyms section.

### 3. ERRATA

Errata include inadvertent omissions, incorrect citations, as well as references in the SAP that have been superseded by a revision to the TVA-KIF-QAPP. Errata are present in SAP Appendices D and E that summarize sample analyses, preservation, and holding times. Revised SAP Appendices D and E are provided as Attachment 2 of this Supplement to the SAP.

## 4. REFERENCES

Environmental Standards, Inc. 2009 (December 18). *Quality Assurance Project Plan for the Tennessee Valley Authority Kingston Ash Recovery Project. TVA-KIF-QAPP*. Prepared for the Tennessee Valley Authority, Office of Environment and Research, Environmental Resources.

Jacobs Engineering Group Inc. 2010 (June 1, EPA approval). *Kingston Ash Recovery Project Non-Time-Critical Removal Action for the River System Sampling and Analysis Plan (SAP)*. Document No. EPA-AO-021. Prepared for the Tennessee Valley Authority.

## **ATTACHMENT 1**

### **Field Change Notices and Change Notices**



# Kingston Ash Recovery Project Field Change Notice (FCN)

## FCN

FCN Number: FCN-001

FCN Title: Soil Metals Analysis from Well Borings

Task: WBS0111: Final Remediation – Groundwater Modeling Task

### Documents Affected by This FCN

Document Number	Revision	Document Title
EPA-A0-021	Rev. 02	Sampling and Analysis Plan for the River System

References/Work Package (if applicable): MACTEC drilling contract (T.O. # )

**Description of Change:**

Collect one soil sample from the center of the screened interval in wells GW-01, GW-02, TWP-04, TWP-05, and TWP-06. Analyze the samples for metals (antimony, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, lead, mercury, nickel, selenium, silver, thallium, vanadium, and zinc).

**Reason for Change/Information Requested:**

Metals may be present in soil within the screened zone of the aquifer that may affect groundwater quality locally in a well. Samples of residuum/alluvium soil should be tested for metals to verify whether future groundwater monitoring results can be correlated to a very localized aquifer formation chemistry.

There are currently no metals data for residuum/alluvium soil in the Dredge Cell area; these data could augment regional soil data for naturally-occurring metals.

**Impact if Change Made:**

Must verify that MACTEC has suitable stainless steel or lined split-spoon sampling device to avoid contaminating sample. Will need to decon the sampler between soil samples. Will need to collect one equipment rinse sample and one duplicate sample for QC. Need to verify that listed metals are consistent with Kingston Ash Recovery Project list of metals. Need to develop appropriate COCs, contact the laboratory, obtain proper containers with preservative.

Estimated cost impact: Expected to be ~\$150/sample for analytical and shipping, plus ~4 hrs data validation and data management = \$1,450.00. No change to MACTEC contract anticipated.

Estimated schedule impact: Negligible.

**Impact if Change not Made:**

Future groundwater monitoring results may indicate levels of metals that are not representative of area-wide levels; may have to conduct further study to find cause of an anomaly.

Requested Date of FCN Disposition: April 28, 2010.

Requestor	Date	Field Engineer	Date
Matt Williams	April 28, 2010	Chun-Yi Wang	April 28, 2010



# Kingston Ash Recovery Project Field Change Notice (FCN)

Response/Disposition of the FCN			
FCN Approval:		FCN Incorporation by DCN Required:	
Approved <input checked="" type="checkbox"/> (see remarks below, if any)	Disapproved <input type="checkbox"/> (see remarks below)	Yes <input type="checkbox"/>	No <input checked="" type="checkbox"/>
<b>Response/Remarks :</b> Per discussions between Matt Williams and Bruce Haas, agree to the change provided this doesn't impact the drilling progress and that the actions identified above in "Impact if Change Made" are taken.			
Lead Engineer/EOR	Date	Project Manager (if required)	Date
N/A		<i>[Signature]</i>	4/30/2010



# Kingston Ash Recovery Project Field Change Notice (FCN)

FCN				
FCN Number: FCN-002		FCN Title: Leaching Test - Hydraulic conductivity testing		
Task Name: WBS 011504 River Restoration - Data Collection; Leaching Test Plan				
Documents Affected by This FCN				
Document Number	Revision	Document Title		
RAWP-072	01	Ash Leaching Test Plan		
EPA-AO-021	03	Sampling and Analysis Plan (SAP) for the River System		
References/Work Package (if applicable): See test plan				
Reason for Change/Information Requested: Hydraulic conductivity data are desirable for use in the groundwater modeling, to determine differences between permeability characteristics of compacted ash and lime-treated ash.				
Existing Condition: No samples of compacted ash or lime-treated ash are to be tested for hydraulic conductivity in either the leaching test or SAP. AECOM data can be used to characterize sluiced ash, but parametric assumptions would have to be used to characterize compacted dry ash or lime-treated ash.				
Description of Change: Collect 3 samples of ash and one of lime. Prepare 3 samples in the lab by compacting to approximately 90% ASTM D 698 dry density (a target of 80 pcf dry density per prior Proctor tests). Similarly, prepare 3 samples of lime-treated ash in the lab by adding 6% by dry weight lime, compacting to a target of 85 pcf, Test samples for saturated hydraulic conductivity per ASTM D 2434. Send samples to DB Stephens Laboratory, Joleen Hines, 505-889-7752.				
Requested Date of FCN Disposition:				
Requestor	Date	Field Engineer	Date	
Mark Boggs	6/8/2010			
Response/Disposition of the FCN				
FCN Approval:		FCN Incorporation by DCN Required:		
Approved <input checked="" type="checkbox"/>	Disapproved <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
(see remarks below)		(see remarks below)		
Response/Remarks : Expected cost of change: \$500 to collect samples; \$100 shipping and supplies; \$1,000 testing.				
Lead Engineer/EOR	Date	Project Manager	Date	
Don Fuller/Stantec	N/A	Bruce Haas/JACOBS	6/8/2010	



**KINGSTON ASH RECOVERY PROJECT  
FIELD CHANGE NOTICE (FCN)**

FCN Number: FCN-003	FCN Title: Bedrock Well Construction
Project Name: WBS 011504 River Restoration Data Collection	

**Document(s) Affected by this Field Change Notice**

Document Number	Revision	Document Title
EPA-AO-021	Rev. 3	Non-Time-Critical Removal Action for the River System, Sampling and Analysis Plan (SAP)

**References/Work Package (if applicable):**

Mactec well drilling

**Reason for Change/Information Requested:**

Drilling technique for installing wells could result in undesirable vibrations within the Dredge Cell dikes; roto sonic techniques will reduce vibrations. Characterization of the flow regime in the weathered bedrock interface will enhance the model calibration. Bedrock water quality cannot be measured in the interface well; however, bedrock water quality will be measured at 2 other bedrock wells, so the loss of data in the one well will not impair the model calibration.

The reason for this change is to allow for direct testing of the weathered bedrock zone, to make sure the range of horizontal conductivities through this zone are within expectation, based on other sites in the region. The reason why we are selecting TWP-24 for the interface well is because we expect it to have the thickest strata of weathered bedrock.

**Existing Condition:**

Wells TWP-24, -25, and -26 were to be installed per the SAP using hollow-stem auger techniques to collect data on hydraulic conductivity and aqueous-phase concentrations in bedrock within the Dredge Cell/Ash Pond. Preliminary well design anticipated installing a surface casing to a nominal depth of 5 feet into top of rock, and open-hole rock core 25-ft below the surface casing.

**Description of Change:**

Wells TWP-24, -25, and -26 will be installed using roto sonic drilling and rock coring techniques.

Wells TWP-25 and -26 will be installed by setting a 5-inch-diameter PVC surface casing 5-ft into top of weathered bedrock. The casing will be sealed with grout and allowed to cure for a 24-hr period. Bedrock will be cored to a 25-ft depth. The wells will be open-hole wells.

Well TWP-24 will be installed by roto sonic drilling a minimum 3.8-inch-diameter borehole down approximately 17 feet into bedrock, beneath the rock-alluvial interface. A 2-inch-diameter PVC screen/riser with centralizers will then be installed. The screen will have a 2-ft "blank" (unperforated) section in the bottom to allow for instrument calibration. The screen will extend from immediately above the blank section, to near the top of the rock (2" below the top of the rock-alluvium interface). Sand will be tremmied into the borehole, to rise 2 to 3 inches above the top of the screen. There will be approximately 5' of bentonite placed on top of the sand, with grout on top of that rising to the surface.

**Requested Date of FCN Disposition:**

Requestor	Date	Field Engineer	Date
Matt Williams	7/20/2010	N/A	



FCN Number: FCN-003	FCN Title: Bedrock Well Construction
Project Name: KINGSTON ASH RECOVERY PROJECT, WBS 011504 River Restoration Data Collection	

Response/Disposition of the Field Change Notice	
FCN Approval:	<input checked="" type="checkbox"/> Approved (see remarks below, if any) <input type="checkbox"/> Disapproved (see remarks below)
FCN Incorporation by DCN Required:	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
Response/Remarks :	

Name	Signature	Date
Mark Boggs Lead Engineer / Engineer of Record	<i>BH for M. Boggs per email</i>	7/21/2010
Bruce Haas Project Manager (if required)	<i>[Signature]</i>	7/21/2010



**KINGSTON ASH RECOVERY PROJECT  
FIELD CHANGE NOTICE (FCN)**

FCN Number: FCN-004	FCN Title: Surface Water Level Measurement Locations
Project Name: WBS 011504 River Restoration Data Collection	

**Document(s) Affected by this Field Change Notice**

Document Number	Revision	Document Title
EPA-AO-021	Rev. 3	Non-Time-Critical Removal Action for the River System, Sampling and Analysis Plan (SAP)

**References/Work Package (if applicable):**  
TVA land surveying team

**Reason for Change/Information Requested:**  
Additional locations surrounding the site on the Swan Pond Embayment, Emory River, Intake Channel, Sluice Channel, and Ash Pond/Stilling Pond will better refine the boundary conditions for the model.

**Existing Condition:**  
The SAP shows 4 surface water locations for measurement of water levels: two in the Ash Pond/Stilling Pond and two in the Sluice Channel. River Water levels would have been taken from TVA river operations reports.

**Description of Change:**  
Add 35 more sampling points, per attached. Report water levels to within 0.01 ft vertical. Date of survey should coincide with site-wide water level measurements by Stantec/TVA in piezometers & wells.

**Requested Date of FCN Disposition:**

Requestor	Date	Field Engineer	Date
Matt Williams	7/20/2010	N/A	

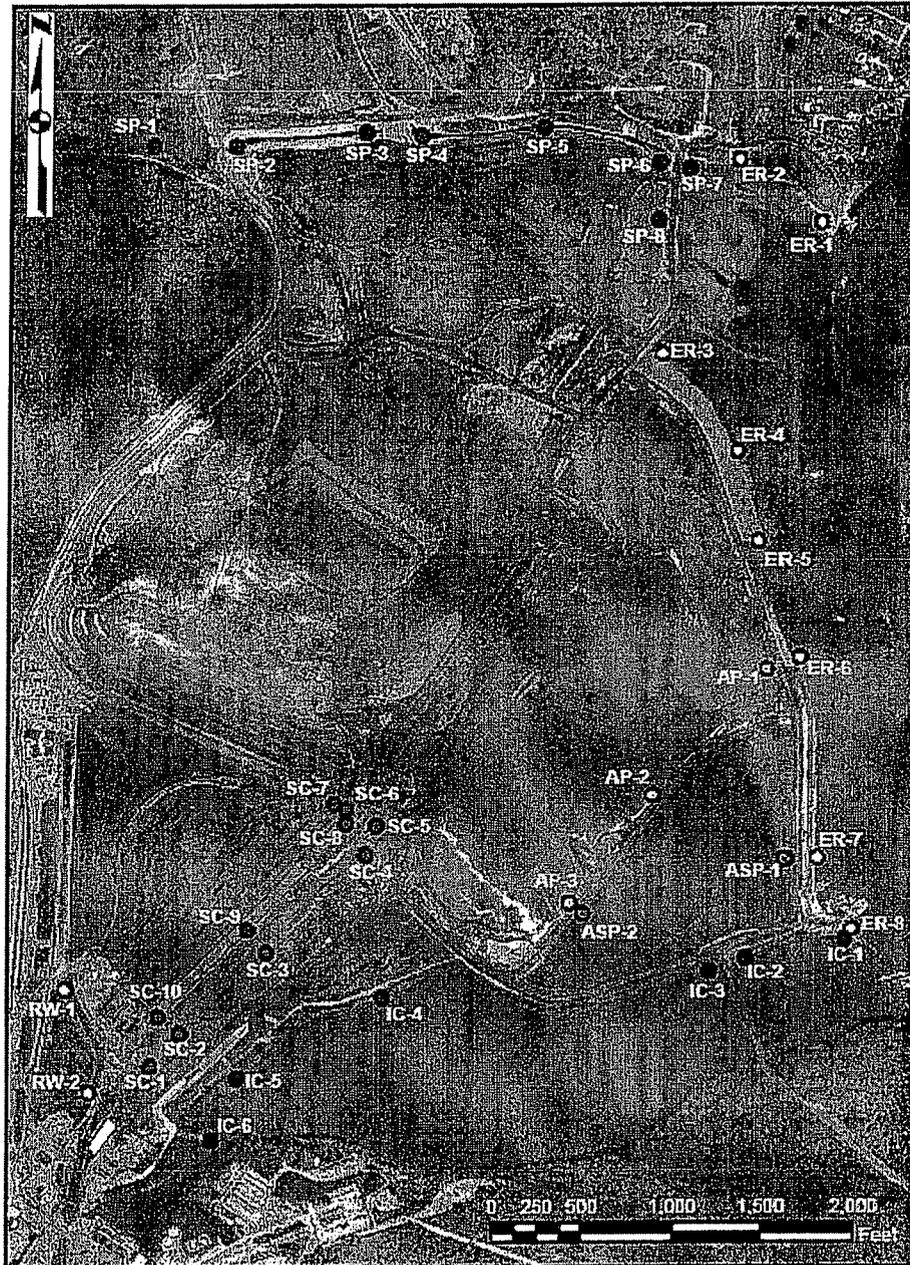
**Response/Disposition of the Field Change Notice**

<b>FCN Approval:</b>	<input checked="" type="checkbox"/> Approved (see remarks below, if any) <input type="checkbox"/> Disapproved (see remarks below)
<b>FCN Incorporation by DCN Required:</b>	<input type="checkbox"/> Yes <input checked="" type="checkbox"/> No
<b>Response/Remarks :</b>	

Name	Signature	Date
Mark Boggs Lead Engineer / Engineer of Record		7/21/2010
Bruce Haas Project Manager (if required)		7/21/2010



TN State Plane, NAD27, feet				
Location_ID	X	Y	Feature	Symbol_Color
SP-1	2,439,256	558,324	Swan Pond Creek	Purple
SP-2	2,439,722	558,320	Swan Pond Creek	Purple
SP-3	2,440,441	558,395	Swan Pond Creek	Purple
SP-4	2,440,733	558,387	Swan Pond Creek	Purple
SP-5	2,441,439	558,420	Swan Pond Creek	Purple
SP-6	2,442,078	558,224	Swan Pond Creek	Purple
SP-7	2,442,245	558,195	Swan Pond Creek	Purple
SP-8	2,442,074	557,911	Swan Pond Creek	Purple
ER-1	2,442,971	557,894	Emory River	Yellow
ER-2	2,442,528	558,242	Emory River	Yellow
ER-3	2,442,102	557,173	Emory River	Yellow
ER-4	2,442,528	556,637	Emory River	Yellow
ER-5	2,442,645	556,142	Emory River	Yellow
ER-6	2,442,866	555,499	Emory River	Yellow
ER-7	2,442,965	554,393	Emory River	Yellow
ER-8	2,443,157	554,003	Emory River	Yellow
IC-1	2,443,119	553,947	Intake Channel	Red
IC-2	2,442,583	553,837	Intake Channel	Red
IC-3	2,442,377	553,770	Intake Channel	Red
IC-4	2,440,554	553,631	Intake Channel	Red
IC-5	2,439,748	553,190	Intake Channel	Red
IC-6	2,439,605	552,847	Intake Channel	Red
ASP-1	2,442,795	554,386	Ash Stilling Pond	Blue
ASP-2	2,441,674	554,088	Ash Stilling Pond	Blue
AP-1	2,442,697	555,434	Ash Pond	Green
AP-2	2,442,060	554,739	Ash Pond	Green
AP-3	2,441,602	554,146	Ash Pond	Green
RW-1	2,438,786	553,679	Red Water Channel	White
RW-2	2,438,920	553,114	Red Water Channel	White
SC-1	2,439,256	553,255	Sluice Channel	Magenta
SC-2	2,439,429	553,435	Sluice Channel	Magenta
SC-3	2,439,911	553,878	Sluice Channel	Magenta
SC-4	2,440,459	554,416	Sluice Channel	Magenta
SC-5	2,440,517	554,576	Sluice Channel	Magenta
SC-6	2,440,353	554,666	Sluice Channel	Magenta
SC-7	2,440,353	554,587	Sluice Channel	Magenta
SC-8	2,440,287	554,694	Sluice Channel	Magenta
SC-9	2,439,807	554,003	Sluice Channel	Magenta
SC-10	2,439,301	553,528	Sluice Channel	Magenta





**KINGSTON ASH RECOVERY PROJECT  
FIELD CHANGE NOTICE (FCN)**

<b>FCN Number:</b>	FCN-005	<b>FCN Title:</b>	Equipment Rinseate
<b>Project Name:</b>	WBS 011504 River Restoration Data Collection		

DOCUMENT(S) AFFECTED BY THIS FIELD CHANGE NOTICE		
Document Number	Revision	Document Title
EPA-AO-021	Rev. 3	Non-time Critical Removal Action for the River System, Sampling and Analysis Plan

**References/Work Package (if applicable):**  
 MACTEC Groundwater Well drilling operations

**Reason for Change/Information Requested:**  
 Current budget allows for only one (1) equipment rinseate per project for metals sampling procedure. An equipment rinseate is needed after each type of equipment is used. There are two types of equipment that are currently being used for the metals sampling process: a split spoon and a 4-inch casing (a third could possibly be used also).

**Existing Condition:**  
 Current budget allows for only 1 (one) rinseate for the project and assumed all sediment samples would be collected from the same equipment using the same method.

**Description of Change:**  
 Allow for up to two (2) additional equipment rinseates to allow QC and data validation for each method of collection.

<b>Requested Date of FCN Disposition:</b>			
<b>Requestor</b>	<b>Date</b>	<b>Field Engineer</b>	<b>Date</b>
Ramona Josefczyk	7-27-10	N/A	N/a

RESPONSE/DISPOSITION OF THE FIELD CHANGE NOTICE	
<b>FCN Approval:</b>	<input checked="" type="checkbox"/> Approved (see remarks below, if any) <input type="checkbox"/> Disapproved (see remarks below)
<b>FCN Incorporation by DCN Required:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Response/Remarks :</b>	

Name	Signature	Date
SHANNON MCKAMEY Lead Engineer / Engineer of Record		8-17-10
BRUCE HAAS Project Manager (if required)		8-17-10



KINGSTON ASH RECOVERY PROJECT  
FIELD CHANGE NOTICE (FCN)

FCN Number:	FCN-006	FCN Title:	Lime Addition
Project Name:	WBS 0112 Embayment Restoration; WBS 0113 Failed Dredge Cell		

DOCUMENT(S) AFFECTED BY THIS FIELD CHANGE NOTICE

Document Number	Revision	Document Title
RDP-0113-C	100%	Interim Ash Stacking & Instrumentation
RDP-0112-A	100%	Swan Pond Embayment Ash Removal (Phase 1)

References/Work Package (if applicable): RAWP-072A, Ash Leaching Test Results. Results concluded that lime applied at 6% by weight is acceptable for use in treating the ash to reduce its moisture content.

Reason for Change/Information Requested: Design specifications for RDP-0112-A and RDP-0113-C do not address addition of lime to reduce the moisture content in the excavation ash and associated sediment material to meet the percent moisture content required for completed ash stacking lifts. This change would allow application of lime, either in the embayment at the time of excavation or in the Dredge Cell at the time of compaction, so as to meet moisture content requirements.

Existing Condition: Ash stacking specifications require a moisture content range of -4 to +2% of optimum for completed lifts. Heavy rains and wet subgrade conditions have resulted in ash in the embayment and in the surface of the Dredge Cell that exceed the 2% maximum limit.

Description of Change: Lime may be added at a rate no greater than 6% by dry weight of embankment material, as described in attached scope of work.

Requested Date of FCN Disposition:			
Requestor	Date	Field Engineer	Date
Steve Cherry	12/13/2010	Randy Denton	12/13/2010

RESPONSE/DISPOSITION OF THE FIELD CHANGE NOTICE

FCN Approval:  Approved (see remarks below, if any)  
 Disapproved (see remarks below)

FCN Incorporation by DCN Required:  Yes  No

Response/Remarks : Lime application will not adversely affect embankment material strength; instead will likely increase its strength. Therefore, no DCN required.

Name	Signature	Date
<u>Don Fuller</u>	<u>[Signature]</u>	<u>12/14/10</u>
Lead Engineer / Engineer of Record		
<u>Bruce Haas</u>	<u>[Signature]</u>	<u>12/14/10</u>
Project Manager		

Lime Kiln Dust (LKD) is a by-product of the production of Quicklime (lime). Quicklime is produced by calcining limestone in high temperature rotary kilns. During production, the kiln draft pushes fine particles (LKD) into the bag house for collection. The resulting chemistry of LKD is 70% - 80% CaO (lime), 2% - 8% MgO, and small amounts of Al<sub>2</sub>O<sub>3</sub> and SiO<sub>2</sub>. Lime Kiln Dust is primarily used in soil drying and soil stabilization applications and in several environmental applications such as coal mine refuse treatment, flue-gas treatment, and site remediation applications.

Work Plan for TVA-Kingston Lime will be added to the ash and associated sediment material, either in the embayment at the time of excavation or in the Dredge Cell at the time of compaction, so as to meet moisture content requirements for stacking in the Dredge Cell.

