



**Memorandum from the Office of the Inspector General**

June 30, 2011

Robert M. Deacy, Sr., LP 5D-C

**FINAL REPORT – INSPECTION 2008-12283-07 – REVIEW OF THE ENVIRONMENTAL SAMPLING AND MONITORING PLANS FOR THE KINGSTON ASH SPILL**

Attached is the subject final report for your review and action. Your written comments, which addressed your management decision and/or actions taken, have been included in the report. Please notify us when final action is complete.

The Office of the Inspector General (OIG) contracted with Marshall Miller & Associates, Inc., to conduct this review. All work pertaining to this review was conducted by Marshall Miller. The OIG relied on Marshall Miller's processes and procedures for quality control in the attached report. Information contained in this report may be subject to public disclosure. Please advise us of any sensitive information in this report that you recommend be withheld.

If you have any questions, please contact Deana D. Scoggins, Senior Auditor, at (423) 785-4822 or Greg R. Stinson, Director, Inspections, at (865) 633-7367. We appreciate the courtesy and cooperation received from your staff during this review.

*Robert E. Martin*

Robert E. Martin  
Assistant Inspector General  
(Audits and Inspections)  
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DDS:FAJ  
Attachment  
cc: See page 2

Robert M. Deacy, Sr.  
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OIG File No. 2008-12283-07

## TITLE PAGE

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### **Title of Report**

Review of the Environmental Sampling and Monitoring Plans for Kingston Ash Spill  
Tennessee Valley Authority Kingston Fossil Plant  
Harriman, Tennessee

### **Effective Date of Report**

February 3, 2011

### **Qualified Persons**

**MARSHALL MILLER & ASSOCIATES, INC.**



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**Timothy D. Grant, P.G.**  
*Senior Project Manager*



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**Eric R. Powers, P.G.**  
*Senior Geologist*

## EXECUTIVE SUMMARY

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**Marshall Miller & Associates, Inc. (*Marshall Miller*)** was hired by the Office of Inspector General (OIG) to review the sampling and monitoring plans prepared by the **Tennessee Valley Authority (TVA)** for its **Kingston Fossil Plant** located in Harriman, Tennessee, following an ash release that occurred on December 22, 2008. Marshall Miller evaluated the adequacy and completeness of TVA's environmental recovery plans to determine whether these plans provide comprehensive and effective measures to adequately monitor the potential short- and long-term impacts to human and ecological receptors. Because of the number of different sampling and monitoring programs, the review spanned a period of several months. The scope of the review included TVA's environmental recovery plans available through June, 2010. In summary, Marshall Miller found no significant deficiencies in the plans or procedures used by TVA or its contractors in characterizing impacts resulting from the ash release or recovery efforts. It should be noted that the assessment of long-term impacts will be an ongoing process during and after the recovery effort.

This report focuses on two key areas, data management and review of the environmental monitoring program. Specifically:

- The data management review focused on the *Quality Assurance Project Plan* and the Standard Operating Procedures.
- The review of the environmental monitoring program focused on TVA's ongoing evaluation of different media including (1) air, (2) water (i.e., surface, raw, storm, and groundwater), (3) sediment, and (4) biological. These media comprise important migration pathways, which could potentially expose human and/or ecological populations in the vicinity of the spill.

To complete the review, Marshall Miller reviewed documentation, conducted interviews, performed a site walkover, and observed sampling activities. While Marshall Miller did not find any significant deficiencies, early in the recovery process some of the analytical results did not pass prescribed quality assurance/quality control standards, and the data were invalidated. When



the deficiency was noted, TVA took appropriate steps to correct the situation, and it does not appear that any decisions regarding the clean-up efforts were affected by the data quality.

Marshall Miller noted the following:

- Bureau Veritas Laboratories used an incorrect analytical method for particulate monitoring from September 2009 to January 2010. This resulted in the Environmental Protection Agency invalidating the Particulate Matter (PM) data.
- There has been limited research on how the ash and the metals associated with ash will affect the various organisms in the river system. Additional investigations by a variety of research organizations are underway, primarily in support of the River System Engineering Evaluation/Cost Assessment.
- Data from air testing for metals and groundwater testing are not readily available to the public.
- Due to "legacy" contaminants in the sediment in the lower 1.8 miles of the Emory River (associated with activities at the Oak Ridge National Laboratory) and the difficulty in removing the ash without distributing existing "legacy" and native river sediments, some ash will remain in the river after dredging is complete.

Based on Marshall Miller's review, TVA should consider the following recommendations:

- TVA should ensure that Inter-Mountain Labs, the laboratory that is currently performing PM<sub>2.5</sub> and PM<sub>10</sub> air sampling and analyses, is reporting the correct analytical methods.
- Research related to the composition of ash and the potential release of metals from the ash into the surrounding river system, which could be bioavailable and have potential affects to organisms, should continue. As sampling to date has been limited, research on how the ash affects benthic organisms should also be continued. Marshall Miller notes that the EE/CA for the river system is expected to address this issue.
- TVA should consider making more comprehensive air testing results and evaluations of metals data available to the public.
- TVA should consider working with the Tennessee Department of Environmental Conservation to provide the public with updated groundwater testing results and evaluations.
- TVA should complete ongoing research designed to understand how river bottom sediments play a role in the overall ecology of the river system by propagating potential spill impacts through the food chain including fish, reptiles, mammals, birds and other

biota over the long term. It is Marshall Miller's understanding that this research is ongoing through a collaborative effort between TVA and various research organizations.

- TVA should continue to monitor for the four principal ash components of concern (arsenic, mercury, selenium, and thallium). With respect to selenium, TVA should continue to follow the guidance of the EPA as outlined in the August 18, 2009, *Review of Potential Selenium Issues Following a Coal Ash Spill at the Tennessee Valley Authority Kingston Fossil Plant*.

TVA management provided additional information on the findings and recommendations in this report. For complete responses, please see Appendix A and Appendix B. Marshall Miller incorporated comments into the report as appropriate and provided additional comments in response to TVA management responses. For Marshall Miller's complete response, please see Appendix C.



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GREG STINSON..... APPENDIX C



## **Item 1: INTRODUCTION AND BACKGROUND**

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In response to an ash release that occurred on December 22, 2008, at the **Kingston Fossil Plant (KIF)** located in Harriman, Tennessee, the **Tennessee Valley Authority (TVA)** enacted an environmental sampling plan. **Marshall Miller & Associates, Inc. (Marshall Miller)** was retained by **TVA's Office of the Inspector General (OIG)** to evaluate the adequacy and completeness of the TVA's environmental recovery plans in response to the December 22, 2008, ash release, which due to the number of different sampling and monitoring programs, the review spanned a period of several months. The scope included environmental recovery plans available through June, 2010. The intent of this review is to evaluate whether TVA's ongoing response and planning are providing comprehensive and effective measures to mitigate the short- and long-term impacts from an estimated 5.4 million cubic yards of coal ash that spilled from the on-site dredge cell into the nearby Emory, Clinch, and Tennessee Rivers and their tributaries. The evaluation has included a review of relevant documentation related to sampling of the various media, interviews with key team members from TVA and subcontractors overseeing the clean-up, and observations of sampling and data collection procedures during site visits conducted on November 18, 19, and 20, 2009. The evaluation focused on the following media:

- Air (fugitive dust originating from coal ash accumulations).
- Surface water and raw water intakes for nearby water treatment plants.
- Storm water (runoff from ash impacted areas and from the ash dewatering area).
- Sediment.
- Groundwater (including domestic water supply wells).
- Biological (biota).

These media comprise important migration pathways, which have the potential to expose human and ecological populations in the vicinity of the spill. The inherent instability and mobility of coal ash contribute to its rapid dispersal throughout the environment, mandating the need for a rapid response program that originally included measures to (1) identify residents whose property was adversely affected by the spill and provide temporary housing for those most



impacted by the spill and recovery efforts, (2) protect downstream drinking water intakes, (3) alert the broader community regarding potential impacts to air and drinking water, (4) assess immediate impacts to wildlife and wildlife habitat, (5) restore roads, railroads and other infrastructure, (6) protect the ability of the KIF facility to continue providing electrical power to the region, and (7) implement containment measures to contain and control as much of the spilled material as possible.