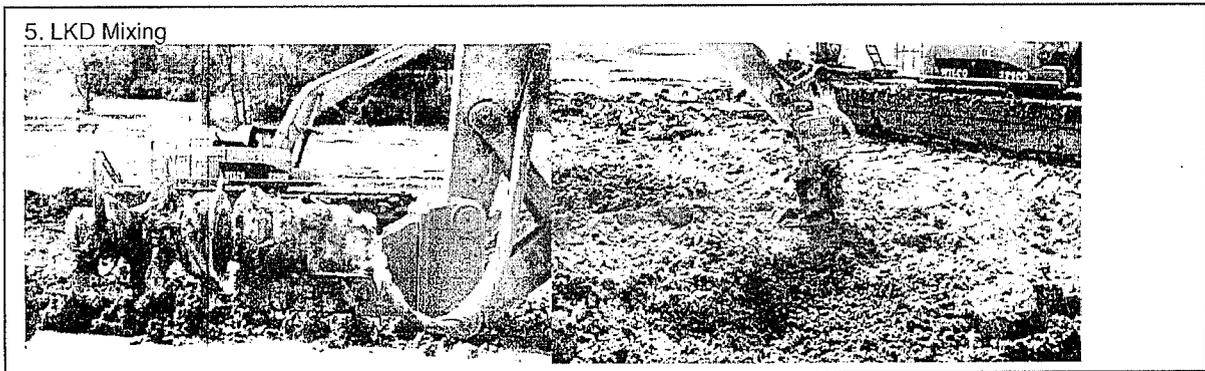
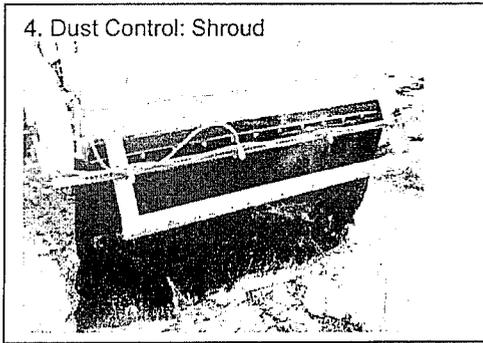
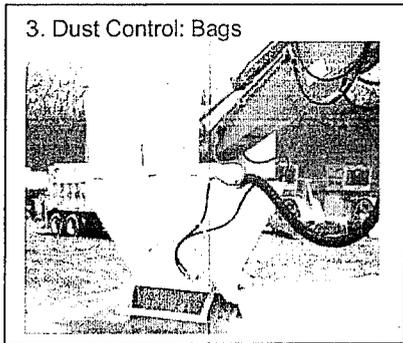
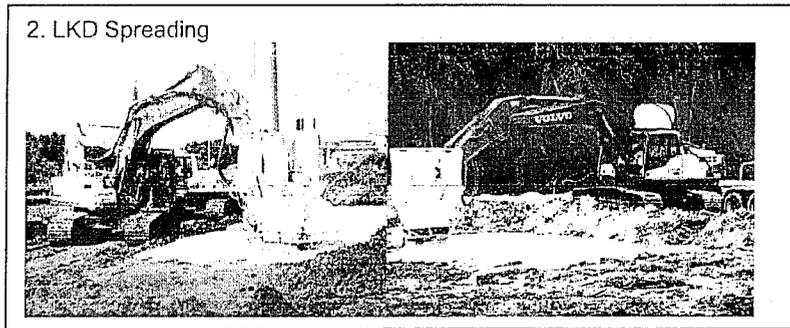
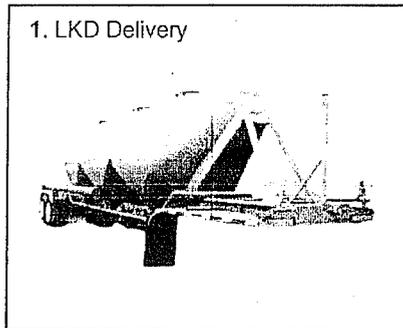
1. Lime will be added only as needed. Because of the additional cost and time to add lime to the excavated material, it is preferred to use untreated ash whenever possible. CP will use a combination of surface grading to shed rainwater runoff, stockpiling to enhance drying by drainage, windrowing and/or disking to enhance drying by evaporation, and similar traditional construction techniques to optimize dewatering without the need for lime addition. When conditions are wet and material cannot be adequately dried, then lime may be added.
2. Lime will be added to a maximum of 6% by dry weight. The LKD application rate will be determined based on the moisture content of the ash and the desired moisture content upon completion of mixing. The amount of lime to be added to a given area will be determined by measuring the size of the treatment area (square feet) and depth of treatment zone (feet) to obtain untreated volume. Excavated ash may be placed in "pits" for use in mixing lime. In-place density and in-place moisture content tests will be measured at a minimum of 5 points within the treatment area to obtain the average dry unit weight (pounds per square foot) of untreated material. The volume will be multiplied by the dry unit weight to obtain the dry weight (pounds) of untreated material. The dry weight will be multiplied by 0.06 to obtain the maximum weight of lime that may be added. During lime addition, the actual weight of lime spread across the treatment area will be determined by counting the number (weight) of bags used. The following LKD application rate chart is based on a dry ash weight of 75 lbs/cubic foot (or 2,025 lbs/cubic yard).

LKD Application Rate (LKD lbs/CY)	LKD Application Rate Percentage of Ash
20.5	1%
41	2%
61.5	3%
82	4%
102.5	5%
<b>123</b>	<b>6%</b>
143.5	7%
167	8%
187.5	9%
208	10%
228.5	11%
249	12%

The 6% highlighted application rate will be the maximum rate of application for this project, and will be controlled based on the amount of ash being treating in a given area. Based on these figures, 1 ton of LKD can treat up to 16.3 CY of ash. The application rate will vary based on moisture content, with the goal being to spread and mix the minimum amount of LKD in order to effectively dry the ash.

3. Lime will be applied uniformly across the treatment area using an Ecto-Spreader™, then disked into the surface using a specialized mixing attachment. Lime application will use the following method:
  - a. The first step in the process is the delivery of the dry bulk LKD (Figure 1). The LKD will be delivered to the site in pneumatic tankers and transported to the area where lime is being applied.
  - b. The pneumatic tankers will be connected by a hose to the Ecto-Spreader™ mounted on a track-hoe excavator (Figure 2). The LKD will be blown from the tanker into the Ecto-Spreader™ constantly during spreading. LKD will be blown into the hopper and gravity fed to the rotary vein-feeder, allowing the LKD to exit the spreader at a controlled rate. The speed of the vein-feeder can be adjusted to increase or decrease the application rate of the LKD. To accomplish spreading over a large area, the excavator arm will be moved back and forth and side to side.
  - c. The Ecto-Spreader™ is equipped with several dust control features. Bags (Figure 3) mounted to the top of the spreader serve a dual purpose: (1) they act as an air vent so the hopper can receive material pneumatically and (2) they also act as dust collectors during transfer of material to the hopper. Material collected in the bags will return to the hopper once it is no longer pressurized.

- d. Another dust control feature (Figure 4) is a shrouded spray system that uses atomized water to blow small amounts of water under high pressure down from the vein feeder to the ground. This system aids in reducing or eliminating what little fugitive dusting may occur during spreading. The water is contained in a small reservoir on the excavator. There is also a shroud made of lightweight, very durable and flexible material that extends from the hopper to the ground. The shroud will drag on the ground and prevent the LKD from being exposed to the open air during spreading. The LKD material will travel from the vein feeder, through the shroud, to the ash being treated. This eliminates the LKD free-falling in the open air, which is the main cause of fugitive dust during spreading.
- e. Mixing the LKD and ash will begin immediately after the LKD is spread and will be accomplished using a specialized mixing attachment on the track hoe excavator (Figure 5). This mixer attachment was used previous during the time-critical work for the Kingston Ash Recover Project. The mixer provides thorough mixing of the ash and LKD to a depth of over 3 feet. Once the LKD and ash are mixed, the ash is ready for loading and transport to the area where it will be stacked.
- f. Each Ecto-Spreader™ has the capability to spread a 25-ton load of LKD in approximately 40 minutes. Site conditions will likely allow the spreading of 6-9 loads of LKD per day per spreader.



Tennessee Valley Authority  
Regulatory Submittal for Kingston Fossil Plant

Documents submitted:

Non-Time- Critical Removal Action Field Change Notice for Lime Addition

Date Submitted:

12/14/2010

Submitted to whom

Craig Zeller, EPA

Concurrence

Received

Not Applicable

TVA

Steve McCracken  
Kathryn Nash  
Steve Cherry  
Michelle Cagley

Received

Not Applicable

Jacobs

Jack Howard  
Bruce Haas

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\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Approvals

TVA

Kathryn Nash

Date

12/14/10

EPA

Cagley

Date

1/08/11

cc:

- Anda Ray, TVA
- Barbara Scott, TDEC
- Brenda Brickhouse, TVA
- John Dizer, TVA
- Craig Zeller, EPA
- Dennis Yankee, TVA
- Kathryn Nash, TVA
- Cynthia Anderson, TVA
- Steve McCracken, TVA
- EDM
- Julie Pfeffer, Jacobs
- Jack Howard, Jacobs
- Michelle Cagley, TVA
- Greg Signer, TVA
- KIF Incident Document Control
- Katie Kline, TVA
- Dannena Bowman, EPA
- Robert Pullen, Jacobs



**KINGSTON ASH RECOVERY PROJECT  
FIELD CHANGE NOTICE (FCN)**

<b>FCN Number:</b>	FCN-006A	<b>FCN Title:</b>	PVC Outer Casing for GW-01 and GW-03
<b>Project Name:</b>	WBS 011504 River Restoration Data Collection		

DOCUMENT(S) AFFECTED BY THIS FIELD CHANGE NOTICE			
Document Number	Revision	Document Title	
EPA-AO-021	Rev. 3	Non-time Critical Removal Action for the River System, Sampling and Analysis Plan	
<b>References/Work Package (if applicable):</b> MACTEC Groundwater Well drilling operations			
<b>Reason for Change/Information Requested:</b> Current design calls for installation of metal outer casing for Monitoring Wells GW-01 and GW-03. After discussion with representatives of TVA, it would be more desirable to have a PVC outer casing so that future groundwater samples will not show potential metals contamination during testing.			
<b>Existing Condition:</b> Outer casings at locations GW-01 and GW-03 call out for 6.25-inch steel type casing.			
<b>Description of Change:</b> Outer casings at locations GW-01 and GW-03 will now be Schedule 40 PVC (6.25-inch).			
<b>Requested Date of FCN Disposition:</b>			
<b>Requestor</b>	<b>Date</b>	<b>Field Engineer</b>	<b>Date</b>
Ramona Josefczyk	8-20-10	N/A	N/a

RESPONSE/DISPOSITION OF THE FIELD CHANGE NOTICE	
<b>FCN Approval:</b>	<input checked="" type="checkbox"/> Approved (see remarks below, if any) <input type="checkbox"/> Disapproved (see remarks below)
<b>FCN Incorporation by DCN Required:</b>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<b>Response/Remarks :</b>	

Name	Signature	Date
SHANNON MCKAMEY Lead Engineer / Engineer of Record		8-20-10
Project Manager (if required)		8-20-10



**KINGSTON ASH RECOVERY PROJECT  
FIELD CHANGE NOTICE (FCN)**

<b>FCN Number:</b>	FCN-007	<b>FCN Title:</b>	Changes to Geoprobe Task Scope
<b>Project Name:</b>	River Restoration WBS 01.15.04 Environmental Data Collection		

DOCUMENT(S) AFFECTED BY THIS FIELD CHANGE NOTICE		
Document Number	Revision	Document Title
EPA-A0-021	Rev. 03	Sampling and Analysis Plan (SAP) for the River System

**References/Work Package (if applicable):**

WP-1056 9/23/10

**Reason for Change/Information Requested:**

1. Geoprobe equipment will not adequately seal off the alluvium from the overlying ash porewater. Monitor wells provide adequate locations for groundwater samples from the alluvium.
2. Several SAP-proposed geoprobe locations could not be safely accessed as they were in the Stilling Pond or Ash Pond. There was not a safe way to mobilize a geoprobe rig (e.g., barge) to these points. The permanent monitoring wells will generate sufficient data to represent porewater in ash below the ponds and meet data quality objectives.
3. Ash samples for column test leaching from the geoprobe investigation are no longer required. The column testing with treated (lime) and untreated ash samples collected from the dredge cell will generate sufficient data to meet data quality objectives.
4. Geoprobe sample locations were not surveyed by a licensed land surveyor. Locations are not permanent and will not be used for subsequent data collection. Handheld GPS units recorded the elevation and location of each point.
5. Clarification of the number of geoprobe sampling locations.
6. Boring logs were not prepared for geoprobe locations, as the borings were through ash only and not through ash to alluvium (see item 1 above).

**See attached e-mails for further documentation.**

**Existing Condition:**

1. SAP proposed 3 samples from the alluvium at GP-9, 12, 15.
2. SAP proposed samples at locations GP-17, 19, 20, and 21 that are in the Ash or Stilling Pond.
3. SAP proposed samples at locations GP-7, 8, 12, 15, and 16.
4. SAP Section 5.0 specified that all completed wells, temporary well points, and boreholes would be surveyed by a licensed land surveyor.
5. Table 3-1 of the SAP cites 15 locations, Appendix D cites 18 locations, and Section 2 of the SAP cites 16 locations.
6. SAP Section 5.0 proposed that boring logs be completed for these locations.

**Description of Change:**

1. Alluvial samples at GP-9, 12, 15 were eliminated.



2. Eliminate samples at locations GP-17, 19, 20, and 21 due to safety concerns.
3. Eliminate column test leaching samples at locations GP-7, 8, 12, 15, and 16.
4. Record elevation and location of each geoprobe sampling location by handheld GPS unit.
5. The total number of locations sampled by geoprobe is 11 (GP-7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 18).
6. Boring logs were not completed; however, boring descriptions of the ash were kept in the field logbook.

Requested Date of FCN Disposition:			
Requestor	Date	Field Engineer	Date
Adam Johnson	8/10/10		

RESPONSE/DISPOSITION OF THE FIELD CHANGE NOTICE	
FCN Approval:	<input checked="" type="checkbox"/> Approved (see remarks below, if any) <input type="checkbox"/> Disapproved (see remarks below)
FCN Incorporation by DCN Required:	<input type="checkbox"/> Yes <input type="checkbox"/> No
Response/Remarks :	

Name	Signature	Date
Lead Engineer / Engineer of Record		
Paul Clay		1/24/11
Project Manager (if required)		

**From:** Haas, Bruce J  
**Sent:** Tuesday, August 24, 2010 2:08 PM  
**To:** Clay, Paul F; Johnson, Adam Paul  
**Subject:** FW: Leaching Test

Looks like Mark no longer wants to test the ash leaching beyond the leaching test already done. So, no need to take any more samples at all – if we did and just held them, we'd exceed holding times anyway.

**From:** Boggs, J Markus  
**Sent:** Tuesday, August 24, 2010 2:03 PM  
**To:** Haas, Bruce J  
**Cc:** 'HJulian@Geosyntec.com'; 'changsheng.lu@jacobs.com'; Williams, Matthew Dallas  
**Subject:** RE: Leaching Test

Bruce - I suggest we postpone ash sampling until need becomes clear. We are running some preliminary transport simulations with model initially set up for landfill mounding evaluation. Early results indicate we might not need refinement of ash source term in order to stay below HHS/aquatic limits in river, although further work is needed to confirm. Note that ash and natural media porewater sampling is still required for transport modeling and should not be delayed. Please call if you want to discuss further. –M.

**From:** Haas, Bruce J  
**Sent:** Tuesday, August 24, 2010 11:46 AM  
**To:** Boggs, J Markus  
**Subject:** Leaching Test

Mark, for next week's geoprobe samples, if there is a test protocol other than the batch tests already conducted by Test America, then I will need to know those details so I can get a price quote.

**Bruce Haas, PE, PMP**  
Jacobs Engineering | Federal Operations  
1134 Swan Pond Road, Harriman, TN 37748  
Cell: 865.659.5108

## **Clay, Paul F**

---

**From:** Johnson, Adam Paul  
**Sent:** Tuesday, October 05, 2010 2:50 PM  
**To:** Johnson, Adam Paul; Clay, Paul F  
**Subject:** RE: FCN needed for changes to Geoprobe Scope

Forgot 1 other point.

- We will not be completing boring logs for these locations. Per phone call with Mark Boggs on 9/15/10 it was decided that since we are only pushing through ash there would not be any valuable information gained from these ash borings. Another factor was that we wanted to expedite these locations and not spend a lot of time describing the ash. Descriptions for each of the borings are only being recorded in the field logbook. This differs from the SAP, page 5-3, that requires us to keep a boring log in accordance with TVA-KIF-SOP-039.

---

**From:** Johnson, Adam Paul  
**Sent:** Tuesday, October 05, 2010 1:20 PM  
**To:** Clay, Paul F  
**Subject:** FCN needed for changes to Geoprobe Scope

Paul,

I have used some text from some old emails to help develop the list of items needed for submittal of an "all-inclusive" FCN for changes to the geoprobe scope. I only have 5 items needed for the FCN.

1. Eliminate the 3 alluvial geoprobe water samples. It is recommended that we eliminate the 3 alluvial geoprobe water samples. Reason for this is that the geoprobe equipment will not adequately seal off the alluvium from overlying ash porewater. This should be acceptable since we already are characterizing the groundwater in the alluvium with our monitoring well program.
2. Geoprobe sample locations in the ponds will be deferred to a later date due to safety and logistical issues (or do we just drop these entirely?). Currently, there are no suitable barge or geoprobe equipment capable of sealing off the pond water and penetrating sufficiently into the ash below the pond bottom. After speaking with Mark Boggs (phone call w/ Paul Clay and Adam Johnson on 9/15/10) in the TVA groundwater modeling group, he did not want to move these to the edges of the ponds, as these areas would be more clay (dike wall) material. He was on board with us that if they can not be safely sampled then we could most likely use the data from all the on-land locations and assume the ash below the ponds would be similar.
3. Eliminate the 3 ash leaching solid samples per Mark Boggs. Decision was made based on the amount of ash leaching data we already have. See attached email.
4. Per Mark Boggs phone call on 9/15/10 the geoprobe locations do not need to be surveyed by licensed land surveyor. Hand held gps unit will record location and elevation at each geoprobe location. These samples are not going to be permanent locations like monitoring wells, thus no need to have detailed surveying performed.
5. Clarification is needed for the number of geoprobe locations to be performed. Total number should be 15 (if pond locations are included) aqueous sample locs from table 3-1. Unfortunately appendix D calls for 18 geoprobe water locations, and the DQO's call for 16.

Other noteworthy items not needed on FCN

-No FCN is needed for bentonite chips. I checked TDEC rule 1200-4-9.16 and Bentonite chips are allowed for what we are doing.

-Brandy Long (TDEC) wanted to know why we did not have GP-23 on the water sampling map. I checked the SAP and this location was not targeted as a water sample location per table 3-1. I am going to follow up with a email to her and Denina Bowman to let them know that we are not planning on collecting a pore water sample at that location.

That should be everything needed for the FCN, unless you can think of anything else.