As initial abatement measures were implemented, TVA along with the **Tennessee Department of Environmental Control (TDEC)**, **US Environmental Protection Agency (EPA)** and local government agencies jointly responded to the spill, in part, by providing sampling and analyses of impacted media. While the common purpose of these efforts was to protect public health from the immediate impact of substances found in the coal ash, it was apparent that the longer-term response would require a more comprehensive program to assess the size and scope of impacts resulting from the release. To this end, TVA is taking the lead in developing an integrated plan, to address both short- and long-term impacts to human and ecological populations. As of June 2010, TVA has prepared the *Non-Time Critical Removal Action Embayment/Dredge Cell Engineering Evaluation/Cost Analysis (EE/CA)* report dated January 15, 2010, and the *Non-Time Critical Removal Action Embayment/Dredge Cell Action Memorandum* dated May 18, 2010, in support of the clean-up efforts for the Swan Pond Embayment. A separate EE/CA will be prepared for the river systems. On May 11, 2009, TVA entered into an Administrative Order and Agreement on Consent with EPA Region IV, which directs all response activities under the Comprehensive Environment Response, Compensation, and Liability Act (CERCLA). The Administrative Order and Agreement on Consent imposes requirements for TVA to develop short- and long-term plans for mitigating off-site spill impacts through a process of continued investigation, analysis, and evaluation to determine the extent of affected media and to assess potential impacts to human and ecological receptors. The Administrative Order and Agreement on Consent also requires that TVA address the short- and long-term management of the coal ash including TVA's clean-up of ash from off-site areas and final containment within the original confines of the KIF facility.

## 1.1. QUALITY ASSURANCE / QUALITY CONTROL

From the outset, TVA was faced with gathering an enormous quantity of environmental data in its effort to develop a rapid and effective clean-up strategy. Consequently, documentation and procedures for data collection and management during the first two to three months (late December 2008 to mid-March 2009) of the post-spill period were developed through adaptation in response to changing conditions as there was little or no precedent for handling an ash spill of this magnitude. By March 2009, TVA was transitioning from an emergency response action to a more measured recovery effort mandated by TDEC and EPA. As a part of this process, numerous planning documents were prepared and submitted to the overseeing regulatory agencies for review. Included in these was an overall *Quality Assurance Project Plan*, which provided the overarching framework for managing how all of the data collected by TVA and its staff and contractor were collected, analyzed, compiled and reported throughout the recovery process.

The site-wide *Quality Assurance Project Plan* calls for the preparation and implementation of plans for specific activities associated with the recovery. One of these plans, the *Phase I Dredging Quality Assurance Project Plan*, integrates the principles and requirements of the overall project *Quality Assurance Project Plan* with an activity-specific plan. Sampling and analysis activities undertaken to address specific data needs related to soil, surface water, air, groundwater, sediment, and related media were bound by procedures outlined in the *Quality Assurance Project Plans* and by specific Standard Operating Procedures all developed to meet Data Quality Objectives defined in the planning documents.

As a part of its review of TVA's environmental documents and data, Marshall Miller reviewed TVA's *Quality Assurance Project Plan* and Standard Operating Procedures documents for their content, completeness, and appropriateness. Although Marshall Miller found that most of these documents were not approved, nor issued until many months after the spill, the overall procedures for sample collection and analysis prior to that time were consistent with the goals of the plans. In instances where sample collection and sample handling/analysis procedures were deficient, it was evident that TVA made changes to the processes and/or contractors involved to bring data into compliance with project Data Quality Objectives. Once the plans were in place,



TVA's data quality evaluation procedures determined that some of the quality assurance/quality control (QA/QC) procedures and documentation in early analytical packages were deficient and would therefore require reevaluation under the new protocols. In the reevaluation, much of this data was invalidated due to unrecoverable deficiencies. TVA immediately retrieved from the analytical laboratories all samples for which there was any retained portion and submitted those for re-analysis by a laboratory that could adhere to the QA/QC requirements. All parameters for which holding times were still valid were re-analyzed and the deficient data were replaced with defensible results. Although this outcome resulted in the loss of some early data, it supports that TVA's QA/QC process is rigorous and capable of insuring that data used in monitoring the ongoing recovery operations and long-term decision making is sound and meets the required Data Quality Objectives.

An important component of any environmental monitoring program is reliable data. As such, TVA staff have conducted independent audits of laboratories and required a qualification package to verify that the facilities are properly certified to provide analytical services. An in-depth and detailed data validation process by a third party also serves to identify potential issues associated with any of the procedures the laboratories are using. However, the method is not fail-safe. During an audit of the air monitoring program by the EPA, it was noted that Bureau Veritas Laboratories had used inadequate humidity controls for the measurement of PM<sub>2.5</sub> and PM<sub>10</sub> analyses and the data was subsequently invalidated. More detail is provided in *Section 2.1* of this report.

In general, the laboratories were determined to be properly certified, and the rigorous QA/QC procedures enable early identification of any deficiencies. When problems were identified, TVA responded appropriately to rectify the situation.

Per the *Quality Assurance Project Plan*, TVA's contractors are also monitored by third-party observers on a regular basis to insure proper field procedures are being conducted, including proper sample collection, handling, labelling, equipment decontamination, and shipping. Moreover, government agencies including TDEC and EPA also collect samples to be analyzed for many or all of the same constituents as TVA's contractors, providing a back-up



check on quality. During Marshall Miller's field visit in November 2009, Marshall Miller did not find any deficiencies in procedures being utilized by TVA or its contractor staff. Marshall Miller's observations included sampling for air, surface water, wildlife, and operational wastes.

## 1.2. INFORMATION/DATA MANAGEMENT PLAN

Since TVA concluded its emergency response phase in early March 2009, the EPA's Administrative Order and Agreement on Consent required TVA to prepare and submit, among other documents, an *Information/Data Management Plan*, which specifies how data from the clean-up efforts are to be generated, validated, stored, and reported.

During the site visit in November 2009, Marshall Miller interviewed key staff in charge of administering the Data Management Plan. The TVA Technical Liaison/QA Manager briefed Marshall Miller on procedures used in all aspects of TVA's recovery sampling including how the sample packages are generated, used in the field, submitted, and evaluated for completeness and accuracy. Based on this and an earlier interview with **Environmental Standards, Inc. personnel**, TVA's data manager contractor, Marshall Miller determined that the process currently in use is extremely rigorous. Environmental Standards' *Data Management Plan* involves many automated and human checks to ensure the sampling process and Data Quality Objectives are designed to meet data goals. The goal of nearly all of Environmental Standards procedures in support of this project is to review data to EPA's National Functional Guidelines for CERCLA sites. Environmental Standards also has a system in place that ensures that samplers are equipped with the appropriate containers, which are pre-labelled and packaged by the lab with appropriate preservation, submitted to the laboratory inside all applicable holding times and shipped under proper chain of custody. Laboratory results are submitted to Environmental Standards promptly and evaluated for completeness before the rigorous validation process by a team of human reviewers is complete and the data are released as final. From Marshall Miller's observations in the field, these procedures were being adhered to, instilling confidence that the data collected under these protocols is accurate and the process reflects a high level of data management.



## **Item 2: REVIEW OF THE ENVIRONMENTAL MONITORING PROGRAM**

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Marshall Miller was tasked with evaluating the adequacy of the environmental monitoring program in place through second quarter 2010 to characterize the potential impacts to the environment resulting from the KIF ash release. Summaries by media of the results of the evaluation are provided in the subsequent sections.

### **2.1. AIR**

During the emergency response, TVA deployed readily-available stationary industrial hygiene-type monitors at several temporary monitoring stations around the perimeter of the site and located a portable air monitoring trailer with Federal Reference Method samplers between the ash ditch and remnant of the dredge cell. On December 28, 2008, TVA began deploying contractors with portable industrial hygiene-type monitors in vehicles to obtain air quality data throughout the community. The air monitoring trailer was removed in mid-January 2009 due to site operations.

TVA established six fixed site air monitoring stations (five locations targeting community-based areas associated with and proximal to the released fly ash and one background sample location). Initial sampling at these locations was performed on a 12-hour and 24-hour frequency and analyzed for particulates less than 10 micrometers in diameter ( $PM_{10}$ ), total suspended particulates, and other identified contaminants of potential concern including quartz and 21 metals. One station also analyzed for particulates less than 2.5 micrometers in diameter ( $PM_{2.5}$ ). Of the 21 metals analyzed, 8 (arsenic, beryllium, cadmium, chromium, lead, selenium, thallium, and vanadium) were selected for reporting based on either having been detected during initial sampling or on a review of the Material Safety Data Sheet of fly ash. For long-term monitoring, TVA had proposed reducing the metals analyzed to include only arsenic and thallium. However, the EPA requested that TVA sample for aluminium, barium, beryllium, cadmium, chromium, lead, manganese, mercury, selenium, and vanadium in order to match the TDEC analyses.