Adam

**Adam Johnson**  
**Restoration Services Inc.**  
**TVA Kingston Ash Recovery Project**  
**865-207-2335**



# Kingston Ash Recovery Project Field Change Notice (FCN)

FCN					
FCN Number: <i>FCN-008</i>			FCN Title: Heron Colony Locations		
Project Name: Kingston Fly Ash Wildlife Studies					
Documents Affected by This FCN					
Document Number	Revision	Document Title			
EPA-AO-021		Kingston Ash Recovery Project Non-Time Critical Removal Action for the River System Sampling and Analysis Plan (SAP)			
References/Work Package (if applicable): WP-1003, WP-1005					
Reason for Change/Information Requested: The heron colony location at CRM 2.5 was inactive in 2010 and could not be sampled. As a result, heron egg collections were inconsistent with locations listed in Section 3.9, Appendix A, and Figure 3-16.					
Existing Condition: Section 3.9 and Appendix A state that collections of eggs will be made at one reference site (near TRM 569.5) and two nesting colonies located within the impacted river system (one near ERM 3.0 and one near CRM 2.5).					
Description of Change: Eggs will be collected from one reference site (near TRM 569.5) and one nesting colony located within the impacted river system (near ERM 3.0). If the heron colony at CRM 2.5 is active for future sampling years, collections may be made from this or any additional colonies established at the site.					
Requested Date of FCN Disposition: 01/03/11					
Requestor	Date	Field Engineer	Date		
Suzy Young / Dan Jones	10/10/2010				
Response/Disposition of the FCN					
FCN Approval:			FCN Incorporation by DCN Required:		
Approved <input checked="" type="checkbox"/>	Disapproved <input type="checkbox"/>	Yes <input type="checkbox"/>		No <input type="checkbox"/>	
(see remarks below, if any)			(see remarks below)		
Response/Remarks :					
Lead Engineer/EOR		Date	Project Manager (if required)	Date	
			<i>Paul F. Clay</i>	<i>1/24/2011</i>	



# Kingston Ash Recovery Project Field Change Notice (FCN)

FCN				
FCN Number: <i>FCN-009</i>		FCN Title: Egg Shell Analysis		
Project Name: Kingston Fly Ash Wildlife Studies				
Documents Affected by This FCN				
Document Number	Revision	Document Title		
EPA-AO-021		Kingston Ash Recovery Project Non-Time Critical Removal Action for the River System Sampling and Analysis Plan (SAP)		
References/Work Package (if applicable): WP-1014				
Reason for Change/Information Requested: Egg content data suggest that trace elements associated with ash are bioavailable near the spill. However, some trace elements, such as strontium which is a calcium analog, have the potential to be particularly elevated in the egg shell (a calcium rich matrix) and can provide an additional line of evidence regarding trace element bioavailability, bioaccumulation, and maternal transport near the spill site.				
Existing Condition: Only contents of bird eggs are currently analyzed for metals.				
Description of Change: A subset of tree swallow eggs will be selected from the potentially impacted area of the spill and also from the reference areas and will be analyzed for metals. A total 20 tree swallow eggs (13 eggs from the potentially impacted area and 7 eggs from the reference sites) will be analyzed. A list of egg samples to be analyzed is attached.				
Requested Date of FCN Disposition: 10/10/2010				
Requestor	Date	Field Engineer	Date	
Bill Hopkins / Suzy Young	10/10/2010			
Response/Disposition of the FCN				
FCN Approval:		FCN Incorporation by DCN Required:		
Approved <input checked="" type="checkbox"/>	Disapproved <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
(see remarks below, if any)		(see remarks below)		
Response/Remarks :				
Lead Engineer/EOR		Date	Project Manager (if required)	Date
			<i>Michelle Begly</i>	<i>10/25/10</i>

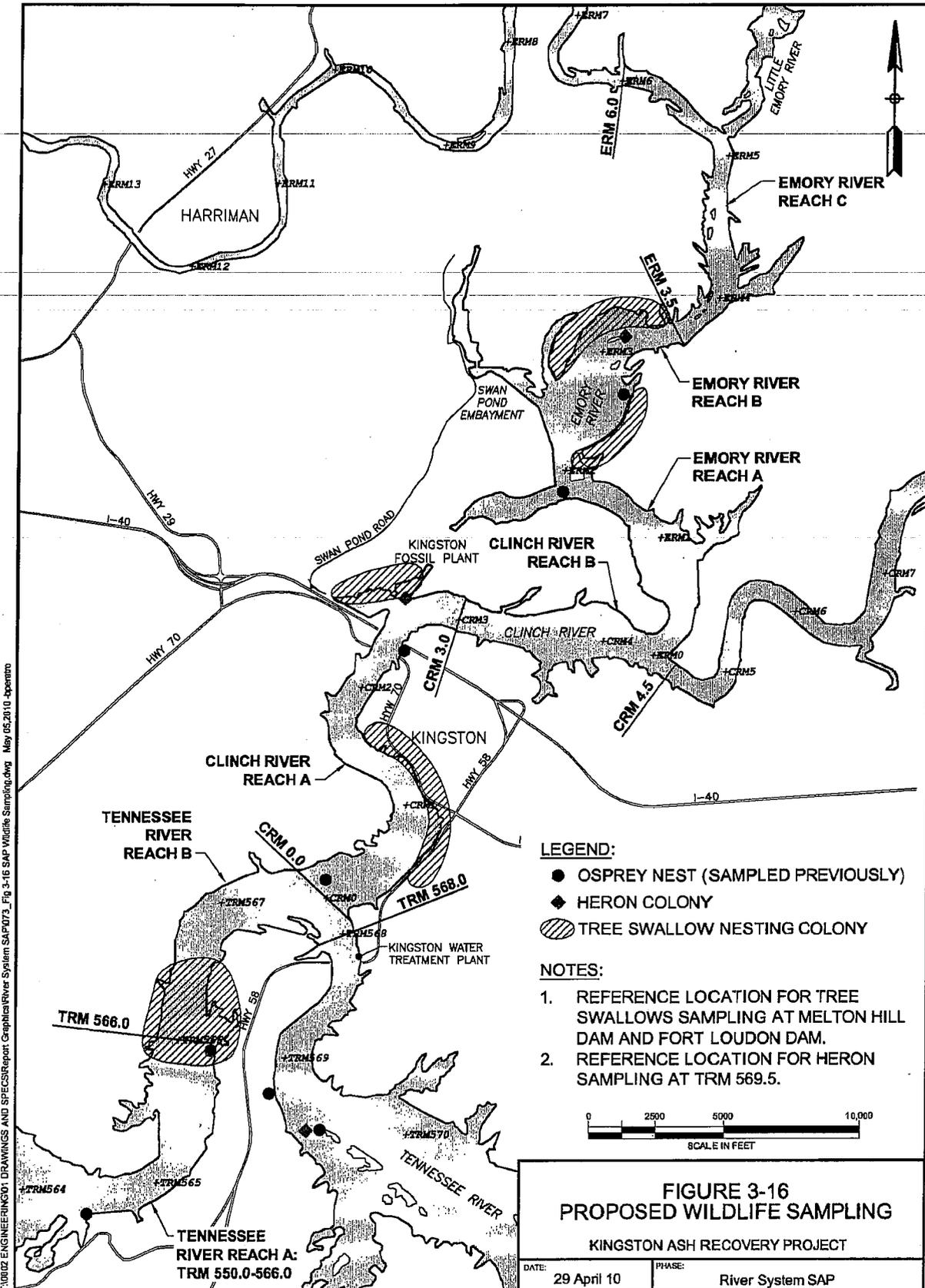
Egg Shells to be Analyzed

Species	Field Sample Id
Tree swallow	KIF-ERM3.O.BH173_TS.E.G.09-BD-050510
Tree swallow	KIF-ERM3.O.BH174_TS.E.G.08-BD-050510
Tree swallow	KIF-MHD.BH061_TS.E.G.06-BD-050410
Tree swallow	KIF-ERM3.O.BH172_TS.E.G.10-BD-050510
Tree swallow	KIF-ERM3.O.BH310_TS.E.G.04-BD-051210
Tree swallow	KIF-NEMBAY.BH243_TS.E.G.01-BD-051110
Tree swallow	KIF-ERM3.O.BH293_TS.E.G.01-BD-051210
Tree swallow	KIF-WEMBAY.BH268_TS.E.G.01-BD-050610
Tree swallow	KIF-ERM3.O.BH178_TS.E.G.06-BD-050510
Tree swallow	KIF-EEMBAY.BH197_TS.E.G.03-BD-050510
Tree swallow	KIF-MHD.BH079_TS.E.G.10-BD-050410
Tree swallow	KIF-TRM566.O.BH417_TS.E.G.01-BD-050410
Tree swallow	KIF-ERM3.5.BH042_TS.E.G.01-BD-051110
Tree swallow	KIF-TRM566.O.BH464_TS.E.G.03-BD-051110
Tree swallow	KIF-EEMBAY.BH208_TS.E.G.01-BD-050510
Tree swallow	KIF-TRM566.O.BH461_TS.E.G.02-BD-051110
Tree swallow	KIF-TLD.BH120_TS.E.G.04-BD-050410
Tree swallow	KIF-TLD.BH119_TS.E.G.05-BD-050410
Tree swallow	KIF-FLD.BH097_TS.E.G.04-BD-050410
Tree swallow	KIF-FLD.BH097_TS.E.G.01-BD-061110



# Kingston Ash Recovery Project Field Change Notice (FCN)

FCN				
FCN Number: <i>FCN-010</i>		FCN Title: Tree Swallow		
Project Name: Kingston Fly Ash Wildlife Studies				
Documents Affected by This FCN				
Document Number	Revision	Document Title		
EPA-AO-021		Kingston Ash Recovery Project Non-Time Critical Removal Action for the River System Sampling and Analysis Plan (SAP)		
References/Work Package (if applicable): WP-1007, WP-1014				
Reason for Change/Information Requested: The tree swallow nest box locations listed in Appendix A are inconsistent with locations listed in Section 3.9 and presented in Figure 3-16.				
Existing Condition: Section 3.9 correctly states that existing collections of eggs and nestlings will be made at two background reference locations (Fort Loudon Dam and Melton Hill Dam) and three on-site locations (one near CRM 2.5 and two near ERM 3.0). Collections may also be made from additional colonies established at the site near ERM 2.5, CRM 1.0, and TRM 566.0.  Appendix A incorrectly states that collections of eggs and nestlings will be made from two background reference locations (Fort Loudon Dam and Melton Hill Dam) and six colonies (near CRM 2.5, CRM 3.5, ERM 1.5, ERM 2.5, and two near ERM 3.0).				
Description of Change: Eggs and nestlings will be collected from two background reference locations (Fort Loudon Dam and Melton Hill Dam) and three on-site locations (one near CRM 2.5 and two near ERM 3.0). If available, collections may also be made from additional colonies established at the site near ERM 2.5, CRM 1.0, and TRM 566.0. Figure 3-16 correctly depicts these locations and is attached for further review.				
Requested Date of FCN Disposition: 10/10/10				
Requestor	Date	Field Engineer	Date	
Suzy Young / Dan Jones	10/10/2010			
Response/Disposition of the FCN				
FCN Approval:		FCN Incorporation by DCN Required:		
Approved <input type="checkbox"/>	Disapproved <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
(see remarks below, if any)		(see remarks below)		
Response/Remarks :				
Lead Engineer/EOR	Date	Project Manager (if required)	Date	
		<i>Michelle Goff</i>	10/29/10	



T:\0002 ENGINEERING\01 DRAWINGS AND SPECS\Report\Graphical\River System SAP\073\_Fig 3-16 SAP Wildlife Sampling.dwg    May 05, 2010 - bpennington



# Kingston Ash Recovery Project Field Change Notice (FCN)

FCN					
FCN Number: <i>011</i>		FCN Title: Addition of Strontium to All SAP Media Analyses			
Project Name:					
Documents Affected by This FCN					
Document Number	Revision	Document Title			
EPA-AO-021		Kingston Ash Recovery Project Non-Time Critical Removal Action for the River System Sampling and Analysis Plan (SAP)			
References/Work Package (if applicable): NA					
Reason for Change/Information Requested: Strontium (Sr) is an element found in ash that is also strongly associated with calcium (Ca) metabolism. As such, Sr is an indicator of potential exposure of organisms to ash. Samples of abiotic media should also be analyzed for Sr to evaluate potential source contribution to any observed uptake in organisms.					
Existing Condition: Strontium is not currently required for analysis in media collected for the SAP.					
Description of Change: Strontium will be added to the list of requested metals analyzed in all sample media in order to support ongoing ecological studies being performed for the ash recovery project.					
Requested Date of FCN Disposition: 10/10/10					
Requestor	Date	Field Engineer	Date		
Bill Hopkins/Dan Jones	01/19/2011				
Response/Disposition of the FCN					
FCN Approval:			FCN Incorporation by DCN Required:		
Approved <input checked="" type="checkbox"/>		Disapproved <input type="checkbox"/>	Yes <input type="checkbox"/>		No <input type="checkbox"/>
(see remarks below, if any)		(see remarks below)			
Response/Remarks-: Reviewed and approved by Neil E. Carriker 1/20/2011. Addition of strontium does not increase analytical costs, since data for strontium is already generated in the analyses, but until now those results have not been extracted from the instrument signals.					
Lead Engineer/EOR	Date	Project Manager (if required)	Date		
		<i>Paul F. Clay</i>	<i>1/24/2011</i>		



# Kingston Ash Recovery Project Field Change Notice (FCN)

FCN					
FCN Number: FCN-012			FCN Title: Arsenic Speciation Reduction in Shad		
Project Name: Kingston Fly Ash Fish Studies					
Documents Affected by This FCN					
Document Number	Revision	Document Title			
EPA-AO-021	Rev. 3	Kingston Ash Recovery Project Non-Time Critical Removal Action for the River System Sampling and Analysis Plan (SAP)			
References/Work Package (if applicable): WP-1063					
Reason for Change/Information Requested: Arsenic speciation is considered unnecessary for shad collected in the River System to quantify potential human exposures to trivalent arsenic (As+3) or pentavalent arsenic (As+5), which are more bioavailable and toxic than organic forms of arsenic, because shad are not consumed by humans. However, shad are herbivorous fish and are important forage for carnivorous fish (bass) and birds (herons, osprey). Recent publicity over the uncertainties associated with As+3/As+5/organo-As species has elevated the need to determine the arsenic pathways through the herbivorous/carnivorous food chain, not just to humans. Therefore, 25% of the gizzard and threadfin shad samples will be submitted for arsenic speciation analysis.					
Existing Condition: The SAP indicates that arsenic speciation will be attained from 100% of the gizzard and threadfin shad samples collected.					
Description of Change: Arsenic speciation will only be attained in 25% of all gizzard and threadfin shad samples collected.					
Requested Date of FCN Disposition: 10/10/10					
Requestor	Date	Field Engineer	Date		
Dan Jones / Mark Stack	12/03/2010				
Response/Disposition of the FCN					
FCN Approval:			FCN Incorporation by DCN Required:		
Approved <input checked="" type="checkbox"/>	Disapproved <input type="checkbox"/>	Yes <input type="checkbox"/>		No <input type="checkbox"/>	
(see remarks below, if any)			(see remarks below)		
Response/Remarks :					
Lead Engineer/EOR		Date	Project Manager (if required)	Date	
			<i>Paul F. Clay</i>	1/25/11	



# Kingston Ash Recovery Project Field Change Notice (FCN)

FCN					
FCN Number: FCN-013			FCN Title: Chromium VI and Mercury Speciation Elimination		
Project Name: Kingston Fly Ash Surface Water Sampling					
Documents Affected by This FCN					
Document Number	Revision	Document Title			
EPA-AO-021	Rev. 3	Kingston Ash Recovery Project Non-Time Critical Removal Action for the River System Sampling and Analysis Plan (SAP)			
References/Work Package (if applicable): WP-1045					
Reason for Change/Information Requested: See attached justification for the elimination of speciation of surface water samples for chromium and mercury.					
Existing Condition: The SAP indicates that chromium VI and mercury speciation will be attained from 25% of the surface water samples collected.					
Description of Change: Chromium VI and mercury speciation will only be eliminated from surface water sample analysis.					
Requested Date of FCN Disposition: 12/03/10					
Requestor	Date	Field Engineer	Date		
Dan Jones / Mark Stack	12/03/2010				
Response/Disposition of the FCN					
FCN Approval:			FCN Incorporation by DCN Required:		
Approved <input checked="" type="checkbox"/>	Disapproved <input type="checkbox"/>	Yes <input type="checkbox"/>		No <input type="checkbox"/>	
(see remarks below, if any)			(see remarks below)		
Response/Remarks :					
Lead Engineer/EOR		Date	Project Manager (if required)	Date	
			<i>Paul F. Clay</i>	1/25/11	

## **Justification for elimination of speciation of surface water samples for chromium and mercury**

The *Kingston Ash Recovery Project Non-Time-Critical Removal Action for the River System Sampling and Analysis Plan (SAP)* specifies that 25 percent of surface water samples will be analyzed for chromium VI and mercury speciation. The purpose of this paper is to provide justification for the elimination of these analyses for surface water samples.

There are various reasons why mercury speciation is considered unnecessary for surface water collected in the River System. The following support the elimination of this specialty analysis in surface water samples:

- Speciation of mercury is intended to quantify exposures to methylmercury, which is more available and toxic than inorganic forms of mercury. However, it is generally observed that no more than 25% of the total mercury in a water column exists as a methylmercury complex; typically, less than 10% is observed (USEPA 1997).
- Mercury in the water column partitions strongly to silts and organic matter (total and dissolved), which settle out of the water column and accumulate in sediments (USEPA 2010).
- Mercury has been detected in less than one percent of surface water samples from routine Kingston Ash Recovery Project sample locations in the Emory, Clinch, and Tennessee Rivers. The detections include 15 of 2,073 samples analyzed for total (unfiltered) mercury and 8 of 2,066 samples analyzed for dissolved (filtered) mercury.
- Constituents detected at frequencies less than five percent are normally screened out during the human health and ecological risk assessment process as being inconsequential to the site characterization.
- The pattern of mercury detections did not demonstrate a spatial or temporal correlation with the site or site activities. Although some occurred at locations near and below the main ash spill area, detections also occurred at upstream-reference locations (ERM 12.2, ERM 4.0, and CRM 5.5) and were sporadic overall.
- There were no total or dissolved mercury detections greater than the inorganic mercury Ambient Water Quality Criterion (AWQC) for protection of aquatic biota (0.00077 mg/L).
- Only nine detected concentrations of total mercury exceed the Tennessee Water Quality Criterion for Human Consumption of Water and Organism (0.00005 mg/L), which is driven by dietary exposures to methylmercury.
- Methylmercury is retained in fish tissue and biomagnifies in aquatic food webs (Kidd et al. 1995 cited in USEPA 2010), which makes it easier to detect in fish samples and is why EPA provides a means to calculate water quality criteria based on concentrations in fish.
- Fish samples collected for the Kingston Ash Recovery Project will continue to be analyzed for mercury.
- Sediment samples collected under the SAP will still include 25% speciation of mercury.

Based on these factors, speciation of mercury in surface water is unwarranted. However, filtered and unfiltered surface water samples will still be analyzed for mercury as specified in the SAP.

The following considerations support the elimination of chromium speciation analyses of surface water samples:

- Speciation of chromium is intended to quantify exposures to hexavalent chromium (Cr VI), which is more toxic than trivalent chromium (Cr III).
- Chromium VI is a strong oxidizing agent that readily reduces to form Cr III.

- Chromium VI speciation was included in the SAP based, in part, on the Department of Energy's Remedial Investigation (RI) and Record of Decision (ROD) for the Clinch River/Poplar Creek Operable Unit. Section 5.5.1.3 Shoreline use scenario of the RI states:

"The shoreline use scenario assumes four potential routes of exposure: (1) ingestion of near-shore sediment, (2) dermal contact with near-shore sediment, (3) inhalation of resuspended near-shore sediment, and (4) external exposure to near-shore sediment. Although the inhalation of resuspended chromium at PCM 3.1 leads to a risk level of concern, the risk estimate conservatively assumes that all chromium is in the chromium IV (sic) valence state, which is the most toxic. Previous studies have indicated that most of the chromium in the Clinch River is not chromium IV (sic) and should not be a problem."

- The ROD for the Clinch River/Poplar Creek Operable Unit reiterates this conservatism in the responsiveness summary with the following statement:

"The two primary risks to human health posed by CR/PC are exposure to (1) mercury, chromium, arsenic, and 137 Cs in deep sediment of the main river channel and (2) polychlorinated biphenyls (PCBs), chlordane, arsenic, and mercury in fish tissue.

Two subreaches (one in Poplar Creek and one in the Clinch River) when added across all contaminants and all pathways do provide a carcinogenic risk of 1.8 and 1.1 X 10<sup>-4</sup>, respectively. However, in both cases, the risk is driven by the presence of chromium. Chromium usually occurs in two states in the environment, Cr(III) and Cr(VI). Chromium-6 is much more toxic but reacts over time to form Cr(III). The conservative risk assessment methodology used for this RI assumes all chromium to be Cr(VI),..."

- Chromium III methods detection limits are relatively low, yielding relatively frequent detects in surface water samples from routine Kingston Ash Recovery Project sample locations in the Emory, Clinch, and Tennessee Rivers. The detections include 787 of 2,255 samples analyzed for total (unfiltered) chromium and 110 of 2,252 samples analyzed for dissolved (filtered) chromium.
- There were no results that exceeded the Maximum Contaminant Level (0.1 mg/L) for drinking water.
- There were only six detections of total (unfiltered) chromium greater than the Cr VI AWQC for protection of aquatic life (0.011 mg/L), and all occurred on or before 01/07/2009. Of these detects, all but one also exceeded the AWQC for Cr III (0.02 mg/L), making speciation of chromium in these unfiltered samples unnecessary.
- Standards for metals in surface water are based on dissolved concentrations, which is the bioavailable fraction for aquatic biota.
- All of the detections of dissolved chromium in surface water were below the AWQC for both Cr III and Cr VI.

Based on these factors, speciation of chromium in surface water is unwarranted. However, filtered and unfiltered surface water samples will still be analyzed for chromium as specified in the SAP.

#### References

United States Environmental Protection Agency 2010. *Guidance for Implementing the January 2001 Methylmercury Water Quality Criterion – Final*. Office of Science and Technology. Washington, DC. EPA-823-R-10-001. April 2010. [www.epa.gov/waterscience](http://www.epa.gov/waterscience)

United States Environmental Protection Agency 1997. *Mercury Study Report to Congress. Volume III: Fate and Transport of Mercury in the Environment*. Office of Air Quality Planning & Standards. Washington D.C., EPA-452/R-97-005 December 1997



# Kingston Ash Recovery Project Field Change Notice (FCN)

FCN				
FCN Number: FCN-014		FCN Title: Justification for 12-week Holding Time for Sediment Toxicity Testing Samples		
Project Name: Kingston NTC SAP Submerged Sediment				
Documents Affected by This FCN				
Document Number	Revision	Document Title		
EPA-AO-021	Rev 3	Kingston Ash Recovery Project Non-Time Critical Removal Action for the River System Sampling and Analysis Plan (SAP)		
References/Work Package (if applicable):				
Reason for Change/Information Requested: Additional holding time for the toxicity test sediment samples may be necessary in order to supply material for any tests that may not meet toxicity test acceptability requirements, thus needing to be repeated. Re-sampling for required tests would result in greater uncertainties than using sediments held for 8-12 weeks.				
Existing Condition: Appendix D and Figure D-4 outline that holding time for submerged sediment for use in toxicity studies is for 8 weeks, stored at <6 °C				
Description of Change: The increase of the previously mentioned holding time to twelve (12) weeks under the same refrigeration and storage requirements				
Requested Date of FCN Disposition: 1/10/11				
Requestor	Date	Field Engineer	Date	
Dan Jones	1/10/2011			
Response/Disposition of the FCN				
FCN Approval:		FCN Incorporation by DCN Required:		
Approved <input checked="" type="checkbox"/>	Disapproved <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
(see remarks below, if any)		(see remarks below)		
Response/Remarks :				
Lead Engineer/EOR		Date	Project Manager (if required)	Date
			<i>Paul F. Clay</i>	1/25/11

### Justification for 12-Week Holding Time for Sediment Toxicity Testing Samples

The *Kingston Ash Recovery Project Non-Time-Critical Removal Action for the River System Sampling and Analysis Plan (SAP)* specifies a holding time of eight (8) weeks for refrigerated (<6 degrees C) sediment samples for toxicity testing purposes. TVA will strive to meet that holding time during implementation of the SAP. However, logistical constraints may prevent initiation of all toxicity tests within the specified holding time. The purpose of this paper is to provide justification for the increase of this holding time to twelve (12) weeks under the same refrigeration and storage requirements.

The SAP calls for sediment toxicity tests for 20 submerged sediment samples: 2 reference and 8 "site" locations from the Emory River, and 2 reference and 8 "site" locations from the Clinch River. The sediment testing strategy will use the results of 10-day screening tests along with preliminary analytical results to select representative sediment samples for use in the longer-term definitive tests. The results from the screening tests will undergo hypothesis testing to determine significant differences in survival, growth or reproduction relative to the reference controls. Following that analysis, four site samples from each river will be used in definitive tests with the 28-day *Hyalella azteca* and partial life cycle *Chironomus dilutus* protocols. Of these four samples from each river, at least one will be selected from among those for which significant effects were not observed in the short-term screening tests and up to three will be selected from among those for which there were significant effects observed in the screening tests.