TDEC and EPA also installed air monitoring equipment at TVA's fixed air monitoring station PS07. The monitoring includes particulates (PM<sub>2.5</sub> and PM<sub>10</sub>) via continuous monitors and a high volume total suspended particulates sampler for metals analysis including aluminium, arsenic, barium, beryllium, cadmium, chromium, lead, manganese, mercury, selenium, thallium, and vanadium. PS07 is considered to be the location of greatest potential to detect ash spill-related particulates, due to the direction of prevailing winds. As of June 2010, TVA was also conducting mobile 24-hour real time monitoring to assess the air quality within the adjacent community during which instantaneous measurements of PM<sub>10</sub> are taken using portable aerosol monitors.

The EPA and TDEC conducted reviews of the initial plan for monitoring, the draft *Air Monitoring Plan* developed in January, 2009, and the *Quality Assurance Plan*, and performed subsequent site visits to monitor on-site air sampling techniques. Following these reviews, TVA revised the draft *Air Monitoring Plan*, and submitted it for regulatory approval in June 2009. TVA operated under the draft plan and its subsequent revisions until the final plan was approved as an appendix to the *Site Dust Control Plan* in August, 2009, under which it would continue to monitor air quality in the vicinity of fly ash release remediation in real time using the six fixed air monitoring stations and mobile air monitoring instruments.

The EPA review noted deficiencies per regulatory requirements as outlined in 40 CFR Parts 50 and 51. In response, TVA made the following updates to its monitoring program:

- Installed a PM<sub>2.5</sub> continuous monitor at PS07 and set an action level at 75 percent of the EPA's National Ambient Air Quality Standard.
- Expanded the total suspended particulates, contaminants of potential concern, and metal analyses to match the analysis that TDEC performs at PS07 (aluminum, arsenic, barium, beryllium, cadmium, chromium, lead, manganese, mercury, selenium, thallium, and vanadium).
- Changed the method of collecting field blank samples.
- Implemented an electronic sample data collection system and started submitting data electronically to the EPA.
- Maintained spare parts for sampling equipment onsite.



- Implemented a data review program.

A memo from Environmental Standards to TVA dated January 5, 2010, was recently provided to Marshall Miller and indicates that Bureau Veritas reported a problem to TVA on December 7, 2009, and that TVA and Environmental Standards personnel conducted an audit on December 15, 2009. In January 2010, the EPA conducted a subsequent audit of the air monitoring program and found that Bureau Veritas, which had been performing PM<sub>2.5</sub>, PM<sub>10</sub>, metals, and silica analyses of air samples at KIF since mid-September 2009, had been analyzing the PM<sub>2.5</sub> and PM<sub>10</sub> data using an incorrect method; therefore, data was disqualified for the period of September 16, 2009, through January 1, 2010. The disqualification was a result of Bureau Veritas's noncompliance with various 40 CFR methods (including inadequate static control, inadequate temperature and humidity, inadequate blanks, and inadequate balance readings) as well as its use of filter weighing methodology, a modified National Institute for Occupational Safety and Health (NIOSH) Method 0600, that is not consistent with the EPA methods specified in TVA's *Site Dust Control and Air Monitoring Plan*. According to TVA, most of the issues reported by the EPA were discovered by the TVA and Environmental Standards auditors and reported to the EPA.

Marshall Miller has reviewed EPA's Memorandum *Evaluation of the Perimeter Air Monitoring Strategy and Identification of Corrective Actions at the TVA Kingston Fly Ash Release Time-Critical Removal* dated January 25, 2010, and TVA-OIG/Environmental Standards' *Memorandum Summary of Observations During On-Site Visit to Bureau Veritas of Novi, Michigan, and Associated Recommendations* dated January 5, 2010.

Marshall Miller determined that there is significant evidence that the disqualification of Bureau Veritas's data during the September 16, 2009, through January 1, 2010, was warranted. Bureau Veritas did not follow prescribed preparation and QA/QC procedures. As noted in TVA's *Dust Control and Air Monitoring Plan* the use of EPA methods is required for PM<sub>2.5</sub> and PM<sub>10</sub> analysis. EPA methods differ significantly from those developed by NIOSH as EPA methods address exposure levels found in ambient air and typically have longer sampling times. Therefore, it is critical to use the correct methods.



Due to the considerably lengthy turnaround time for Bureau Veritas to provide data deliverables, the first complete Bureau Veritas data were not received by Environmental Standards until December 14, 2009, three months after the first samples were sent to Bureau Veritas on September 16, 2009. During Marshall Miller's initial review, this data were not yet available for review. Beginning on January 20, 2010, TVA no longer uses Bureau Veritas for PM<sub>2.5</sub> and PM<sub>10</sub> analysis; however, Bureau Veritas continued to analyze samples for metals thorough March 24, 2010.

Considering that mobile instantaneous PM<sub>10</sub> readings, federal reference compliant PM<sub>2.5</sub> Tapered Element Oscillating Microbalance readings at PS07, and laboratory silica and metals analyses had not revealed any exceedances of the EPA's National Ambient Air Quality Standards through June 2010, and there are significant on-site dust suppression activities at the site, it is Marshall Miller's opinion that the air quality of the surrounding area was safe during the periods of mid-September 2009 through mid-January 2010.

Fixed-site PM<sub>10</sub> and PM<sub>2.5</sub> monitors have not, to date, revealed an exceedance of National Ambient Air Quality Standards. Lab analyses of fixed-site samples have detected some metals at very low levels, but these levels do not present health concerns. The only exceptions have been several elevated mobile PM<sub>10</sub> results that were associated with brush fires.

The air monitoring plans reviewed by Marshall Miller appear to be detailed and comprehensive and provide sufficient monitoring to protect the air quality of the surrounding impacted area. The *Site Dust Control and Air Monitoring Plan, August 2009*, effectively addresses the comments and concerns of EPA and TDEC for continued monitoring.

One limitation Marshall Miller experienced while reviewing air data was the difficulty of finding publically available metal analyses data on the TVA, TDEC, and EPA Web sites. Data for PM<sub>10</sub> and PM<sub>2.5</sub> are readily available; however, metals analyses results (with the exception of arsenic) are not readily available to the public on the TVA and EPA Web sites. The EPA has requested that TVA post the metals data on EPA's Air Quality System database. But as of the date of this report, that data was not available. Since January 2010, the TDEC Web site has presented the metals analyses data from its sampling station.



## 2.2. SURFACE WATER

Surface waters within the scope of this project include the lower Emory River, lower Clinch River, upper Tennessee River, and the Watts Bar Reservoir, which encompasses portions of these rivers. These rivers serve as raw water sources for drinking water supplies to several local water utilities. As such, these waters are designated as domestic water supplies. It should be noted that prior to the KIF ash release portions of the Emory, Clinch, and Tennessee Rivers and the Watts Bar Reservoir on these rivers were listed on the TDEC 2008 303(d) List of Impaired Waters due to the historical presence of one or more pollutants including polychlorinated biphenyls (PCBs), chlordane, and mercury.

TVA developed the *Kingston Fossil Plant Fly Ash Pond Incident Environmental Sampling Plan* as a framework for actions in the short term following the incident. Subsequently, TVA developed a *Field Sampling Plan*, Standard Operating Procedures, the site-wide *Quality Assurance Project Plan*, and the *Revised Surface Water Monitoring Plan for the Emory, Clinch and Tennessee Rivers* to guide recovery and long-term monitoring of the affected sites.

After the release, TDEC initiated sampling of public water intakes at the four closest water utilities. Through June 2010, at the Kingston Water Treatment Plant (the closest public water supply), TDEC had been testing twice weekly, and the City of Kingston was testing daily. As of June 2010, no utility samples have exceeded drinking water maximum contaminant levels. TDEC reportedly plans to continue routine monitoring of public water supplies throughout the ash clean-up effort.

Immediately after the release, TVA, TDEC, EPA, and other agencies commenced surface water quality monitoring and field monitoring activities in the Emory, Clinch and Tennessee Rivers. The sampling locations encompass approximately 14 miles of the local river system, which include upstream, point-of-release, and downstream water sampling locations. Marshall Miller determined that the scope and location of the sampling is comprehensive and well conceived.



Surface water monitoring was initially conducted under the *Revised Surface Water Monitoring Plan for the Emory, Clinch and Tennessee River* approved by TDEC and EPA on August 26, 2009. The plan included the following:

- Routine surface water monitoring at 10 (or 11 based on a turbidity measurement action level) fixed locations on the Emory, Clinch, and Tennessee Rivers conducted by TVA two days a week, which complements TDEC's sampling of the same stations on two different weekdays. From January 2009, until approval of the Revised Surface Water Monitoring Plan on August 26, 2009, TVA collected samples from these locations three days per week.
- Continuous monitoring at two additional fixed locations on the Emory River and three sites in the vicinity of KIF.
- Monitoring the KIF Stilling Pond National Pollutant Discharge Elimination System (NPDES) permitted outfall at location KIF 001.
- Dredge plume monitoring performed daily during daylight hours of dredging operations.