The previously identified 8-week holding time served as a general guideline based on the minimum time necessary to complete both 10-day and long-term studies. This holding time may, however, require an extension to 12 weeks should any of the *H. azteca* and *C. dilutus* screening or long-term tests fail to meet toxicity test acceptability requirements. In that event, it is preferable to use remaining original sample material to repeat those tests rather than re-collecting new sediment samples. This recommended change to a possible 12-week holding time is based on the following considerations:

- All sediment samples will be refrigerated (< 6°C) and held in the dark.
- Stable metals, weathered PAHs, PCBs, and pesticides are the contaminants of potential concern for the Clinch and Emory Rivers submerged sediments toxicity evaluations.
- These contaminants of potential concern do not include volatile or highly labile compounds.
- If repetition of toxicity tests is necessary due to failure of toxicity tests to meet acceptability criteria (i.e., observed toxicity is greater than acceptability criteria for tests with laboratory control sediments), every effort will be made to complete the initiation of the re-tests within the original 8 week period, however it could take up to 12 weeks from the original sample collection date to complete all the preliminary testing, determine that long-term tests in progress have failed acceptability criteria, and get long-term toxicity re-testing started.
- If re-collection of sediment samples is required, the entire process would have to be repeated for that location (10-day screening tests, analysis of those results to select samples for long-term tests, performance of long-term tests, and analysis of those results). The likely outcome would be that results of re-tests would not be available in time to be considered in the ecological risk assessment.

- Most importantly, the variability in collecting additional site samples is arguably greater than the potential for changes due to further degradation of the weathered PAHs or other contaminants of concern in the Clinch and Emory River sediments that might occur between 8 and 12 week holding times.
- The EPA-recommended 8-week holding time is a general guideline and is not based on any specific long-term investigations of changes in chemical, physical, or toxicity parameters; sediment toxicity holding times reported in the literature vary substantially.
- Sediment holding times of >8 weeks have been reported to be acceptable for stable (i.e., non-labile) and high molecular weight compounds, including PCBs; these contaminants do not exhibit substantial changes in their toxicity over time (Moore et al. 1999; Defoe and Ankley 1998).

Defoe, D.L and G.T. Ankley. 1998. Influence of storage time on toxicity of freshwater sediments to benthic macroinvertebrates. *Environmental Pollution* 99:123-131.

Moore, D.W., T.M. Dillon, and E.W. Gamble. 1996. Long-term storage of sediments: Implications for sediment toxicity testing. *Environmental Pollution* 89:341-342.

**Clay, Paul F**

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**From:** Zeller.Craig@epamail.epa.gov  
**Sent:** Monday, January 24, 2011 1:41 PM  
**To:** Cagley, April M; Rogers, William J; Clay, Paul F; Sherrard, Rick M  
**Cc:** Barbara Scott; Brandy.Long@tn.gov  
**Subject:** Fw: Justification for change in sediment toxicity test holding time\_ARS-NEC-1-14-11.docx

My eco support (Jim Eldridge) concurs...and greatly appreciates your effort in the quality write-ups. Good job people!!!

CZ

----- Forwarded by Craig Zeller/R4/USEPA/US on 01/24/2011 01:39 PM -----

**From:** "Eldridge, James C." <EldridgeJC@bv.com>  
**To:** Craig Zeller/R4/USEPA/US@EPA  
**Date:** 01/24/2011 12:47 PM  
**Subject:** RE: Justification for change in sediment toxicity test holding time\_ARS-NEC-1-14-11.docx

Craig,  
I concur. I really appreciate TVA taking the time to provide quality justifications for their SAP changes.  
Jim.

-----Original Message-----

**From:** [Zeller.Craig@epamail.epa.gov](mailto:Zeller.Craig@epamail.epa.gov) [mailto:[Zeller.Craig@epamail.epa.gov](mailto:Zeller.Craig@epamail.epa.gov)]

**Sent:** Monday, January 24, 2011 7:27 AM  
**To:** Eldridge, James C.  
**Subject:** Fw: Justification for change in sediment toxicity test holding time\_ARS-NEC-1-14-11.docx

Howdy Jim...can you please take a quick look at this attachment and let me know if you concur?

Thanks,

CZ

----- Forwarded by Craig Zeller/R4/USEPA/US on 01/24/2011 10:26 AM -----

**From:** "Cagley, April M" <[amcagley@tva.gov](mailto:amcagley@tva.gov)>  
**To:** "Barbara Scott" <[Barbara.Scott@tn.gov](mailto:Barbara.Scott@tn.gov)>, Craig

Zeller/R4/USEPA/US@EPA, "Brandy Long"  
<[Brandy.Long@tn.gov](mailto:Brandy.Long@tn.gov)>

Cc: "Incident.Documentation" <[Incident.Documentation@tva.gov](mailto:Incident.Documentation@tva.gov)>,  
"Dizer, John E Jr" <[jedizer@tva.gov](mailto:jedizer@tva.gov)>,  
"Anderson, Cynthia M" <[cmanderson@tva.gov](mailto:cmanderson@tva.gov)>, "Carriker,  
Neil E" <[necarriker@tva.gov](mailto:necarriker@tva.gov)>, "Clay, Paul F"  
<[pclay@tva.gov](mailto:pclay@tva.gov)>, "Sherrard, Rick M" <[rmsherrard@tva.gov](mailto:rmsherrard@tva.gov)>

Date: 01/21/2011 11:10 AM

Subject: Justification for change in sediment toxiciity test  
holding time\_ARS-NEC-1-14-11.docx

Barbara and Craig,

Can you please review the attached Justification for change and let me know if you have any questions or comments. If you concur then we will prepare a field change notice which will be added to the addendum to the River Sampling and Analysis plan.

Thank you,

Michelle Cagley

Regulatory Interface Specialist

TVA

865-717-1636

(See attached file: winmail.dat)(See attached file: message\_body.rtf)  
(See attached file: Justification for change in sediment toxiciity test  
holding time\_ARS-NEC-1-14-11.docx)



# Kingston Ash Recovery Project Field Change Notice (FCN)

FCN				
FCN Number: FCN-015		FCN Title: Chemical Analysis of Water for Toxicity Tests		
Project Name: Kingston NTC SAP				
Documents Affected by This FCN				
Document Number	Revision	Document Title		
EPA-AO-021		Kingston Ash Recovery Project Non-Time Critical Removal Action for the River System Sampling and Analysis Plan (SAP)		
References/Work Package (if applicable):				
<b>Reason for Change/Information Requested:</b> The Kingston Ash Recovery Project <i>Non-Time Critical Removal Action for the River System Sampling and Analysis Plan</i> does not explicitly indicate that chemical analyses will be performed on water sent for toxicity testing, in addition to the co-located routine surface water samples. The setup and processing steps of the toxicity tests could potentially introduce changes to the water chemistry, particularly the step that includes irradiation of the water with ultraviolet light to control pathogens.				
<b>Existing Condition:</b> The NTCRA SAP does not specify chemical analysis of the water used in surface water toxicity tests.				
<b>Description of Change:</b> Subsamples of the day 0 and the day 6 water (4 site locations, 1 reference location, and the lab control water) collected by the toxicity lab will be sent to the analytical laboratory. The day 0 samples will be analyzed for Total and Dissolved Metals and Mercury, Dissolved Hexavalent Chromium, Dissolved Arsenic Species, Dissolved Selenium Species, Total Suspended Solids, Total Dissolved Solids, Dissolved Organic Carbon, and Turbidity. The day 6 samples will be held pending review of the toxicity test results. Evidence of significant toxicity may indicate a need to analyze the day 6 water, depending on the results of the day 0 analyses.				
Requested Date of FCN Disposition: 10/10/10				
Requestor	Date	Field Engineer	Date	
Dan Jones	10/10/2010			
Response/Disposition of the FCN				
FCN Approval:		FCN Incorporation by DCN Required:		
Approved <input checked="" type="checkbox"/>	Disapproved <input type="checkbox"/>	Yes <input type="checkbox"/>		No <input type="checkbox"/>
(see remarks below, if any)		(see remarks below)		
Response/Remarks :				
Lead Engineer/EOR	Date	Project Manager (if required)	Date	
		<i>Mark S. Lamb</i>	9/12/11	

## Justification for chemical analysis of water used in surface water toxicity tests

The *Kingston Ash Recovery Project Non-Time-Critical Removal Action for the River System Sampling and Analysis Plan (SAP)* did not explicitly indicate that chemical analyses would be performed on water sent for toxicity testing, in addition to the co-located routine surface water samples. The purpose of this paper is to clarify the sub-sampling process and explain the need for these additional measurements.

Bulk water samples are collected for shipment to the toxicity testing laboratory during the routine surface sampling events. Preservation is limited to storage at four degrees centigrade because chemical preservatives would make the water unsuitable for toxicity testing. The routine surface water samples collected during those events are preserved using standard methods (chemical and/or refrigeration) and are sent directly to the analytical laboratories for chemical testing.

It is important to document the chemical exposures experienced by the animals in these chronic toxicity tests. Setup procedures for these tests include several handling steps, some of which might introduce changes to the water chemistry. The processing step of particular concern is irradiation with ultraviolet (UV) light to control pathogens. Although effects of UV light on metal concentrations not well studied, there is at least some evidence of changes in hardness, alkalinity, and even some metals. In order to document any possible changes due to UV treatment, the UV-treated and untreated water should be analyzed for chemical concentrations.

Bulk water samples shipped to the toxicity testing laboratory are refrigerated until the tests are initiated. The first day of a toxicity test is referred to as Day Zero (Day-0). Test water is renewed daily, the last time occurring on Day Six (Day-6). To provide sufficient chemical data for interpretation of the toxicity test results without unnecessarily complicating the testing protocols, samples will be collected and analyzed as follows:

- A subsample of Day-0 water collected by the toxicity lab will be sent to the analytical laboratory for testing. This applies to all four site locations, the reference location, and the lab control water.
- A subsample of Day-6 water collected by the toxicity lab will be sent to the analytical laboratory and held pending review of the toxicity test results. Evidence of significant toxicity may indicate a need to analyze the Day-6 water, depending on the results of the Day-0 analyses. Water to be analyzed includes the site samples, the reference samples, and the lab control water.
- Chemical analysis of Day-6 water from the first toxicity test has already begun. Therefore, the procedure for holding the Day-6 samples applies to the last three toxicity tests.
- The following chemical analyses will be performed: Total Metals/Mercury, Dissolved Metals/Mercury, Dissolved Hexavalent Chromium, Dissolved Arsenic Species, Dissolved Selenium Species, Total Suspended Solids, Total Dissolved Solids, Dissolved Organic Carbon, and Turbidity.
- Analysis of these subsamples of water for PCBs, organic pesticides, and PAHs is not warranted because these constituents strongly partition to sediments and are not anticipated to be at measurable in ambient river water.
- Analysis of these subsamples of water for radionuclides is not warranted, because existing site data indicates that radionuclide concentrations are not sufficient to pose a risk to aquatic biota such as those used for the toxicity test. Furthermore, adverse effects of environmental levels of radiation require substantially longer exposure durations than those experienced by the organisms in these tests.



# Kingston Ash Recovery Project Field Change Notice (FCN)

FCN				
FCN Number: FCN-016		FCN Title: Elimination of Aroclor 1262 and 1268		
Project Name: Kingston Fly Ash Sediment Sampling				
Documents Affected by This FCN				
Document Number	Revision	Document Title		
EPA-AO-021		Kingston Ash Recovery Project Non-Time Critical Removal Action for the River System Sampling and Analysis Plan (SAP)		
References/Work Package (if applicable): WP-1051 and WP 1023				
Reason for Change/Information Requested: The list of PCBs analyzed should be based on the legacy constituents in the Emory, Clinch, and Tennessee Rivers. After reviewing the DOE RI/FS for the Clinch River, seven Aroclors were identified as potential constituents of concern; three of which (PCB-1248, PCB-1254, and PCB-1260) were evaluated through the ecological risk assessment process. PCB-1262 and PCB-1268 were not included in the lists of PCBs analyzed by DOE in the Clinch River sediments. This, coupled with the fact that the lab does not have standards for these Aroclors, suggest that these are not commonly found Aroclors.				
Existing Condition: The SAP indicates that Aroclor 1262 and 1268 should be included in the MAG for sediment sampling.				
Description of Change: Remove Aroclor 1262 and Aroclor 1268 from the sediment sampling MAG.				
Requested Date of FCN Disposition: 01/25/11				
Requestor	Date	Field Engineer	Date	
Dan Jones / Mark Stack	01/25/2011			
Response/Disposition of the FCN				
FCN Approval:		FCN Incorporation by DCN Required:		
Approved <input checked="" type="checkbox"/>	Disapproved <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
(see remarks below, if any)		(see remarks below)		
Response/Remarks : Approved by Neil E. Carriker 1/26/11.				
Lead Engineer/EOR	Date	Project Manager (if required)	Date	
		<i>Paul F. Clay</i>	1/26/2011	



# Kingston Ash Recovery Project Field Change Notice (FCN)

FCN				
FCN Number: FCN-018		FCN Title: Use of compositing for analysis of fish filet samples for select constituents		
Project Name:				
Documents Affected by This FCN				
Document Number	Revision	Document Title		
EPA-AO-xxx		Kingston Ash Recovery Project Non-Time Critical Removal Action for the River System Sampling and Analysis Plan (SAP)		
References/Work Package (if applicable): NA				
Reason for Change/Information Requested: The TVA Kingston Ash Recovery Project will use compositing of filets for analysis of pesticides, PCBs, and radionuclides. The use of composite samples is based on the mass of tissue necessary for these analyses and the method for developing fish consumption advisories followed by EPA and the State of Tennessee.				
Existing Condition: There is insufficient mass of some fish species from different trophic levels to perform the necessary analyses unless the fish samples are homogenized. In addition to the 7 grams of mass required for metals and metals speciation analyses, the sample mass required for pesticide and PCB analysis is 20 grams; for gamma spectroscopy is 150 grams; and for alpha spectroscopy is 1 to 2 grams.				
Description of Change: The fish species to be analyzed are largemouth bass, catfish, and bluegill. The bass and catfish samples are generally of sufficient size to provide the necessary mass of tissue for these analyses. However, the bluegill samples only weigh 20 to 30 grams each. TVA proposes to perform the pesticide, PCB, and radiological analyses using homogenized tissue samples from each species.				
Requested Date of FCN Disposition: 10/10/10				
Requestor	Date	Field Engineer	Date	
Mark Stack/Dan Jones	01/31/2011			
Response/Disposition of the FCN				
FCN Approval:		FCN Incorporation by DCN Required:		
Approved <input checked="" type="checkbox"/> (see remarks below, if any)	Disapproved <input type="checkbox"/> (see remarks below)	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
Response/Remarks :				
Lead Engineer/EOR	Date	Project Manager (if required)	Date	
		<i>Paul F. Clay</i>	2/14/11	



# Kingston Ash Recovery Project Field Change Notice (FCN)

FCN				
FCN Number: FCN-019		FCN Title: Change in holding time for fish file samples		
Project Name:				
Documents Affected by This FCN				
Document Number	Revision	Document Title		
EPA-AO-xxx		Kingston Ash Recovery Project Non-Time Critical Removal Action for the River System Sampling and Analysis Plan (SAP)		
References/Work Package (if applicable): NA				
Reason for Change/Information Requested: The holding time specified in the SAP QAPP Addendum for pesticides and PCBs is based on the SW-846 Method 8081 and 8082 holding time for solid samples (i.e., soil or sediment). The TVA Kingston Ash Recovery Project will extend the holding time from 14 days from sample collection and extraction and 40 days for analysis to one year for tissue samples frozen below -10° C. An extended holding time for pesticides and PCBs is appropriate for frozen biological tissue and such extended holding times are routinely accepted by EPA.				
Existing Condition: Samples collected in the spring 2010 to be analyzed for pesticides and PCBs are beyond the 14 day holding time specified in the SAP QAPP Addendum.				
Description of Change: The TVA Kingston Ash Recovery Project will extend the holding time from 14 days from sample collection and extraction and 40 days for analysis to one year for tissue samples frozen below -10° C.				
Requested Date of FCN Disposition: 10/10/10				
Requestor	Date	Field Engineer	Date	
Mark Stack/Dan Jones	01/31/2011			
Response/Disposition of the FCN				
FCN Approval:		FCN Incorporation by DCN Required:		
Approved <input checked="" type="checkbox"/>	Disapproved <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
(see remarks below, if any)		(see remarks below)		
Response/Remarks :				
Lead Engineer/EOR	Date	Project Manager (if required)	Date	
		<i>Paul F. Clay</i>	<i>2/14/11</i>	



# Kingston Ash Recovery Project Field Change Notice (FCN)

FCN				
FCN Number: FCN-020		FCN Title: Addition of PLM on Submerged Sediments Sent for Toxicity Testing and Porewater Extraction		
Project Name: Kingston NTC SAP Submerged Sediment				
Documents Affected by This FCN				
Document Number	Revision	Document Title		
EPA-AO-021		Kingston Ash Recovery Project Non-Time Critical Removal Action for the River System Sampling and Analysis Plan (SAP)		
References/Work Package (if applicable): WP-1023, WP-1051				
<p><b>Reason for Change/Information Requested:</b>            Submerged sediment samples will be collected for use in both laboratory bioassays and for extraction of porewater. Submerged sediment laboratory bioassays (toxicity testing) are being performed for benthic and epi-benthic invertebrate species exposed to submerged sediments in order to observe potential effects of ash-related constituents on growth, reproduction, and survivability. Ultimately, the purpose of this testing is to estimate the bioavailability and risk of ash-related constituents relative to the presence of ash and ash-related constituents in sediment.</p> <p>It is important to document how the percent ash in sediment relates to both the toxicity to aquatic organisms and to the concentrations of metals in the porewater. This is best accomplished by using polarized light microscopy (PLM) analysis to quantitatively estimate the ash content in each composite sample sent for toxicity testing and in the residual sediment from which porewater was extracted.</p>				
<p><b>Existing Condition:</b>            The SAP does not explicitly indicate that PLM analysis will be performed on submerged sediments that are used in the laboratory toxicity bioassays or on composited, porewater extracted (residual) sediment samples.</p>				
<p><b>Description of Change:</b>            PLM analysis should be added to the characterization methods listed in Appendix D-4 for sediments collected for toxicity testing and porewater analysis. The PLM analysis would utilize the same method as for all other sediment and ash samples; EPA-600/M4-82-020. PLM analysis would be conducted on composited sediment for laboratory bioassays and composited, porewater extracted (residual) sediment samples.</p>				
Requested Date of FCN Disposition: 1/25/2011				
Requestor	Date	Field Engineer	Date	
Dan Jones	1/25/2011			
Response/Disposition of the FCN				
FCN Approval:		FCN Incorporation by DCN Required:		
Approved <input checked="" type="checkbox"/>	Disapproved <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
(see remarks below, if any)		(see remarks below)		
Response/Remarks : Re-Approved by Neil Carriker, following revisions by Dan Jones				



# Kingston Ash Recovery Project Field Change Notice (FCN)

Lead Engineer/EOR	Date	Project Manager (if required)	Date
		<i>Paul F. Gray</i>	<i>2/14/11</i>



# Kingston Ash Recovery Project Field Change Notice (FCN)

FCN				
FCN Number: FCN-021		FCN Title: Addition of Metals Analysis on Compositied Porewater-extracted Sediments		
Project Name: Kingston NTC SAP Submerged Sediment				
Documents Affected by This FCN				
Document Number	Revision	Document Title		
EPA-AO-021		Kingston Ash Recovery Project Non-Time Critical Removal Action for the River System Sampling and Analysis Plan (SAP)		
References/Work Package (if applicable):				
<p><b>Reason for Change/Information Requested:</b>            Porewater sampling will be conducted in both the Clinch and Emory Rivers by sediment core collection. Sediment samples are shipped to labs for porewater extraction. The purpose for this sampling effort is to better understand the adsorption-desorption relationships of constituents from the ash/sediment and the potential risk to ecological receptors.</p> <p>Porewater is extracted from sediment and analyzed for the parameters outlined in SAP section D-4. Metals analysis for both the sediment and porewater fractions is essential in relating the two phases as well as making well-informed predictions of risk to ecological receptors. This is best accomplished by analyzing the residual sediment material from which the pore water was extracted.</p>				
<p><b>Existing Condition:</b>            The SAP does not explicitly indicate that metals analysis will be performed on composited, porewater-extracted (residual) sediment samples.</p>				
<p><b>Description of Change:</b>            Metals analysis should be added to the sediment collected for porewater analysis in Appendix D-4. The metals analysis would utilize the same methods as outlined for the submerged sediment sampling in D-4.</p>				
Requested Date of FCN Disposition: 1/27/2011				
Requestor	Date	Field Engineer	Date	
Dan Jones	1/27/2011			
Response/Disposition of the FCN				
FCN Approval:		FCN Incorporation by DCN Required:		
Approved <input checked="" type="checkbox"/>	Disapproved <input type="checkbox"/>	Yes <input type="checkbox"/>	No <input type="checkbox"/>	
(see remarks below, if any)		(see remarks below)		
Response/Remarks : Approved by Neil Carriker. 2/9/11				
Lead Engineer/EOR		Date	Project Manager (if required)	Date
				<i>Paul F. Gray</i> 2/14/11