Results of TVA's sampling have indicated that increased levels of metals have occurred in surface water immediately after the spill and after subsequent rainfall events. The four principal ash components of concern are arsenic, mercury, selenium, and thallium. Through the end of June 2009, TVA's analyses found that dissolved arsenic in four surface water samples from the Emory River exceeded the Tennessee Domestic Water Supply criteria of 0.01 milligrams per liter (mg/L); total arsenic exceeded the same criteria five times. All of these exceedances were in samples collected in the vicinity of the December 22, 2008, ash spill immediately after the occurrence of the ash spill and in early January 2009 (after a heavy rainfall event). No other analytes found in the Emory River exceeded their respective Tennessee Domestic Water Supply criteria. TDEC reported similar results with arsenic being its only exceedance of the Tennessee Domestic Water Supply criteria through May 2009 in samples collected immediately adjacent to the ash spill in the Emory River. Through June 2009, TVA reported exceedances of the Tennessee Domestic Water Supply criteria for arsenic three times at different locations in the Clinch River, which again coincided with heavy rainfall events.

In a March 2009 surface water assessment, TDEC concluded that no Tennessee Water Quality Criteria were exceeded at any location for antimony, chromium, copper, nickel,



selenium, or zinc. However, other metals including aluminium, cadmium, iron, and lead were each measured above the Tennessee Water Quality Criteria for the protection of fish and aquatic life at least once in January 2009. Most of these water quality exceedances were from a sampling location near the ash spill.

Between March 3, 2009, and June 2010, TVA conducted daily monitoring and sampling of dredge plumes and those results indicate at least one exceedance of water quality standards for arsenic, antimony, beryllium, lead, nickel, and thallium under the Tennessee Domestic Water Supply criteria and arsenic, dissolved copper and selenium under Tennessee fish and aquatic life criteria. Samples collected from downstream fixed stations have not detected exceedances for either arsenic or selenium since the heavy rainfall event in January 2009. A surface water data summary report dated May 6, 2010, which graphically presented the maximum value for total arsenic concentrations, indicated that the Tennessee Domestic Water Supply criteria was exceeded once in mid-January 2010 and again in mid-February 2010 in the Emory River. Additionally, as noted previously, TDEC had reported exceedances of the Tennessee Domestic Water Supply for arsenic in the Clinch River after rainfall events.

TVA will continue surface water monitoring as a component of several active plans including the *Kingston Fossil Plant Fly Ash Pond Incident Environmental Sampling Plan, Phase I Emory River Dredging Plan, the Sampling Plan for Phase I Dredging Operations* and the *Revised Surface Water Monitoring Plan for the Emory, Clinch and Tennessee Rivers*. Surface water monitoring will be conducted throughout the ash spill clean-up effort.

Marshall Miller's review of TVA's written plans finds them to be appropriate to meet data quality objectives and regulatory requirements. The scope of the study area for surface water sampling and the selection of monitoring sites are comprehensive. The current plans such as the *Surface Water Monitoring Plan* and Standard Operating Procedure for *Surface Water Monitoring* are comprehensive and utilize methodology, test methods, and guidance approved by state and federal regulatory agencies. The stated objectives of the *Surface Water Monitoring Plan* should be achievable. TVA's written plans, such as the *Corrective Action Plan, Surface*



*Water Monitoring Plan* along with the *Field Sampling Plan* and *Quality Assurance Project Plan*, appear to be appropriate to meet data quality objectives and regulatory requirements.

Marshall Miller observed surface water sampling procedures on November 22, 2009, and samples were collected in accordance with the applicable Standard Operating Procedures and monitoring plans. Both surface water monitoring data and public water intake analysis data are readily obtainable on publically accessible Web sites.

### **2.3. STORM WATER**

The control of storm water flow from the ash storage and handling areas is important for minimizing the potential for continued ash migration, soil/sediment erosion, and related water quality impacts to the Tennessee River water system. The purpose of Marshall Miller's storm water management evaluation was to identify and review available TVA documents for evidence that an adequate systematic program has been developed and is being implemented in order to minimize the potential ongoing water quality impacts caused by unmanaged storm water runoff.