**KINGSTON ASH RECOVERY PROJECT  
CHANGE NOTICE (CN)**

for Procedures, Work Plans, and Other, Documents Controlled by Environmental

CN-Number:	KRP-CN-001	Page-No(s) Impacted:	2-11, 2-12, 5-2, 5-3, A-14, A-15, A-16
CN Title: Well Installation Materials and Equipment Changes			
<b>DOCUMENT AFFECTED BY THIS CHANGE NOTICE</b>			
Document Number	Revision	Document Title	
EPA-AO-021	0	NTC Removal Action Plan for the River System SAP	
Requestor: Adam Johnson			
Date of Request: 04/19/11			
Reason for Change:			
<ol style="list-style-type: none"> <li>Plastic liners were not used with the split-barrel sampler due to the drilling company's inability to acquire them. Decontaminated stainless steel split spoons were used to collect samples sent to the lab for analysis. Equipment rinsates were collected for each type of sampling method.</li> <li>A fluid rotary drill rig was needed to drill bedrock well locations GW-01 and GW-03 instead of air rotary. The access road to these well locations would not safely allow access of the larger air rotary rig.</li> <li>Twenty (20) feet of Schedule 40 PVC screen was installed instead of 10 feet of Schedule 40 PVC screen at GW-01 and GW-03 in order to maximize the amount of data collected with the borehole flow meter.</li> </ol>			
Existing Condition:			
<ol style="list-style-type: none"> <li>SAP requires plastic liners to be used during sampling with split spoons.</li> <li>SAP requires air rotary to install the off-site bedrock wells GW-01 and GW-03.</li> <li>SAP requires all wells to have 10 feet of screen installed.</li> </ol>			
Change (Change to):			
<ol style="list-style-type: none"> <li>Allow use of decontaminated stainless steel split spoons for sampling.</li> <li>Allow use of fluid rotary rig to install off-site bedrock wells GW-01 and GW-03.</li> <li>Allow use of longer screen lengths (20' length) at off-site bedrock wells.</li> </ol>			

Requestor completes the information requested above and submits to Document Control

<b>RESPONSE/DISPOSITION OF THE CHANGE NOTICE</b>		
Name	Signature	Date
<u>Adam Johnson</u>	<u><i>Adam Johnson</i></u>	<u>7-11-11</u>
Document Owner:	<input checked="" type="checkbox"/> Concurrency	
Technical Reviewer's Organization, Name, Signature, and Date:		
Name	Signature	Date
<u>W. J. ROGERS</u>	<u><i>W. J. Rogers</i></u>	<u>7-11-11</u>
Quality Assurance:	<input checked="" type="checkbox"/> Concurrency	
<u>A. M. Cagley</u>	<u><i>A. Michelle Cagley</i></u>	<u>7-12-11</u>
Name	Signature	Date
Regulatory Compliance:	<input checked="" type="checkbox"/> Concurrency	



Name Neil E. Carrick Signature Neil E. Carrick Date 7/11/11  
Environmental Management  Approved

Comments:



**KINGSTON ASH RECOVERY PROJECT  
CHANGE NOTICE (CN)**

for Procedures, Work Plans, and Other, Documents Controlled by Environmental

CN Number:	<u>KRP-CN-002</u>	Page No(s) Impacted:	<u>2-4, 2-5, A-4, A-5, D-2, D-3</u>
CN Title: Additional laboratory PLM analyses in vibracore sediment samples from the Clinch, Emory and Tennessee Rivers			
<b>DOCUMENT AFFECTED BY THIS CHANGE NOTICE</b>			
Document Number	Revision	Document Title	
EPA-AO-021		Kingston Ash Recovery Project Non-Time Critical Removal Action for the River System Sampling and Analysis Plan (SAP)	
Requestor: <b>Amber Stojak</b>			
Date of Request: <b>3-29-11</b>			
Reason for Change: The use of field PLM data meets the SAP objective of identifying ash deposits that are sufficiently thick to make dredging a potentially viable remedy. However, greater accuracy is required when selecting locations for sediment toxicity testing. The conservative field PLM estimates of ash content may also lead to over-estimates of potential risks to benthic invertebrates.			
Existing Condition: The SAP indicates that visual observations and field polarized light microscopy (PLM) will be used to assess % ash in the sediment samples in the Clinch, Emory and Tennessee Rivers. The SAP states that only 10% of the VibeCore™ submerged and exposed samples in each river will be confirmed with laboratory PLM.			
Change (Change to): All samples with field PLM results greater than 50% ash will be sent for lab PLM analysis. Priority will be given to Emory River samples in order to facilitate timely selection of locations for sediment toxicity testing.			

Requestor completes the information requested above and submits to Document Control

RESPONSE/DISPOSITION OF THE CHANGE NOTICE		
Name	Signature	Date
Document Owner:	<input type="checkbox"/> Concurrence	
Technical Reviewer's Organization, Name, Signature, and Date:		
Name	Signature	Date
Quality Assurance:	<input type="checkbox"/> Concurrence	
Name	Signature	Date
Regulatory Compliance:	<input type="checkbox"/> Concurrence	
Name	Signature	Date
Neil E. Carriker	<i>Neil E. Carriker</i>	<u>4/21/11</u>
Environmental Management	<input checked="" type="checkbox"/> Approved	



**Comments:**

**This approval is an after-the-fact completion of documentation. The referenced samples have already been sent for PLM analysis because of the need for obtaining those results for use in selecting sites for bioassay testing.**

**I held the original request for change until we made final modifications to the Change Notice form. Neil Carriker**



**KINGSTON ASH RECOVERY PROJECT  
CHANGE NOTICE (CN)**

for Procedures, Work Plans, and Other, Documents Controlled by Environmental

CN Number:	KRP-CN-003	Page No(s) Impacted:	Page 14
CN Title: Revisions to Table 2 of TVA-KIF-SOP-02			
<b>DOCUMENT AFFECTED BY THIS CHANGE NOTICE</b>			
Document Number	Revision	Document Title	
TVA-KIF-SOP-02	1	Groundwater Sampling	
Requestor: Jacob Gruzalski			
Date of Request: 7-13-2011			
Reason for Change: Most groundwater monitoring at TVA KIF is performed by the TVA groundwater sampling team. The "Preliminary Groundwater Data Field Worksheet" utilized by the sampling team fulfills the documentation requirements of TVA-KIF-SOP-02, is preferred by the sampling team and will be consistent with documentation from other TVA facilities.			
Existing Condition: Currently Table 2 "Low-Flow Indicator Parameter Stabilization Form" is included in TVA-KIF-SOP-02 to document water parameter readings during sampling.			
Change (Change to): Replace current Table 2 with the "Preliminary Groundwater Data Field Worksheet". The proposed form is attached to this Change Notice.			

Requestor completes the information requested above and submits to Document Control

RESPONSE/DISPOSITION OF THE CHANGE NOTICE		
Name	Signature	Date
Jacob Gruzalski		7-19-11
Document Owner:	<input checked="" type="checkbox"/> Concurrence	
Technical Reviewer's Organization, Name, Signature, and Date:		
William J Rogens		7/19/11
Quality Assurance:	<input checked="" type="checkbox"/> Concurrence	
Michelle Cagley		7/19/11
Regulatory Compliance:	<input checked="" type="checkbox"/> Concurrence	
Neil E. Giviter		7/20/11
Environmental Management	<input checked="" type="checkbox"/> Approved	





**KINGSTON ASH RECOVERY PROJECT  
CHANGE NOTICE (CN)**

for Procedures, Work Plans, and Other, Documents Controlled by Environmental

<b>CN Number:</b>	KRP-CN-004	<b>Page No(s) Impacted:</b>	Page 4
<b>CN Title:</b> TVA-KIF-SOP-059 Revision – on-boat sample processing			
<b>DOCUMENT AFFECTED BY THIS CHANGE NOTICE</b>			
<b>Document Number</b>	<b>Revision</b>	<b>Document Title</b>	
TVA-KIF-SOP-59	0	Periphyton Sampling	
<b>Requestor:</b> Jacob Gruzalski			
<b>Date of Request:</b> 7-13-2011			
<b>Reason for Change:</b> During recent periphyton sampling, the sample team elected to collect the sample on the boat as opposed to transferring periphytometers back to the sample house for processing. Doing this ensures minimal moisture loss prior to freezing samples for shipment to the lab.			
<b>Existing Condition:</b> Section 3.4 of TVA-KIF-SOP-59 states that periphytometers placed in plastic sealable bags and transported to a pre-selected location (such as the Lakeshore Dr. Sampling House) for processing.			
<b>Change (Change to):</b> <ol style="list-style-type: none"> <li><b>Edit Section 3.4 c as follows:</b> If transporting periphytometers to an onshore location for processing, place each periphytometer in a separate resealable plastic bag. Label bag with the following information: sample ID, time of collection, and sample collector name(s). Place bag in an environmental cooler on bagged wet ice.</li> <li><b>Edit Section 3.4 d as follow:</b> If processing periphyton samples at the sampling location, proceed to Section 3.5 of this SOP.</li> </ol>			

Requestor completes the information requested above and submits to Document Control

RESPONSE/DISPOSITION OF THE CHANGE NOTICE		
Name	Signature	Date
Jacob Gruzalski		7-19-11
<b>Document Owner:</b>	<input checked="" type="checkbox"/> Concurrency	
<b>Technical Reviewer's Organization, Name, Signature, and Date:</b>		
William J. Rogers		7-19-2011
<b>Quality Assurance:</b>	<input checked="" type="checkbox"/> Concurrency	
Michelle Cagley		7-19-11
<b>Regulatory Compliance:</b>	<input checked="" type="checkbox"/> Concurrency	
Neil E. Carriker		7/21/11
<b>Environmental Management</b>	<input checked="" type="checkbox"/> Approved	



**KINGSTON ASH RECOVERY PROJECT  
CHANGE NOTICE (CN)**

for Procedures, Work Plans, and Other, Documents Controlled by Environmental

<b>CN Number:</b>	KRP-CN-005	<b>Page No(s) Impacted:</b>	Appendices D and E
<b>CN Title: Radionuclide and Metals Speciation Holding Times Changes and Various Other Edits to Appendices D and E of the SAP</b>			

**DOCUMENT AFFECTED BY THIS CHANGE NOTICE**

Document Number	Revision	Document Title
EPA-AO-021		Kingston Ash Recovery Project Non-Time Critical Removal Action for the River System Sampling and Analysis Plan (SAP)

**Requestor: Erin Rodgers – Environmental Standards, Inc.**

**Date of Request: 6/27/11**

**Reason for Change:** The holding time in the SAP QAPP addendum for radionuclide in frozen fish tissue is 6 months. The TVA Kingston Ash Recovery Project will employ a 1 year holding time. This holding time is justified due to the long half-life of the radionuclides of interest to the project and the chemical stability and lack of volatility of the radionuclides of interest. Cs-137 uses of a technique which does not require chemical separation. Additionally, a holding time for speciation in frozen fish tissue was not identified in the SAP QAPP addendum. The holding time for speciation in frozen fish tissue should be 1 year. Various other small edits and omissions to App D of the SAP QAPP addendum are addressed in the attached memorandum dated 12-15-2010.

**Existing Condition:** For the biota holding times addressed above, Spring 2010 fish samples were sent to the laboratories for analysis beyond the 6 month holding time.

**Change (Change to):** Corrections and additions to App D of the SAP QAPP addendum per the attached memorandum dated 12-15-10.

Requestor completes the information requested above and submits to Document Control

**RESPONSE/DISPOSITION OF THE CHANGE NOTICE**

<b>Name</b> Jennifer Garbe for Erin Rodgers	<b>Signature</b> 	<b>Date</b> 7/20/11
<b>Document Owner:</b> <input checked="" type="checkbox"/> Concurrence		
<b>Technical Reviewer's Organization, Name, Signature, and Date:</b>		
<b>Name</b> William J. Rogers	<b>Signature</b> 	<b>Date</b> 7/20/11
<b>Quality Assurance:</b> <input checked="" type="checkbox"/> Concurrence		
<b>Name</b> Michelle Cagley	<b>Signature</b> 	<b>Date</b> 7/21/11
<b>Regulatory Compliance:</b> <input checked="" type="checkbox"/> Concurrence		
<b>Name</b> Neil E. Carrick	<b>Signature</b> 	<b>Date</b> 7/21/11
<input checked="" type="checkbox"/> Approved		



Neil Crocker

Neil E. Paul

7/21/0

Environmental Management  Approved

Comments:

## MEMORANDUM

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To: William J. Rogers, Ph.D. – Tennessee Valley Authority

From: Jennifer N. Gable – Environmental Standards, Inc.

Copy to: Michelle Cagley – Tennessee Valley Authority  
Paul Clay – Restoration Services, Inc.  
Mark Stack – Jacobs Engineering  
Michael Houck – Jacobs Engineering  
Rock J. Vitale, CEAC, CPC – Environmental Standards, Inc.  
Ruth L. Forman, CEAC – Environmental Standards, Inc.

Subject: Revised Review Comments for Appendices D and E to the *Kingston Ash Recovery Project Non-Time-Critical Removal Action for the River System Sampling and Analysis Plan (SAP; May 24, 2010)*

Date: Revised July 29, 2011; Originally Provided December 15, 2010

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In July 2009, Environmental Standards, Inc. (Environmental Standards) was requested to review the draft *Kingston Ash Recovery Project Non-Time-Critical Removal Action for the River System Sampling and Analysis Plan (SAP)*. Environmental Standards' comments about this document were provided on August 9, 2009. The draft SAP reviewed previously did not include the Appendices to the document, which were in preparation at the time of review. The Appendices were not reviewed by Environmental Standards prior to finalization of the SAP.

With the recent implementation of several sampling tasks identified in the SAP, it has become apparent that some information presented in the SAP Appendices is incorrect or inappropriate for the sampling described; in addition, it is apparent that some information was excluded from the SAP Appendices. Accordingly, Environmental Standards performed a comprehensive review of the SAP Appendix D (Field Sampling Summary) and Appendix E (QAPP Addendum). A summary of Environmental Standards' comments is provided below.

### Appendix D – Field Sampling Summary

#### Ash Deposit Sampling

##### Analytical Method

- The Polarized Light Microscopy (PLM) method reference for fixed-base laboratory analysis is EPA-600/M4-82-020; should reference laboratory SOP OPT-023 (*Standard Operating Procedure for Determining Fly Ash in Bulk Samples by Polarized Light Microscopy*).

### Seasonally Exposed Sediment Sampling

#### Required Analysis

- TOC analysis should be added for the randomly selected 25% samples.

#### Analytical Method

- TOC analyses should be reference SW-846 Method 9060/Lloyd Kahn/ASTM D2974.
- The PLM method reference is EPA-600/M4-82-020; however, the Required Analysis field indicates field analysis of ash by PLM only.
- The PLM-method reference for fixed-base laboratory analysis is EPA-600/M4-82-020; should reference laboratory SOP OPT-023 *Standard Operating Procedure for Determining Fly Ash in Bulk Samples by Polarized Light Microscopy*.
- The method reference for mercury is SW-846 7470A. The method reference for mercury in solid samples should be SW-846 Method 7471A.

#### Holding Time

- The holding times for metals speciation are not listed. The holding time for arsenic species is 28 days from collection and the holding times for selenium and mercury species are 1 year from collection for frozen samples.
- The holding time for Cr(VI) is indicated as "24 hours from collection." The holding time for hexavalent chromium in solid samples is 30 days from collection.

#### Analytical Method

- Radionuclides – all radionuclide analyses should reference EML HASL 300 (gamma spectroscopy).

#### Sample Preservation

- As, Se, Hg speciation – samples must be frozen (<- 10° C) and shipped on dry ice.

#### Containers

- PLM – indicates two 4-ounce jars to be collected (1 field laboratory; 1 fixed laboratory). Required Analysis indicates field analysis of PLM only.
- TOC – samples should be collected in one 8-ounce glass containers.
- As, Se, Hg species – samples should be collected in one 500-mL HDPE container.

### Submerged Sediment Sampling by Hand Auger/VibeCore

#### Analytical Method

- Radionuclides – all radionuclide analyses should reference EML HASL 300 (gamma spectroscopy).
- Method reference for mercury is SW-846 7470A. The sediment method reference should be SW-846 Method 7471A.

#### Holding Time

- The mercury holding time is not listed; the mercury holding time is 28 days from collection.
- The holding times for metals speciation are not listed. The holding time for arsenic species is 28 days and the holding times for selenium and mercury species are 1 year for frozen samples.
- The holding time for Cr(VI) is indicated as “24 hours.” The holding time for hexavalent chromium in solid samples is 30 days from collection.

#### Sample Preservation

- AVS/SEM – samples must be frozen (< -10°C) and shipped on dry ice.
- As, Se, Hg speciation – samples must be frozen (< -10°C) and shipped on dry ice.

#### Containers

- TOC – samples should be collected in one 8-ounce glass containers.
- As, Se, Hg species – samples should be collected in one 500-mL HDPE container.

### Submerged Sediment Sampling by Ponar Sampling Device

#### Analytical Method

- Radionuclides – all radionuclide analyses should reference EML HASL 300 (gamma spectroscopy).

#### Sample Preservation

- AVS/SEM – samples must be frozen (< -10°C) and shipped on dry ice.

#### Containers

- TOC – samples should be collected in one 8-ounce glass containers.

### Surface Water

#### Holding Time

- The holding time for mercury not listed; the mercury holding time is 28 days from collection.
- The holding time for Cr(VI) is indicated as "28 days." The holding time for hexavalent chromium in aqueous samples is 24 hours to sample preservation.

#### Preservation

- Samples for radionuclide analyses must be preserved with HNO<sub>3</sub> to pH < 2.

### Groundwater Sampling and Aquifer Testing

#### Holding Time

- The holding time for mercury not listed; the mercury holding time is 28 days.

#### Preservation

- Radionuclides should be preserved with HNO<sub>3</sub> to pH < 2.

### Benthic Invertebrates Sampling

#### Analytical Method

- Metals and mercury analyses are currently conducted using SW-846 Method 6020.
- SW-846 Method 7471 citation should remain to allow flexibility.

#### Holding Time

- The metals and mercury holding times are 1 year for frozen (<- 10°C) or freeze-dried tissue samples.

#### Sample Preservation

- Samples must be maintained frozen (<- 10°C) until preparation.

### Fish Sampling

#### Analytical Method

- Metals and mercury analyses are currently conducted using SW-846 Method 6020. SW-846 Method 7471 citation should remain to allow flexibility.

#### Holding Time

- Holding times for all parameters are 1 year for frozen tissue (< - 10°C). A pesticide/PCB holding time extension has been addressed in a justification memorandum prepared by Mark Stack.

#### Containers

- Radionuclides analyses require 150 – 200 grams of sample.

#### Wildlife Sampling

##### Sample Point

- The only species identified is birds; amphibians, turtles, and raccoons should be included in the wildlife section.

##### Analytical Method

- Metals and mercury analyses are currently conducted using SW-846 Method 6020. SW-846 Method 7471 citation should remain to allow flexibility.

##### Holding Time

- Holding times for all parameters are 1 year for frozen (< - 10°C) tissue samples.

#### Aquatic Vegetation Sampling

##### Analytical Method

- Metals and mercury analyses are currently conducted using SW-846 Method 6020. SW-846 Method 7471 citation should remain to allow flexibility.

##### Holding Time

- Holding times for all parameters are 1 year for frozen (<- 10°C) tissue samples.

### **Appendix E – Quality Assurance Project Plan Addendum**

#### Tables E-3 and E-6

- Strontium is not listed; strontium should be included as a metal of interest for sediment/ash and surface water.

Table E-7

- The Polarized Light Microscopy (PLM) Field Duplicate Precision acceptance criterion should be relative percent difference (RPD) < 35%. The acceptance criteria for PLM laboratory duplicates should be ± 10% difference.

Table E-8

- Precision and Accuracy Objectives for Polynuclear Aromatic Hydrocarbons (PAHs) provided in the SAP are not consistent with the Precision and Accuracy Objectives for PAHs provided in the TVA-KIF-QAPP.
- LCS Accuracy and MS/MSD Accuracy limits are very strict for extractable methods. LCS and MS/MSD Accuracy limits for PAHs, Alkylated PAHs, Pesticides, and PCBs should be 50-130% (consistent with QAPP limits for similar extractable methods).
- Precision and Accuracy Objectives are not provided for arsenic, selenium, and mercury speciation analyses or for PLM analyses (fixed-base laboratory).

Analyte	Method	Surrogate Compound Recoveries / Chemical Yield (%)	LCS Accuracy (% Recovery)	MS/MSD Accuracy (% Recovery)	LCS/LCSD Precision (RPD)	MS/MSD Precision (RPD)	Laboratory Duplicate Precision	Field Duplicate Precision
Metals Speciation (As, Se, Hg, Cr)	Cr(VI) – SW-846 3060A/7199  As, Se, Hg – Laboratory SOPs	NA	80-120%	75-125%	35%	35%	35%	RPD < 35% Difference < 2× RL
PLM (fixed laboratory)	EPA-600/M4-82-020	NA	NA	NA	NA	NA	± 10%	35%

Table E-10

- LCS Accuracy and MS/MSD Accuracy limits are very strict for extractable methods. LCS and MS/MSD Accuracy limits for PAHs, Alkylated PAHs, Pesticides, and PCBs should be 50-130% (consistent with QAPP limits for similar extractable methods).
- Precision and Accuracy Objectives are not provided for arsenic, selenium, and mercury speciation analyses or for PLM analyses (fixed-base laboratory).

Analyte	Method	Surrogate Compound Recoveries/ Chemical Yield (%)	LCS Accuracy (% Recovery)	MS/MSD Accuracy (% Recovery)	LCS/LCSD Precision (RPD)	MS/MSD Precision (RPD)	Laboratory Duplicate Precision (RPD)	Field Duplicate Precision
Metals Speciation (As, Se, Hg, Cr)	Cr(VI) – SW-846 3060A/7199  As, Se, Hg – Laboratory SOPs	NA	80-120%	75-125%	35%	35%	35	RPD < 35% Difference < 2× RL
Radiological Parameters	EPA 901.1 Modified /EPA 903.1 Modified/EPA 904.0 Modified/EML HASL 300	30-110%	80-120%	70-130%	NA	NA	RPD < 35% RER < 3%	RPD < 35% RER < 3%

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End of Memorandum.

## **ATTACHMENT 2**

### **Revised Sampling and Analysis Plan Appendices D and E**

Modifications to the SAP are highlighted in **red**

**Appendix D  
Field Sampling Summary**

Sample Task	Sample Point	Approx Sample No	Matrix	Sampling Method/ Equipment	Required Analysis	Analytical Method	Holding Time	Sample Preservation	Containers
<b>Ash Deposit Sampling</b>									
Emory River Reference Reach	10 locations upstream of ERM 6.0, 3 locations upstream of CRM 4.5, 3 locations upstream of TRM 568.0	16 samples	Ash/ Sediment	Vibracore	Visual observations PLM (field lab)	Field Observations <b>TVA-KIF-SOP-27</b>	None	None	PLM - 1 x 4-oz jar
Emory Reach C	ERM 3.5 - ERM 6.0 - 10 1/4 mile transects, samples collected left-center-right in river channel	30 samples							
Emory Reach B (Channel)	ERM 1.5 - ERM 3.5 - 16 dredge grid sections with 2 samples per grid section	32 samples							
Emory Reach B (Non-channel)	ERM 1.5 - ERM 3.5 - 16 1/8 mile sections, samples collected left-right of channel, plus 10 samples targeting larger coves	32 samples							
Intake Channel	5 random locations collected similar to non-channel sections above	5 samples							
Emory Reach A	ERM 0.0 - ERM 1.5 - 12 1/8 mile sections, samples collected left-center-right of channel	36 samples							
Clinch Reach B	CRM 3.0 - CRM 4.5 - 12 1/8 mile sections, samples collected left-center-right of channel	36 samples							
Clinch Reach A	CRM 0.0 - CRM 3.0 - 12 1/8 mile sections, samples collected left-center-right of channel	36 samples							
Tennessee Reach B	TRM 566 - 568 - 8 1/2 mile sections, samples collected left-center-right of channel	12 samples							
Tennessee Reach A	TRM 550 - 566 - 4 sections, every 5 miles; samples collected left-center-right of channel	12 samples							
Small coves	Selected small coves or anomalies	21 samples							
Confirmatory PLM	10% or samples sent to fixed lab for PLM	26 samples			PLM (fixed lab)	EPA-600/M4-82-020, <b>RJ Lee Group, Inc. SOP OPT-023</b>	None	None	PLM - 1 x 4-oz jar
<b>Seasonally-Exposed Sediment Sampling</b>									
Emory Reference Reach	Upstream of ERM 6.0 in the Emory River, collected randomly along shoreline	5 samples	Ash/ Sediment	Hand Auger/ Vibracore	Visual observations PLM (field lab) Metals	<b>PLM - TVA-KIF-SOP-27</b> <b>Metals/Hg - SW-846</b> <b>6010B/6020/7471A</b>	<b>PLM - none</b> <b>Metals - 180 days</b> <b>Hg - 28 days</b>	<b>PLM - none</b> <b>Metals/Hg - cool</b> <b>&lt;6°C</b>	<b>PLM - 1 x 4-oz jar</b> <b>Metals/Hg -</b> <b>1 x 8-oz jar</b>
Emory Reach C	ERM 3.5 - ERM 6.0 - 10 locations, 4 per mile alternating left-right bank	10 samples							
Emory Reach B	ERM 1.5 - ERM 3.5 - 16 locations, 8 per mile alternating left-right bank	16 samples							
Intake Channel	2 random locations	2 samples							
Emory Reach A	ERM 0.0 - ERM 1.5 - 12 locations, 8 per mile alternating left-right bank	12 samples							

**Appendix D  
Field Sampling Summary**

Sample Task	Sample Point	Approx Sample No	Matrix	Sampling Method/ Equipment	Required Analysis	Analytical Method	Holding Time	Sample Preservation	Containers					
Clinch Reach B	CRM 3.0 - CRM 4.5 - 12 locations, 8 per mile alternating left-right bank	12 samples												
Clinch Reach A	CRM 0.0 - CRM 3.0 - 12 locations, 4 per mile alternating left-right bank	12 samples												
Radionuclides, Legacy Constituents, and Chemical Speciation Samples	Random selection of 25% of above locations	18 samples								Radionuclides (K-40, RA 226/228, iso-Th, iso-U, Cs-137, Co-60) PAHs (parent & alkylated) PCBs Pesticides Metals speciation (As, Se, Hg, Cr) TOC	<b>Radionuclides -EML HASL-300</b> <b>PAHs</b> - SW-846 8270 SIM <b>PCBs</b> - SW-846 8082 <b>Pest</b> - SW-846 8081A <b>CrVI</b> - SW846 3060A/7199 <b>As</b> - EPA 1632 mod <b>Hg</b> - EPA 1630/1631 mod <b>Se</b> - Lab SOP <b>TOC</b> - ASTM D-2974/ Walkley Black	<b>Radionuclides</b> - 180 days <b>PAHs, PCBs, Pest</b> - 14 days prep, then 40 days to analysis <b>CrVI</b> - <del>24 hours</del> 30 days <b>As</b> - 28 days <b>Se and Hg</b> - 1 year <b>TOC</b> - 14 days	<b>Radionuclides</b> - cool <6°C <b>PAHs, PCBs, Pest</b> - cool <6°C <b>CrVI</b> - cool <6°C <b>As, Se, Hg</b> - frozen (-10° C) ship on dry ice <b>TOC</b> - cool <6°C	<b>Radionuclides</b> - 1 x 8-oz jar <b>PAHs, PCBs, Pest, Metals</b> - 1 x 8-oz jar <b>CrVI</b> - 1 x 8 oz jar <b>As, Se, Hg</b> - 1 x 500 ml HDPE jar <b>TOC</b> - 1 x 8 oz jar
Confirmatory PLM	Random selection of 10% of above locations	7 samples								PLM (fixed lab)	EPA-600/M4-82-020, <b>RJ Lee Group, Inc. SOP OPT-023</b>	None	None	<b>PLM</b> - 1 x 4-oz jar
<b>Submerged Sediment Sampling</b>														
Reference Locations (Emory, Clinch, Tennessee Rivers)	3 locations upstream of ERM 6.0, 3 locations upstream of CRM 4.5, 3 locations upstream of TRM 568.0	9 samples	Ash/ Sediment	Hand Auger/ Vibracore	Visual observations and PLM (included in ash deposit sampling) Metals	<b>Metals</b> - SW-846 6010B/6020/7471A	<b>Metals</b> - 180 days <b>Hg</b> - 28 days	<b>Metals</b> - cool <6°C	<b>Metals</b> - 1 x 8-oz jars					
Emory Reach C	ERM 3.5 - ERM 6.0 - 10 locations, 4 per mile	10 samples												
Emory Reach B	ERM 1.5 - ERM 3.5 - 16 locations, 8 per mile	16 samples												
Intake Channel	2 random locations	2 samples												
Emory Reach A	ERM 0.0 - ERM 1.5 - 12 locations, 8 per mile	12 samples												
Clinch Reach B	CRM 3.0 - CRM 4.5 - 12 locations, 8 per mile	12 samples												
Clinch Reach A	CRM 0.0 - CRM 3.0 - 12 locations, 4 per mile	12 samples												
Tennessee Reach B	TRM 566 - 568 - 4 locations, 2 per mile	4 samples												
Tennessee Reach A	TRM 550 - 566 - 4 locations, every 5 miles	4 samples												

**Appendix D  
Field Sampling Summary**

Sample Task	Sample Point	Approx Sample No	Matrix	Sampling Method/ Equipment	Required Analysis	Analytical Method	Holding Time	Sample Preservation	Containers
Radionuclides, Legacy Constituents, and Chemical Speciation Samples	Random selection of 25% of above samples	20 samples			Radionuclides (K-40, Ra-226/228, iso-Th, iso-U, Cs-137, Co-60) PAHs (parent & alkylated) PCBs Pesticides AVS/SEM Metals speciation (As, Se, Hg, Cr) TOC	<b>Radionuclides - EML HASL-300</b> <b>PAHs - SW-846 8270 SIM</b> <b>PCBs - SW-846 8082</b> <b>Pest - SW-846 8081A</b> <b>AVS/SEM - EPA-821-R-91-100</b> <b>CrVI - SW-846 3060A/7199,</b> <b>As - EPA 1632 mod</b> <b>Hg - EPA 1630/1631 mod</b> <b>Se - Lab SOP</b> <b>TOC - ASTM D2974/ Walkley Black</b>	<b>Radionuclides - 180 days</b> <b>PAHs, PCBs, Pest - 14 days prep, then 40 days to analysis</b> <b>AVS/SEM - 14 days</b> <b>CrVI- 24 hours 30 days</b> <b>As - 28 days</b> <b>Se and Hg - 1 year</b> <b>TOC - 14 days</b>	<b>Radionuclides - cool &lt;6°C</b> <b>PAHs, PCBs, Pest - cool &lt;6°C</b> <b>AVS/SEM - cool &lt;6°C</b> <b>&lt;6°C frozen (-10°C) ship on dry ice</b> <b>As, Se, Hg - frozen (-10° C) ship on dry ice</b> <b>CrVI - cool &lt;6°C</b> <b>TOC - pH&lt;2 HCl, cool &lt;6°C</b>	<b>Radionuclides - 1 x 8-oz jars</b> <b>PAHs, PCBs, Pest - 2 x 8 oz jar</b> <b>TOC - 2 x 4 oz jar</b> <b>AVS/SEM - Lexan liner/4 oz glass (zero headspace)</b> <b>As, Se, Hg - TOC - 2 x 40 mL glass vial</b> <b>1 x 500 ml HDPE jar</b> <b>CrVI - 1 x 8 oz jar</b>
<b>Submerged Sediment Sampling - Bioassay</b>									
Reference Locations	Upstream Emory River > ERM 6.0	2 samples	Ash/ Sediment	Ponar Sampling Device	PLM PAHs (parent & alkylated) PCBs Pesticides Metals CrVI Radionuclides (K-40, Ra-226/228, iso Th, iso U, Cs-137, Co-60) AVS/SEM EPA tox test parameters (e.g, TOC, grain size) Sequent-extract metals Metals speciation (As, Se, Hg)	<b>PLM - EPA-600/M4-82-020, RJ Lee Group, Inc. SOP OPT-023</b> <b>PAHs - SW-846 8270 SIM</b> <b>PCBs - SW-846 8082</b> <b>Pest - SW-846 8081A</b> <b>Metals - SW-846 6010B/6020/7471A</b> <b>CrVI - SW-846 3060A/7199</b> <b>Radionuclides - EML HASL-300</b> <b>AVS/SEM - EPA-821-R-91-100</b> <b>TOC - ASTM D2974/ Walkley Black</b> <b>Grain size - ASTM D 422</b> <b>Sequentially-extracted metals (SEM) - Querol et. al. (1999)</b> <b>As - EPA 1632 mod</b> <b>Hg- EPA 1630/1631 mod</b> <b>Se - Lab SOP</b>	<b>PLM - none</b> <b>PAHs, PCBs, Pest - 14 days prep, then 40 days to analysis</b> <b>Metals - 180 days</b> <b>Hg - 28 days</b> <b>CrVI - 30 days</b> <b>Rad - 180 days</b> <b>AVS/SEM - 14 days to AVS analysis, 180 days to metals analysis</b> <b>TOC - 14 days</b> <b>Grain size - none</b> <b>SEM - 14 days prep/ 180 analysis</b> <b>As - 28 days</b> <b>Se and Hg - 1 year</b>	<b>PLM - none</b> <b>PAHs, PCBs, Pest - cool &lt;6°C</b> <b>Metals - none</b> <b>CrVI - cool &lt;6°C</b> <b>Radionuclides - cool &lt;6°C</b> <b>AVS/SEM - cool &lt;6°C</b> <b>&lt;6°C frozen (-10°C) ship on dry ice</b> <b>TOC - none cool &lt;6°C</b> <b>Grain size - none</b> <b>SEM - cool &lt;6°C</b> <b>As, Se, Hg - frozen (-10° C) ship on dry ice</b>	<b>PLM - 1 x 4 oz jar</b> <b>PAHs, PCBs, Pest, Metals - 2 x 8 oz jars</b> <b>TOC - 2 x 4 oz jars</b> <b>CrVI - 1 x 8 oz jar</b> <b>Radionuclides - 1 x 8 oz jar</b> <b>AVS/SEM - Lexan liner/4 oz glass (zero headspace)</b> <b>Grain size - 1 x 8 oz jar</b> <b>SEM - 1 x 4oz Jar, no headspace</b> <b>As, Se, Hg - 1 x 500 ml HDPE jar</b>
Emory Reaches A, B, C	ERM 0.0 - 1.5, ERM 1.5 - 3.5, ERM 3.5 - 6.0	8 samples							
Reference Locations	Upstream Clinch River > CRM 4.5	2 samples							
Clinch Reaches A, B	CRM 0.0 - 3.0, ERM 3.0 - 4.5	8 samples							
<b>Sediment Porewater Sampling</b>									
Reference Locations	Upstream Emory River > ERM 6.0	2 samples	Sediment Porewater	Ponar Sampling Device or Vibracore	PLM Metals (dissolved) Metals speciation (As and Se) DOC Hardness Major ions (chloride, sulfate)	<b>PLM - EPA-600/M4-82-020, RJ Lee Group, Inc. SOP OPT-023</b> <b>Metals - SW-846 6010B/6020/7470A</b> <b>As - EPA 1632 mod</b> <b>Se - Lab SOP</b> <b>DOC - SM 5310B</b> <b>Hardness - EPA 200.7/200.8, SM 2340B</b>	<b>PLM - none</b> <b>Metals - 180 days</b> <b>Hg - 28 days</b> <b>As - 28 days</b> <b>Se - 1 year</b> <b>DOC - 28 days</b> <b>Hardness - 180 days</b> <b>Major ions - 28 days</b>	<b>PLM - none</b> <b>Metals/Hg - filter then pH&lt;2 HNO3</b> <b>As and Se - cool &lt;6°C</b> <b>DOC - field filter, pH&lt;2 H2SO4, cool &lt;6°C</b>	<b>PLM - 1 x 4 oz jar</b> <b>Metals/Hg - 1 x 1-L HDPE</b> <b>As, Se, Hg - 1 x 250 mL HDPE</b> <b>DOC - 1 x 250 mL jar</b> <b>Hardness - 1 x 250</b>
Emory Reaches A, B, C	ERM 0.0 - 1.5, ERM 1.5 - 3.5, ERM 3.5 - 6.0	8 samples							
Reference Locations	Upstream Clinch River > CRM 4.5	2 samples							

**Appendix D  
Field Sampling Summary**

Sample Task	Sample Point	Approx Sample No	Matrix	Sampling Method/ Equipment	Required Analysis	Analytical Method	Holding Time	Sample Preservation	Containers					
Clinch Reaches A, B	CRM 0.0 - 3.0, ERM 3.0 - 4.5	8 samples			Alkalinity DO, pH, ORP, SC	<b>Major ions</b> - EPA 300 <b>Alkalinity</b> - SM 2320B <b>DO, pH, ORP, SC</b> - direct measurement	<b>Alkalinity</b> - 14 days	<b>Hardness</b> - pH<2 HNO3, cool <6°C <b>Major ions</b> - cool <6°C <b>Alkalinity</b> - cool <6°C	mL HDPE <b>Major ions</b> - 1 x 250 mL HDPE <b>Alkalinity</b> - 1 x 250 mL HDPE					
<b>Overlay Water Sampling</b>														
Emory Reference Reach	Upstream of ERM-6.0	12 samples	Surface Water	Peristaltic pump	Metals	<b>Metals</b> - SW-846 6010B/7470A	<b>Metals</b> - 180 days <b>Hg</b> - 28 days	<b>Metals/Hg</b> - pH<2 HNO3, cool <6°C	<b>Metals/Hg</b> - 1 x 500 mL HDPE					
Clinch Reference Reach	Upstream of CRM-4.5	15 samples			DOC TSS	<b>DOC</b> - SM5310B <b>TSS</b> - SM2540D	<b>DOC</b> - 28 days <b>TSS</b> - 7 days	<b>DOC</b> - pH<2 H2SO4, cool <6°C <b>TSS</b> - cool <6°C	<b>DOC</b> - 1 x 1L HDPE <b>TSS</b> - 2 x 1L HDPE					
<b>Surface Water Sampling</b>														
Reference Locations (Emory, Clinch, Tennessee Rivers)	ERM 8.0, CRM 6.0, TRM 568.5 (adjust to correlate with reference sediments) - 3 locations x 2 depths x 8 weekly rounds	48 samples	Surface Water	Peristaltic pump	Metals (total/dissolved) TSS/TDS DOC Hardness DO, pH, ORP, SC, temp, turbidity	<b>Metals</b> - SW-846 6010B/6020/7470A; EPA 200.7/200.8/245.7 <b>TSS</b> - EPA 160.2 <b>TDS</b> - EPA 160.1 <b>DOC</b> - SM 5310B <b>Hardness</b> - EPA 200.7/200.8, SM 2340B <b>DO, pH, ORP, SC, temp, turbidity</b> - direct measurement	<b>Metals</b> - 180 days <b>Hg</b> - 28 days <b>TSS/TDS</b> - 7 days <b>DOC</b> - 28 days <b>Hardness</b> - 180 days	<b>Metals</b> - pH<2 HNO3, cool <6°C <b>TSS/TDS</b> - cool <6°C <b>DOC</b> - field filter, pH<2 H2SO4, cool <6°C <b>Hardness</b> - pH<2 HNO3 cool <6°C	<b>Total metals</b> - 1 x 1 L HDPE <b>Diss metals</b> - 1 x 1 L HDPE <b>TSS</b> - 2 x 1 L HDPE <b>TDS</b> - 1 x 1 L HDPE <b>DOC</b> - 1 x 250 mL glass jar <b>Hardness</b> - 1 x 250 ml HDPE					
Emory River Locations	ERM 1.0, 2.0, 3.0, 4.0 (adjust to correlate with submerged sediments) 4 locations x 2 depths x 8 weekly rounds	64 samples												
Clinch River Locations	CRM 2.0, 3.5 (adjust to correlate with submerged sediments) 2 locations x 2 depths x 8 weekly rounds	32 samples												
Tennessee River Location	TRM 566 (adjust to correlate with submerged sediments) 1 locations x 2 depths x 8 weekly rounds	16 samples												
Radionuclides, and Chemical Speciation Samples	Random selection of 25% of above locations	40 samples								Radionuclides (K-40, Ra-226/228, iso-Th, iso-U, Cs-137, Co-60) Metals speciation (As and Se)	<b>Radionuclides</b> - EML HASL-300 <b>As</b> - EPA 1632 <b>Se</b> - Lab SOP	<b>Radionuclides</b> - 180 days <b>As</b> - 28 days <b>Se</b> - 14 days	<b>Radionuclides</b> - HNO3 to pH<2, cool <6°C <b>As, Se</b> , - cool <6°C	<b>Radionuclides</b> - 1 x 2.5 gal cubitainer <b>As, Se</b> - 1 x 250 mL HDPE
Reference Bioassay Location (Emory River)	ERM 8.0 (adjust to correlate with reference sediments) - 1 location	1 sample								<i>C. dubia</i> - 7 day <i>P. promelas</i> - 7 day	Inland Testing Manual, EPA-821-R-02-013 (EPA Method 1000.0 and 1002.0)	36 hours to first use	Cool <6°C	5 or 2.5 gallon cubitainers
Emory River Bioassay Locations	ERM 1.0, 2.0, 3.0, 4.0 (adjust to correlate with submerged sediments) 4 locations	4 samples												

**Appendix D  
Field Sampling Summary**

Sample Task	Sample Point	Approx Sample No	Matrix	Sampling Method/ Equipment	Required Analysis	Analytical Method	Holding Time	Sample Preservation	Containers
<b>Groundwater Sampling and Aquifer Testing</b>									
Water Level Measurements (Feb-Apr)	4 existing SW locations onsite 60 existing well points in ash 82 existing well points in alluvium 2 existing wells in alluvium 4 new well points in alluvium 3 existing wells in residuum	170 tests	Ground-water	Water Level Meter	Water level	Field Measurement	None	None	None
Water Level Measurements (Jul-Sep)	1 new well in residuum 8 existing well points in bedrock 3 new well points in bedrock 1 existing well in bedrock 2 new wells in bedrock	170 tests							
Vertical Gradient Measurements	8 paired well points	16 tests	Ground-water	Pressure transducers	Hydraulic head	Field Measurement	None	None	None
Soil Porosity/ Density Tests	3 new well boreholes in residuum 3 new well point boreholes in alluvium (sand & clay) 2 boreholes in alluvium (sand & clay)	12 samples	Soil	Shelby Tubes	Dry bulk density Effective porosity Total porosity Moisture content	ASTM D 7263 Article reference (Corey, A.T. 1994) ASTM D 7263 ASTM D 7263	28 days	Sealed ends of sample tube, cool 4°C	Shelby tube
Hydraulic Conductivity Tests	2 new well boreholes in residuum	2 samples	Soil	Shelby Tubes	<del>Vertical Saturated</del> hydraulic conductivity Water Potential Specific Gravity Fine	ASTM D2434 ASTM D6836 ASTM D854	None	Sealed ends of sample tube	Shelby tube
In-situ Hydraulic Conductivity Measurements	3 new well points in Dredge/Ash Pond Area -- alluvium (silt/clay and sand)	3 tests	Aquifer	Borehole flow meter test	Horizontal hydraulic conductivity	Field measurement	None	None	None
	AD-1, AD-2, 6AR, 22, TWP-22, and new upgradient residuum well GW-1	6 tests		Aquifer slug test					
	3 new well points in Dredge/Ash Pond Area -- bedrock	3 tests		Single well aquifer pump test					
	2 new upgradient bedrock wells	2 tests							
Column Leaching Tests	6 samples - ash landfill/stilling pond 2 samples - ash processing area	8 samples	Ash	Split barrel samplers	Column leaching test (As, Hg, Cr, Se, Ra-226, Th-228)	SW-846 Method 1314 (draft) ASTM D4793	None	None	2 x 16 oz jars

**Appendix D  
Field Sampling Summary**

Sample Task	Sample Point	Approx Sample No	Matrix	Sampling Method/ Equipment	Required Analysis	Analytical Method	Holding Time	Sample Preservation	Containers
<b>Groundwater Sampling and Aquifer Testing</b>									
Soil Attenuation Capacity Tests	4 samples of alluvial clay/silt 5 samples of alluvial silty sand	9 samples	Soil	Shelby tube or split barrel sampler w/ liner	Mineral composition Free iron oxide CEC, exchangeable cations, calcite equivalent, soluble salts, soil pH	<b>Mineral composition</b> - XRD and polarized light microscopy <b>Free Iron Oxide</b> - Chao and Zhou (1983) <b>CEC, exchangeable cations, calcite equivalent, soluble salts, soil pH</b> - ASA 1996, Methods 14,15,16, and 40, or equivalent Lab SOP	28 days	Sealed ends of sample tube, cool <6°C	Shelby tube or split-barrel liner
Constituent Concentrations in Groundwater in Contact with Ash	18 boreholes/Geoprobes in ash	18 samples	Leachate	DPT or low-flow sampling	Metals (diss.) TSS, TDS Anions (chloride, fluoride, sulfate, nitrate-nitrite) Ammonia-N Radionuclides (diss.) (K-40, Ra-226/228, iso-Th, iso-U) Field parameters (pH, ORP, DO, SC, temperature)	<b>Metals</b> - SW-846 6010B/6020/7470A ; EPA 200.7/200.8/245.7 <b>TSS</b> - EPA 160.2 <b>TDS</b> - EPA 160.1 <b>Anions</b> - EPA 300 <b>Ammonia-N</b> - EPA 350.1 <b>Radionuclides</b> - <b>EML HASL 300</b>	<b>Metals</b> - 180 days <b>Hg</b> - 28 days <b>TSS/TDS</b> - 7 days <b>Anions</b> - 28 days <b>Ammonia-N</b> - 28 days <b>Radionuclides</b> - 180 days	<b>Metals</b> - pH<2 HNO3, cool <6°C <b>TSS/TDS/Anions</b> - cool <6°C <b>Ammonia</b> - pH<2 H2SO4, cool <6°C <b>Radionuclides</b> - <b>HNO3 to pH &lt;2</b> , cool <6°C	<b>Metals</b> - 1 x 1 L HDPE <b>TSS/TDS</b> - 1 x 1 L HDPE <b>Anions</b> - 1 x 1 L HDPE <b>Ammonia</b> - 1 x 1 L HDPE <b>Radionuclides</b> - 1 x 2.5 gal. cube
Constituent Concentrations in Groundwater	6 existing wells 3 new wells 4 new well points in alluvium 3 new well points in bedrock 3 boreholes/Geoprobes in alluvium	19 samples	Ground-water	DPT or low-flow sampling	Metals (diss.) TSS, TDS Anions (chloride, fluoride, sulfate, nitrate-nitrite) Ammonia-N Radionuclides (diss.) (K-40, Ra-226/228, iso-Th, iso-U) Field parameters (pH, ORP, DO, SC, temperature)	<b>Metals</b> - SW-846 6010B/6020/7470A; EPA 200.7/200.8/245.7 <b>TSS</b> - EPA 160.2 <b>TDS</b> - EPA 160.1 <b>Anions</b> - EPA 300 <b>Ammonia-N</b> - EPA 350.1 <b>Radionuclides</b> - <b>EML HASL 300</b>	<b>Metals</b> - 180 days <b>Hg</b> - 28 days <b>TSS/TDS</b> - 7 days <b>Anions</b> - 28 days <b>Ammonia-N</b> - 28 days <b>Radionuclides</b> - 180 days	<b>Metals</b> - pH<2 HNO3, cool <6°C <b>TSS, TDS, Anions</b> - cool <6°C <b>Ammonia</b> - pH<2 H2SO4, cool <6°C <b>Radionuclides</b> - <b>HNO3 to pH &lt;2</b> , cool <6°C	<b>Metals</b> - 1 x 1 L HDPE <b>TSS, TDS</b> - 1 x 1 L HDPE <b>Anions</b> - 1 x 1 L HDPE <b>Ammonia</b> - 1 x 1 L HDPE <b>Radionuclides</b> - 1 x 2.5 gal cube <b>TSS, TDS</b> - 1 x 1 L HDPE
<b>Benthic Invertebrates Sampling</b>									
Reference Locations	Emory River > ERM6.0, Clinch River near CRM 6.0; 3 composite samples per location; each of 3 taxon (snail, larval mayfly, adult mayfly)	18 samples	Benthos non-depurated	Ponar/Peterson	Metals	<b>Metals</b> - SW-846 6010B/6020/7471A	<b>Metals</b> - <del>180 days</del> 1 year <b>Hg</b> - <del>28 days</del> 1 year	<b>Metals/Hg</b> - frozen (-10°C) <del>none</del>	<b>Metals/Hg</b> - 1 x 8 - oz jar (2 g min volume)
Emory Reaches A, B, C	ERM 1.0, 2.5, 4.0; 3 composite samples per location; each of 3 taxon (snail, larval mayfly, adult mayfly)	27 samples							
Clinch Reaches A, B	CRM 1.5, CRM 3.5; 3 composite samples per location; each of 3 taxon (snail, larval mayfly, adult mayfly)	18 samples							

**Appendix D  
Field Sampling Summary**

Sample Task	Sample Point	Approx Sample No	Matrix	Sampling Method/ Equipment	Required Analysis	Analytical Method	Holding Time	Sample Preservation	Containers
Reference Locations	Emory River > ERM6.0, Clinch River near CRM 6.0; 3 composite samples per location; each of 2 taxon (snail, larval mayfly)	12 samples	Benthos depurated	Ponar/ Peterson	Metals	Metals - SW-846 6010B/6020/7471A	Metals -180 days 1 year Hg -28 days 1 year	Metals/Hg - none frozen (-10°C)	Metals/Hg - 1 x 8 - oz jar (2 g min. volume)
Emory Reaches A, B, C	ERM 1.0, 2.5, 4.0; 3 composite samples per location; each of 2 taxon (snail, larval mayfly)	18 samples							
Clinch Reaches A, B	CRM 1.5, CRM 3.5; 3 composite samples per location; each of 2 taxon (snail, larval mayfly)	12 samples							
Reference Location transects	Emory River near ERM 6.0 Clinch River near CRM 6.0 Tennessee River near TRM 574.0; 10 samples/transect	30 samples	Benthos	Ponar/ Peterson	Biosurvey of Benthic Communities	Laboratory identification and enumeration	N/A	Formalin	pint and/or quart jars
Emory River biosurvey transects	ERM 1.0, 2.0, 3.0, 4.0, and 5.0; 10 samples/transect	50 samples							
Clinch River biosurvey transects	CRM 0.5, 1.5, 3.0, and 4.0; 10 samples/transect	40 samples							
Tennessee River biosurvey transects	TRM 560.8 and 566.5; 10 samples/transect	20 samples							
<b>Fish Sampling</b>									
Reference Locations (bass, bluegill, catfish)	Upstream Emory River near ERM 8.0 Upstream Clinch River near CRM 8.0; 3 species per reach; up to 6 replicates	36 samples	Non-Filet Portion of Fish	Electro-shock/ gill net	Metals Speciation (As) % Moisture % Lipids Pest/PCB - 25% of the samples	Metals - SW-846 6010B/6020/7471A % Moisture - ASTM D2974-87 % Lipids - Lab SOP As speciation - EPA 1632 mod PCBs - SW-846 8082 Pest - SW-846 8081A	Metals - 1 year, Hg - 1 year PCBs, Pest - 1 year As speciation - 1 year	frozen (-10°C) ship on dry ice	Plastic bag Metals - 2 g (min. volume) PCBs, Pest - 20 g (min. volume) % Moisture - 0.2 g (min. volume)
Emory Reaches A, B, C (bass, bluegill, catfish)	ERM 1.0, 2.5, 4.5; 3 species per reach; up to 6 replicates	54 samples							
Clinch Reaches A, B (bass, bluegill, catfish)	CRM 1.5, CRM 3.5; 3 species per reach; up to 6 replicates	36 samples							
Reference Locations (bass, bluegill, catfish)	Same as above; filet portion	36 samples	Filet Portion of Fish		Metals Speciation (As) % Moisture % Lipids Pest/PCB - 25% of the samples Radionuclides (K-40, RA 226/228, iso-Th, iso-U, Cs-137, Co-60) (25% of the filet samples)	Metals - SW-846 6010B/6020/7471A % Moisture - ASTM D2974-87 % Lipids - Lab SOP As speciation - EPA 1632 mod PCBs - SW-846 8082 Pest - SW-846 8081 Radionuclides - EML HASL-300	Metals - 1 year Hg - 1 year As speciation - 1 year PCBs, Pest - 1 year Radionuclides - 1 year	frozen (-10°C) ship on dry ice	Plastic bag Metals - 2 g (min. volume) PCBs, Pest - 20 g (min. volume) Radionuclides - 150 - 200 g % Moisture - 0.2 g (min. volume)
Emory Reaches A, B, C (bass, bluegill, catfish)	Same as above; filet portion	54 samples							
Clinch Reaches A, B (bass, bluegill, catfish)	Same as above; filet portion	36 samples							

**Appendix D  
Field Sampling Summary**

Sample Task	Sample Point	Approx Sample No	Matrix	Sampling Method/ Equipment	Required Analysis	Analytical Method	Holding Time	Sample Preservation	Containers
Reference Locations (gizzard shad, threadfin shad)	Upstream Emory River near ERM 8.0 Upstream Clinch River near CRM 8.0; 3 composite samples per reach; 2 species	12 samples	Whole Body Fish		Metals Speciation (As) % Moisture % Lipids Pest/PCB - 25% of the samples	<b>Metals</b> - SW-846 6010B/6020/7471A <b>% Moisture</b> - ASTM D2974-87 <b>% Lipids</b> - Lab SOP <b>As speciation</b> - EPA 1632 mod <b>PCBs</b> - SW-846 8082 <b>Pest</b> - SW-846 8081	<b>Metals - 1 year</b> <b>Hg - 1 year</b> <b>As speciation - 1 year</b> <b>PCBs, Pest - 1 year</b>	frozen (-10°C) ship on dry ice	Plastic bag <b>Metals</b> - 2 g (min. volume) <b>PCBs, Pest</b> - 20 g (min. volume) <b>% Moisture</b> - 0.2 g (min. volume)
Emory Reaches A, B, C (gizzard shad, threadfin shad)	ERM 1.0, 2.5, 4.0; 3 composite samples per reach; 2 species	18 samples							
Clinch Reaches A, B (gizzard shad, threadfin shad)	CRM 1.5, CRM 3.5; 3 composite samples per reach; 2 species	12 samples							
Reference Locations (biosurvey)	Use historical data only	none	Fish		Biosurvey of Fish Community	Field Observations	N/A	N/A	N/A
Emory Reach B (biosurvey)	ERM 1.5-3.5 1 survey per reach	1 survey							
Confluence Emory/Clinch (biosurvey)	Confluence of Emory and Clinch Rivers (ERM 0.0 to 1.0 and CRM 4.0 to 5.0)	1 survey							
Clinch Reaches A (biosurvey)	CRM 0.0-2.0 1 survey per reach	1 survey							
<b>Wildlife Sampling</b>									
Reference Locations (tree swallow)	Melton Hill Dam, Fort Loudon Dam; min. 10 replicates each site	20 samples	Tree Swallow egg/ nestling	Nest Robbing	Metals % Moisture	<b>Metals</b> - SW-846 6010B/6020/7471A <b>Moisture</b> - Lab SOP	<b>Metals - 1 year <del>180</del> days</b> <b>Mercury - 1 year <del>28</del> days</b>	frozen (-10°C) ship on dry ice	Plastic bag <b>Metals</b> - 2 g (min. volume) <b>% Moisture</b> - 0.2 g (min. volume)
Emory River (tree swallow)	Near ERM 2.5 and ERM 3.0; min. 10 replicates each site	20 samples							
Clinch River (tree swallow)	Near CRM 1.0 and CRM 2.5; min. 10 replicates each site	20 samples							
Tennessee River (tree swallow)	Near TRM 566.0; min. 10 replicates each site	10 samples							
Reference Locations (heron)	TN River near TRM 569.5; up to 10 replicates each site	10 samples	Heron egg/ nestling						
Emory River (heron)	Near ERM 3.0; up to 10 replicates each site	10 samples							
Clinch River (heron)	Near CRM 2.5; up to 10 replicates each site	10 samples							
<b>Aquatic Vegetation Sampling</b>									
Reference Locations (emergent macrophytes)	Upstream of ERM 6.0, upstream of CRM 4.5, and upstream of TRM 568.0; 3 locations per reach; 2 samples per location (one of each plant type)	18 samples	Macro-phyte	Plant Clippings	Metals % Moisture	<b>Metals</b> - SW-846 6010B/6020/7471A <b>Moisture</b> - ASTM D2974-87	<b>Metals - 1 year <del>180</del> days</b> <b>Hg - 1 year <del>28</del> days</b>	frozen (-10°C) ship on dry ice	Plastic bag <b>Metals</b> - 2 g (min. volume) <b>% Moisture</b> - 0.2 g

**Appendix D  
Field Sampling Summary**

Sample Task	Sample Point	Approx Sample No	Matrix	Sampling Method/ Equipment	Required Analysis	Analytical Method	Holding Time	Sample Preservation	Containers
Emory Reaches A, B, C (emergent macrophytes)	ERM 0.0-1.5, 1.5-3.5, 3.5-6.0; 3 locations per reach; 2 samples per location (one of each plant type)	18 samples							(min. volume)
Clinch Reaches A, B (emergent macrophytes)	CRM 0.0-3.0, 3.0-4.5; 3 locations per reach; 2 samples per location (one of each plant type)	12 samples							
Tennessee Reach B (emergent macrophytes)	TRM 566-568; 3 locations per reach; 2 samples per location (one of each plant type)	6 samples							
Reference Locations (periphyton)	Upstream of ERM 6.0, upstream of CRM 4.5; one location each reach; 3 composite samples per location	6 samples	Peri-phyton	Artificial Substrate	Metals % Moisture	Metals - SW-846 6010B/6020/7471A Moisture - ASTM D2974-87	Metals - 1 year <del>180</del> days; Hg - 1 year <del>28</del> days	frozen (-10°C) ship on dry ice	Plastic cup Metals - 2 g min % Moisture - 0.2 g (min. volume)
Emory Reaches A, B, C (periphyton)	ERM 1.0, 2.5, 4.0; one location per reach; 3 composite samples per location	9 samples							
Clinch Reaches A, B (periphyton)	CRM 1.5, 3.5; one location per reach; 3 composite samples per location	6 samples							

## Appendix E

### Quality Assurance Project Plan Addendum

The Kingston Ash Recovery Project has developed a comprehensive Quality Assurance Project Plan (QAPP) which governs the collection, analysis, reporting, and use of environmental data associated with the overall project. The QAPP (ESI 2009) has been approved by the U.S. Environmental Protection Agency (EPA) and the Tennessee Department of Environmental Conservation and is available in the Administrative Record, available at [http://www.tva.gov/kingston/admin\\_record/index.htm](http://www.tva.gov/kingston/admin_record/index.htm). The QAPP was prepared in accordance with EPA's *Guidance for Quality Assurance Project Plans*, EPA QA/G-5 (EPA 2002). The QAPP provides the framework for implementation of the environmental sampling to support both time-critical and non-time-critical removal actions, as needed. The QAPP addresses most of the required elements of a QAPP.

This addendum supplements the QAPP by providing task-specific information for the required elements that are not included in the approved QAPP (e.g., task-specific data quality objectives). Table E-1 provides a "cross-walk" that summarizes the document location where the task-specific QAPP-required elements may be found.

Task-specific sampling procedures are described in Section 5.0 of the River System Sampling and Analysis Plan (SAP). Details are specified in the Standard Operating Procedures (SOPs) listed in Table E-2.

Appendix C to the QAPP presents quality assurance requirements for aqueous matrices. For the SAP, aqueous matrices will include sediment porewater, surface water (mid-depth and epibenthic), and groundwater (both in contact with the ash and within the aquifer system). The following supplementary information is provided for the SAP:

- Sample containers, preservation, and holding times for aqueous samples are listed in Table C-1 in the QAPP. Task-specific sample containers, preservation, and holding times shown in Appendix D of the SAP, and take precedence over the QAPP.
- Analytes, methods, and target reporting limits are listed in Table C-2 in the QAPP. The requirements for dissolved organic carbon (DOC) are the same as for total organic carbon (TOC). The target reporting limits for metals speciation (arsenic, chromium, mercury, and selenium) are the same as for the Target Analyte List (TAL) metals. Target reporting limits are compared to human health and ecological screening values in Table E-3, as a check that the limits are adequate for use in risk assessment screening. Laboratory-specific SOPs will be followed for arsenic, chromium, mercury, and selenium speciation once the laboratory has been selected.
- Precision and accuracy objectives for quality control (QC) samples for aqueous matrices are listed in Table C3 of the QAPP. The requirements for DOC are the same as for TOC. The target reporting limits for metals speciation (arsenic, chromium, mercury, and selenium) are the same as for the TAL metals.
- Appendix D to the QAPP presents quality assurance (QA) requirements for solid matrices. For the SAP, solid matrices will include ash deposits, seasonally-exposed sediment, submerged sediment, and geological formation soil. The following supplementary information is provided for the SAP:
- Sample containers, preservation, and holding times for solid samples are listed in Table D-1 in the QAPP. Task-specific sample containers, preservation, and holding times shown in Appendix D of the SAP, and take precedence over the QAPP.

- Analytes, methods, and target reporting limits are listed in Table D-2 in the QAPP. Task-specific analytical methods for solid matrices are shown in Appendix D of the SAP. Target reporting limits are shown in Table E-4 in this QAPP Addendum for those analytes not included in the QAPP. These target reporting limits are compared to human health and ecological screening values in Tables E-5 and E-6, as a check that the limits are adequate for use in risk assessment screening.
- Precision and accuracy objectives for QC samples for aqueous matrices are listed in Table D-3 of the QAPP. Task-specific objectives for solid matrices are shown in Tables E-7 and E-8 of this QAPP Addendum for those analytes not included in the QAPP.

Appendix G to the QAPP presents QA requirements for biological matrices. For the SAP, biological matrices will include benthic invertebrates (snails and mayflies), fish (largemouth bass, bluegill, channel catfish, gizzard shad, and threadfin shad), and birds eggs/hatchlings (tree swallow and heron). The following supplementary information is provided for the SAP:

- Sample containers, preservation, and holding times for solid samples are listed in Table G-1 in the QAPP. Task-specific sample containers, preservation, and holding times are shown in Appendix D of the SAP, and take precedence over the QAPP.
- Analytes, methods, and target reporting limits are listed in Table G-2 in the QAPP. Task-specific analytical methods for solid matrices are shown in Appendix D of the SAP. Target reporting limits are shown in Table E-9 in this QAPP Addendum for those analytes not included in the QAPP. These target reporting limits are compared to human health and ecological screening values in Table E-9, as a check that the limits are adequate for use in risk assessment screening.
- Precision and accuracy objectives for QC samples for aqueous matrices are listed in Table G-3 of the QAPP. Task-specific objectives for solid matrices are shown in Table E-10 of this QAPP Addendum for those analytes not included in the QAPP.

**Table E-1. Quality Assurance Project Plan Cross-Walk**

<b>QAPP Element</b>	<b>Location in SAP</b>	<b>Location in SOPs</b>
Data Quality Objectives	Appendix A: Data Quality Objectives for Environmental Media	
Sampling Design	Section 2.2: Study Design 2.2.1 Ash Deposits 2.2.2 Seasonally Exposed Sediment 2.2.3 Submerged Sediment 2.2.4 Sediment Porewater 2.2.5 Surface Water 2.2.6 Groundwater 2.2.7 Benthic Invertebrates 2.2.8 Fish 2.2.9 Wildlife	
Sampling Methods	Section 5.1 Field Sampling Procedures 5.1.1 Ash Deposits 5.1.2 Seasonally-Exposed Sediment 5.1.3 Submerged Sediment 5.1.4 Sediment Porewater 5.1.5 Surface Water 5.1.6 Groundwater 5.1.7 Benthic Invertebrates 5.1.8 Fish 5.1.9 Wildlife  Appendix D: Field Sampling Summary	Applicable SOPs <sup>1</sup>
Sample Collection	Appendix D: Field Sampling Summary	Applicable SOPs <sup>1</sup>
Data Review and Validation (TVA-KIF-QAPP Section 21.0)	Appendix B: Baseline Ecological Risk Assessment Methodology Appendix C: Groundwater Transport Modeling Methodology	
Assessments and Response Actions (TVA-KIF-QAPP Section 19.0)		

**Note:**

<sup>1</sup>Applicable SOPs are referenced in the SAP and listed in Table E-2.

**Table E-2. Standard Operating Procedures for the River System Sampling and Analysis**

SOP Number	SOP Title
TVA-KIF-SOP-01	Surface Water Sampling
TVA-KIF-SOP-02	Groundwater Sampling
TVA-KIF-SOP-04	Soil Sampling for Inorganic Analysis
TVA-KIF-SOP-05	Sediment Sampling
TVA-KIF-SOP-06	Field Documentation
TVA-KIF-SOP-07	Sample Labeling, Packing, and Shipping
TVA-KIF-SOP-08	Decontamination of Equipment
TVA-KIF-SOP-09	Sediment Sampling For AVS/SEM Analysis
TVA-KIF-SOP-11	Field Quality Control Sampling
TVA-KIF-SOP-12	Management of Investigation-Derived Waste
TVA-KIF-SOP-13	Sample Retain Archive and Maintenance
TVA-KIF-SOP-14	Hydrolab Datasonde <sup>®</sup> Standardization and Field Parameter Measurement
TVA-KIF-SOP-15	Collecting and Processing Heron and Osprey Eggs
TVA-KIF-SOP-18	Management and Implementation of EQUIS-Based Chain-of-Custody
TVA-KIF-SOP-20	Ash Homogenization
TVA-KIF-SOP-29	Mayfly Sampling
TVA-KIF-SOP-30	Snail Sampling
TVA-KIF-SOP-31	Fish Sampling With Gill Nets
TVA-KIF-SOP-32	Fish Sampling With Seines
TVA-KIF-SOP-33	Fish Sampling - Boat-Mounted Electrofishing
TVA-KIF-SOP-35	Benthic Macroinvertebrate Community Sampling
TVA-KIF-SOP-39	Monitoring Well and Piezometer Well Installation and Completion
TVA-KIF-SOP-42	Slug Testing
TVA-KIF-SOP-43	Porewater Collection from Sediment and Ash

**Table E-3. Comparison of Screening Levels for Inorganics and Radionuclides with Target Reporting Limits Aqueous Matrices**

Analyte	CAS No.	QAPP Target Reporting Limit (ug/L)	Surface Water RBSL (ug/L or pCi/L)	Surface Water Basis	Groundwater RBSL (ug/L or pCi/L)	Groundwater Basis	Surface Water ESL Values (mg/L or pCi/L)	Source
Aluminum	7429-90-5	100	3,700	RBSL	3,700	RBSL	087.0	AWQC
Antimony	7440-36-0	2.0	1.5	RBSL	1.5	RBSL		
Arsenic	7440-38-2	2.0	0.018	AWQC, Consumption of Water and Organism	0.045	RBSL	150.0	AWQC
Barium	7440-39-3	10	730	RBSL	730	RBSL	NA	
Beryllium	7440-41-7	3.0	4	MCL	4	MCL	NA	
Boron	7440-42-8	10	730	RBSL	730	RBSL	NA	
Cadmium	7440-43-9	1.0	1.8	RBSL	1.8	RBSL	002.2	
Chromium	7440-47-3	2.0	100	MCL	100	MCL	011.0	AWQC
Cobalt	7440-48-4	2.0	1.1	RBSL	1.1	RBSL	NA	
Copper	7440-50-8	5.0	150	RBSL	150	RBSL	009.0	AWQC
Iron	7439-89-6	50	300	RBSL	2,600	RBSL	NA	
Lead	7439-92-1	2.0	5	Tennessee MCL	5	MCL	NA	
Manganese	7439-96-5	5.0	50	AWQC, Consumption of Water and Organism	88	RBSL	NA	
Mercury	7439-97-6	0.2	0.05	TWQC, Water and Organisms	0.057	RBSL	000.77	AWQC
Molybdenum	7439-98-7	5.0	18	RBSL	18	RBSL	NA	
Nickel	7440-02-0	5.0	73	RBSL	73	RBSL	052.0	AWQC
Selenium	7782-49-2	2.0	18	RBSL	18	RBSL	005.0	AWQC
Silver	7440-22-4	2.0	18	RBSL	18	RBSL	NA	
Strontium	7440-24-6	NA	22,000	RBSL	22,000	RBSL	1.5	ORNL
Thallium	7440-28-0	2.0	0.24	RBSL	0.24	RBSL	NA	
Vanadium	7440-62-2	4.0	18	RBSL	18	RBSL	NA	
Zinc	7440-66-6	50	7,400	AWQC, Consumption of Water and Organism	11,000	RBSL	120.0	AWQC
Cs-137		1.0	1.57	RBSL	1.57	RBSL	NA	
Co-60		1.0	3.03	RBSL	3.03	RBSL	NA	
K-40		1.0	1.93	RBSL	1.93	RBSL	NA	
Ra-226		1.0	0.000816	RBSL	0.000816	RBSL	NA	
Ra-228		1.0	0.0458	RBSL	0.0458	RBSL	NA	

**Table E-3. Comparison of Screening Levels for Inorganics and Radionuclides with Target Reporting Limits Aqueous Matrices**  
(continued)

Analyte	CAS No.	QAPP Target Reporting Limit (ug/L)	Surface Water RBSL (ug/L or pCi/L)	Surface Water Basis	Groundwater RBSL (ug/L or pCi/L)	Groundwater Basis	Surface Water ESL Values (mg/L or pCi/L)	Source
Th-228		1.0	0.159	RBSL	0.159	RBSL	NA	
Th-232		1.0	0.471	RBSL	0.471	RBSL	NA	
U-234		1.0	0.674	RBSL	0.674	RBSL	NA	
U-235		1.0	0.663	RBSL	0.663	RBSL	NA	
U-238		1.0	0.547	RBSL	0.547	RBSL	NA	

**Notes:**

- AWQC = Ambient Water Quality Criterion
- CAS = Chemical Abstract Service
- ESL = ecological screening level
- mg/L = milligrams per liter
- MCL = maximum contaminant level
- NA = not available or applicable
- ORNL = Oak Ridge National Laboratory
- pCi/L = picocuries per liter
- RBSL = risk-based screening level
- TWQC = Tennessee Water Quality Criterion
- µg/L = microgram per liter

**Table E-4. (QAPP Table D-2) Analytes, Methods, and Target Reporting Limits Solid Matrices**

Sample Type(s)	Test Parameter / Physical Parameter	Test Method	Reporting Limit
Cell Ash Soil Bedrock	Bulk Density	ASTM D2937	0.1 pcf
	Effective Porosity	ASTM D4404-86	0.01%
	Total Porosity	ASTM D6836	0.01%
	Moisture Content	ASTM D2216	0.001%
	Vertical Hydraulic Conductivity	ASTM D5126-90	0.1 cm/sec
	Soil pH	ASTM D4972-01	0.1 pH units
	Polarized Light Microscopy	EPA-600/M4-82-020 or equivalent Lab SOP	4%
	Column Leaching	ASTM D4793	QAPP Table C-2
	Free Iron Oxide	Chao and Zhou (1983)	1%
	Cation Exchange Capacity Exchangable Cations Calicte Equivalent Soluble Salts	ASA 1996 Methods 14,15,16, or equivalent Lab SOP	1.0 meq/100 grams

**Notes:**

ASTM = American Society for Testing Materials  
 pcf = per cubic foot  
 cm/sec = centimeters per second  
 meq = milliequivalent

Table E-5. (QAPP Table D-2) Analytes and Target Reporting Limits Solid Matrices

Sample Type(s)	Test Parameter Method	CASRN	QAPP Reporting Limit (µg/kg)	Sediment Target CRQL <sup>1</sup> (µg/kg)	Sediment RBSL <sup>2</sup>	Sediment Region 4 ESVs (µg/kg)	Sediment Notes
Released Ash  Sediment	<b>Pesticides - SW-846 8081A</b>						
	aldrin	309-00-2	ND	1.7	29	2	Region III
	alpha-BHC	319-84-6	ND	1.7	77	6	Region III
	alpha-chlordane	5103-71-9	ND	1.7	1,600	0.5	chlordane as basis
	beta-BHC	319-85-7	ND	1.7	270	5	Region III
	delta-BHC	319-86-8	ND	1.7	NA	6,400	Region III
	4,4'-DDD	72-54-8	ND	3.3	2,000	1.22	
	4,4'-DDE	72-55-9	ND	3.3	1,400	2.07	
	4,4'-DDT	50-29-3	ND	3.3	1,700	1.19	
	dieldrin	60-57-1	ND	3.3	30	0.02	
	endosulfan I	115-29-7	ND	1.7	370,000	2.9	Region III
	endosulfan II	33213-65-9	ND	3.3	370,000	14	Region III
	endosulfan sulfate	1031-07-8	ND	3.3	370,000	5.4	Region III
	endrin	72-20-8	ND	3.3	18,000	0.02	
	endrin aldehyde	7421-93-4	ND	3.3	18,000	0.02	endrin as basis
	endrin ketone	53494-70-5	ND	3.3	18,000	0.02	endrin as basis
	gamma-BHC (lindane)	58-89-9	ND	1.7	520	0.32	
	gamma-chlordane	5103-74-2	ND	1.7	1,600	0.5	chlordane as basis
	heptachlor	76-44-8	ND	1.7	110	68	Region III
	heptachlor epoxide	1024-57-3	ND	1.7	53	2.47	Region III
	methoxychlor	72-43-5	ND	17.0	310,000	18.7	Region III
	toxaphene	8001-35-2	ND	170.0	440	0.1	Region III
	<b>Polychlorinated Biphenyls - SW-846 8082</b>						
	aroclor-1016	12674-11-2	ND	33.0	3,900	NA	
	aroclor-1221	11104-28-2	ND	33.0	140	NA	
	aroclor-1232	11141-16-5	ND	33.0	140	NA	
	aroclor-1242	53469-21-9	ND	33.0	220	NA	
	aroclor-1248	12672-29-6	ND	33.0	220	NA	
	aroclor-1254	11097-69-1	ND	33.0	220	NA	
	aroclor-1260	11096-82-5	ND	33.0	220	NA	
	aroclor-1262	37324-23-5	ND	33.0	220	NA	
	aroclor-1268	11100-14-4	ND	33.0	220	NA	
	PCBs (total)		ND		220	21.6	

**Table E-5. (QAPP Table D-2) Analytes and Target Reporting Limits Solid Matrices**  
(continued)

Sample Type(s)	Test Parameter Method	CASRN	QAPP Reporting Limit (µg/kg)	Sediment Target CRQL <sup>1</sup> (µg/kg)	Sediment RBSL <sup>2</sup>	Sediment Region 4 ESVs (µg/kg)	Sediment Notes
Released Ash  Sediment	<b>Polynuclear Aromatic Hydrocarbons - SW-846 8270 SIM</b>						
	acenaphthene	83-32-9	67	3.3	3,400,000	6.71	
	acenaphthylene	208-96-8	67	3.3	NA	5.87	
	anthracene	120-12-7	67	3.3	17,000,000	46.9	
	benzo(a)anthracene	56-55-3	67	3.3	150	74.8	
	benzo(a)pyrene	50-32-8	67	3.3	15	88.8	
	benzo(b)fluoranthene	205-99-2	67	3.3	150	27.2	Region III
	benzo(e)pyrene	192-97-2	67	3.3	NA		
	benzo(g,h,i)perylene	191-24-2	67	3.3	NA	170	Region III
	benzo(k)fluoranthene	207-08-9	67	3.3	1,500	240	Region III
	chrysene	218-01-9	67	3.3	15,000	108	
	dibenzo(a,h)anthracene	53-70-3	67	3.3	15	6.22	
	fluoranthene	206-44-0	67	3.3	2,300,000	113	
	fluorene	86-73-7	67	3.3	2,300,000	21.2	
	indeno(1,2,3-cd)pyrene	193-39-5	67	3.3	150	17	Region III
	2-methylnaphthalene	91-57-6	67	3.3	310,000	34.6	naphthalene as basis
	naphthalene	91-20-3	67	3.3	3,600	34.6	
	phenanthrene	85-01-8	67	3.3	NA	86.7	
	pyrene	129-00-0	67	3.3	1,700,000	153	

**Table E-5. (QAPP Table D-2) Analytes and Target Reporting Limits Solid Matrices**  
(continued)

Sample Type(s)	Test Parameter	CASRN	QAPP Reporting Limit (µg/kg)	Soil RL <sup>3</sup> (µg/L)	Soil MDL <sup>3</sup> (µg/kg)	Soil CRQL <sup>1</sup> (µg/kg)
Released Ash  Sediment	<b>Alkylated Polynuclear Aromatic Hydrocarbons- SW-846 8270 SIM</b>					
	C1-Chrysenes	NA	ND	10	5.0	3.3
	C1-Fluoranthenes/Pyrenes	NA	ND	10	5.0	3.3
	C1-Fluorenes	NA	ND	10	5.0	3.3
	C1-Naphthalenes	NA	ND	10	5.0	3.3
	C1-Phenanthrenes/Anthracenes	NA	ND	10	5.0	3.3
	C2-Chrysenes	NA	ND	10	5.0	3.3
	C2-Fluorenes	NA	ND	10	5.0	3.3
	C2-Naphthalenes	NA	ND	10	5.0	3.3
	C2-Phenanthrenes/Anthracenes	NA	ND	10	5.0	3.3
	C3-Chrysenes	NA	ND	10	5.0	3.3
	C3-Fluorenes	NA	ND	10	5.0	3.3
	C3-Naphthalenes	NA	ND	10	5.0	3.3
	C3-Phenanthrenes/Anthracenes	NA	ND	10	5.0	3.3
	C4-Chrysenes	NA	ND	10	5.0	3.3
	C4-Naphthalenes	NA	ND	10	5.0	3.3
C4-Phenanthrenes/Anthracenes	NA	ND	10	5.0	3.3	

**Notes:**

<sup>1</sup> CRQLs are from EPA's Contract Laboratory Program and are provided for reference until an analytical laboratory is selected. Project specific quantitation limits will be selected consistent with or as close as possible to the applicable screening levels.

<sup>2</sup> EPA 2009 Mid-Atlantic Risk Assessment website [http://www.epa.gov/reg3hscd/risk/human/rb-concentration\\_Table/Generic\\_Tables/index.htm](http://www.epa.gov/reg3hscd/risk/human/rb-concentration_Table/Generic_Tables/index.htm)

<sup>3</sup> Lab reporting limits and method detection limits from Pace Analytical Laboratories.

CASRN = Chemical Abstract Registry Number  
 CRQL = Contract Required Quantitation Limit  
 ESV = ecological screening value  
 MDL = method detection limit  
 ND = not determined

**Table E-6. Comparison of Screening Levels for Inorganics and Radionuclides with Target Reporting Limits Solid Matrices**

Analyte	CAS No.	QAPP Target Reporting Limit (mg/kg)	Sediment RBSL (mg/kg or pCi/g)	Sediment ESLs (mg/kg)	Source
Aluminum	7429-90-5	40	7,700	NA	
Antimony	7440-36-0	6.0	3.1	12	R4
Arsenic	7440-38-2	2.0	0.39	7.24	R4
Barium	7440-39-3	1.0	1,500	NA	
Beryllium	7440-41-7	1.0	16	NA	
Boron	7440-42-8	20	1,600	NA	
Cadmium	7440-43-9	0.5	7	1	R4
Chromium	7440-47-3	1.5	280	52.3	R4
Cobalt	7440-48-4	5.0	2.3	NA	
Copper	7440-50-8	2.5	310	18.7	R4
Iron	7439-89-6	20	5,500	NA	
Lead	7439-92-1	1.5	400	30.2	R4
Manganese	7439-96-5	1.5	180	NA	
Mercury	7439-97-6	.02	4.3	0.13	R4
Molybdenum	7439-98-7	4.0	39	NA	
Nickel	7440-02-0	4.0	150	15.9	R4
Selenium	7782-49-2	1.5	39	NA	
Silver	7440-22-4	3.0	39	2	R4
Strontium	7440-24-6	NA	47,000	NA	
Thallium	7440-28-0	3.5	0.51	NA	
Vanadium	7440-62-2	2.5	39	NA	
Zinc	7440-66-6	6.0	2,300	124	R4
Cs-137		1.0	3.88	NA	
Co-60		1.0	0.0361	NA	
K-40		1.0	0.108	NA	
Ra-226		1.0	0.0124	NA	
Ra-228		1.0	0.0677	NA	
Th-228		1.0	0.154	NA	
Th-232		1.0	3.1	NA	
U-234		1.0	4.01	NA	
U-235		1.0	0.195	NA	
U-238		1.0	0.742	NA	

**Table E-7. (QAPP Table D-3) Summary of Precision and Accuracy Objectives for Quality Control Samples, Groundwater Modeling Input Parameters**

Compound	Test Method	LCS Accuracy (% Recovery)	MS/MSD Accuracy (% Recovery)	LCS/LCSD Precision (RPD)	MS/MSD Precision (% Recovery)	Laboratory Duplicate Precision (RPD)	Field Duplicate Precision <sup>1</sup>
Bulk Density	ASTM D2937	NA	NA	NA	NA	NA	RPD <10% difference < the RL
Effective Porosity	ASTM D4404-86	NA	NA	NA	NA	NA	RPD <10% difference < the RL
Total Porosity	ASTM D6836	NA	NA	NA	NA	NA	RPD <10% difference < the RL
Moisture Content	ASTM D2216	NA	NA	NA	NA	NA	RPD <10% difference < the RL
Vertical Hydraulic Conductivity	ASTM D5126-90	NA	NA	NA	NA	NA	None (No Field Duplicates)
Soil pH	ASTM D4972-01	NA	NA	NA	NA	NA	RPD <20% difference < the RL
Polarized Light Microscopy	EPA-600/M4-82-020 or equivalent Lab SOP	NA	NA	NA	NA	<del>+/- 4%</del> +/- 10%	<del>+/- 4%</del> RPD <35%
Column Leaching	ASTM D4793	NA	NA	NA	NA	20	None (No Field Duplicates)
Free Iron Oxide	Chao and Zhou (1983)	NA	NA	NA	NA	20	RPD <20% difference < the RL
Cation Exchange Capacity Exchangable Cations Calicte Equivalent Soluble Salts	ASA 1996, Methods 14,15,16, or equivalent Lab SOP	NA	NA	NA	NA	20	RPD <20% difference < the RL

**Notes:**

<sup>1</sup> When both field duplicate results are > 5 times the RL, the RPD must be < 35%. When at least one result is <5 times the RL, the difference must be <2 times the RL.

LCS = laboratory control sample  
 LCSD = laboratory control sample duplicate  
 RL = reporting limit  
 RPD = relative percent difference

**Table E-8. (QAPP Table D-3) Summary of Precision and Accuracy Objectives for Quality Control Samples Solid Matrices**

Compound	CASRN	Surrogate Compound Recoveries/Chemical Yield (%)	LCS Accuracy (% Recovery)	MS/MSD Accuracy (% Recovery)	LCS/LCSD Precision (RPD)	MS/MSD Precision (% Recovery)	Laboratory Duplicate Precision (RPD)	Field Duplicate Precision <sup>1</sup>
Metals Speciation (As, Se, Hg, Cr)	NA	NA	80 - 120	75-125	35	35	35	RPD <35% difference < 2 times the RL
Polarized Light Microscopy (fixed laboratory)	NA	NA	NA	NA	NA	NA	+/- 10%	RPD <35%
Polynuclear Aromatic Hydrocarbons	83-32-9	50 - 130	<del>80 - 120</del> 50 - 130	<del>75 - 125</del> 50 - 130	35	35	35	RPD <35% difference < 2 times the RL
Alkylated Polynuclear Aromatic Hydrocarbons	208-96-8	50 - 130	<del>80 - 120</del> 50 - 130	<del>75 - 125</del> 50 - 130	35	35	35	RPD <35% difference < 2 times the RL
Pesticides	309-00-2	50 - 130	<del>80 - 120</del> 50 - 130	<del>75 - 125</del> 50 - 130	35	35	35	RPD <35% difference < 2 times the RL
Polychlorinated Biphenyls	11104-28-2	50 - 130	<del>80 - 120</del> 50 - 130	<del>75 - 125</del> 50 - 130	35	35	35	RPD <35% difference < 2 times the RL

**Note:**

<sup>1</sup> When both field duplicate results are > 5 times the RL, the RPD must be < 35%. When at least one result is < 5 times the RL, the difference must be < 2 times the RL.

**Table E-9. Comparison of Screening Levels for Inorganics and Radionuclides with Target Reporting Limits, Biological (Fish Fillet) Matrices**

Analyte	CAS No.	QAPP Target Reporting Limit (mg/kg)	Fish RBSL <sup>1</sup> (mg/kg or pCi/g)
Aluminum	7429-90-5	25	135
Antimony	7440-36-0	0.1	0.0541
Arsenic	7440-38-2	0.1	0.0021
Barium	7440-39-3	0.1	27
Beryllium	7440-41-7	0.1	0.27
Boron	7440-42-8	0.5	27
Cadmium	7440-43-9	0.1	0.135
Chromium	7440-47-3	0.1	203
Cobalt	7440-48-4	.01	0.0406
Copper	7440-50-8	0.5	5.41
Iron	7439-89-6	25	94.6
Lead	7439-92-1	.01	NA
Manganese	7439-96-5	0.5	18.9
Mercury	7439-97-6	0.02	0.0135
Molybdenum	7439-98-7	1.0	0.676
Nickel	7440-02-0	0.1	2.7
Selenium	7782-49-2	0.2	0.676
Silver	7440-22-4	0.05	0.676
<b>Strontium</b>	<b>7440-26-4</b>	<b>NA</b>	<b>NA</b>
Thallium	7440-28-0	0.1	0.00876
Vanadium	7440-62-2	0.2	0.681
Zinc	7440-66-6	2.0	40.6
Cs-137		ND	0.0472
Co-60		ND	0.0791
K-40		ND	0.0514
Ra-226		ND	0.00342
Ra-228		ND	0.00123
Th-228		ND	0.00418
Th-232		ND	0.0133
U-234		ND	0.0185
U-235		ND	0.0181
U-238		ND	0.0146

**Note:**

<sup>1</sup> ORNL 2010. [http://rais.ornl.gov/cgi\\_bin/prg/prg\\_search?select=chem](http://rais.ornl.gov/cgi_bin/prg/prg_search?select=chem)

**Table E-10. (QAPP Table G-3) Summary of Precision and Accuracy Objectives for Quality Control Samples, Biological Samples**

Compound	CASRN	Surrogate Compound Recoveries/Chemical Yield (%)	LCS Accuracy (% Recovery)	MS/MSD Accuracy (% Recovery)	LCS/LCSD Precision (RPD)	MS/MSD Precision (% Recovery)	Laboratory Duplicate Precision (RPD)	Field Duplicate Precision <sup>1</sup>
Metals Speciation (As, Se, Hg, Cr)	NA	NA	80 - 120	75 - 125	35	35	35	RPD <35 difference < the RL
Radiological Parameters	NA	30 - 110	80 - 120	70 - 130	NA	NA	RPD < 35 RER < 3	RPD <35 RER < 3
Polynuclear Aromatic Hydrocarbons	83-32-9	50 - 130	<del>80-120</del> 50 - 130	<del>75-125</del> 50 - 130	35	35	35	RPD <35% difference < the RL
Alkylated Polynuclear Aromatic Hydrocarbons	208-96-8	50 - 130	<del>80-120</del> 50 - 130	<del>75-125</del> 50 - 130	35	35	35	RPD <35% difference < the RL
Pesticides	309-00-2	50 - 130	<del>80-120</del> 50 - 130	<del>75-125</del> 50 - 130	35	35	35	RPD <35% difference < the RL
Polychlorinated Biphenyls	11104-28-2	50 - 130	<del>80-120</del> 50 - 130	<del>75-125</del> 50 - 130	35	35	35	RPD <35% difference < the RL

**Note:**

<sup>1</sup> When both field duplicate results are > 5 times the RL, the RPD must be < 35%. When at least one result is < 5 times the RL, the difference must be <2 times the RL.

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