Key documents related to storm water management reviewed by Marshall Miller included, but are not limited to, the following: (1) the *Corrective Action Plan*, (2) the *Site Stormwater Management Plan*, (3) *Stormwater Pollution Prevention Plans*, (4) a *Surface Water Monitoring Plan* and implementation reports, and (5) various periodic work summaries and inspection reports and documentation. Other documents related to water quality management and monitoring included the *NPDES Permit No. TNR0005452; Tennessee Stormwater Multi-Sector Permit for Industrial Activities NPDES Permit No. TNR050000*, and *Tennessee General NPDES Permit for Discharges of Stormwater Associated with Construction Activities Permit No. TNR100000*.

The *Site Stormwater Management Plan/Stormwater Pollution Prevention Plan* documents were prepared to comply with the requirements of the construction NPDES permit. The *Stormwater Pollution Prevention Plans* appear to present a cohesive approach to controlling storm run-on/runoff at the ash management areas, as well as appear to meet the NPDES requirements for construction activities. Three versions of the *Stormwater Pollution Prevention*



*Plans* were reviewed, which included the initial document and two subsequent updated versions to account for changes in project conditions and scheduling.

The *Site Stormwater Management Plan/Stormwater Pollution Prevention Plan* documents describe and illustrate best management practices for storm water flow control and ash movement/erosion control. The *Stormwater Pollution Prevention Plans* further describe the routing and detention of storm water through basins and structures prior to discharge at NPDES Outfall 001 (KIF 001), a primary NPDES compliance point for the KIF facility. KIF 001 is the final point of discharge for water that conveys ash from plant operations as well as the current (Phase 1) dredging operation. In addition to runoff control, the *Stormwater Pollution Prevention Plans* present a control system to divert storm water run-on away from the ash management areas. The documents present a schedule and inspection log forms necessary to regularly inspect and document best management practices conditions and effectiveness. Marshall Miller reviewed the available inspection logs and found them to be consistent with the requirements of the *Stormwater Pollution Prevention Plans*.

Major activity reports, weekly reports, storm water inspection forms and other project work documentation indicate that the *Site Stormwater Management Plan / Stormwater Pollution Prevention Plan* measures are being implemented, monitored, and maintained. The *Site Stormwater Management Plan* states that TVA initiated daily sampling of the NPDES permitted outfall (KIF 001) in March 2009, and through June 2010, the TVA had collected daily samples (seven days per week) for total suspended solids and total and dissolved metals five days per week from the outfall that discharges into the KIF plant intake channel. Weekly reports confirm the implementation of dust/erosion control measures, total suspended solids water quality monitoring at KIF 001, and the construction of storm water control channels.

The weekly reports through first quarter 2010 that were reviewed by Marshall Miller suggest that the implemented storm water best management practices have minimized water quality impacts at the KIF 001 outfall. The reports either specifically identify low total suspended solids concentrations for KIF 001 or generally state that fixed station total suspended solids concentrations have consistently averaged less than 20 mg/l. The reported values are less



than the average monthly total suspended solids concentration limit of 29.9 mg/l that is established for KIF 001 under NPDES Permit No. TNR0005452.

In summary, the reviewed plans and supporting documentation suggest that TVA has developed and implemented a program to minimize, control and monitor storm water flow within the ash management areas so that the potential for ongoing ash/sediment movement to the river system is minimized. The program appears to be in compliance with NPDES requirements for storm water best management practices.

## 2.4. SEDIMENT

Marshall Miller examined the Standard Operating Procedures and ongoing field procedures used in collecting sediment samples on the river bottom during a site visit conducted on November 19, 2009. Initially, TVA's sediment sampling program is focused primarily on determining the extent and thickness of ash that escaped during the spill. It is also used to monitor the potential spreading of the ash that might occur during the Phase I dredging activities and from natural transport by river currents, particularly during flood events.

Until October 2009, TVA's sediment samples were collected exclusively using a combination of gravity, Ponar and/or Ekman grab sampler devices, which collect the upper 5 to 10 centimeters of sediment from the river bottom. At the time of Marshall Miller's review in the first half of 2010, 91 samples had been analyzed for 23 metals, PCBs, chlordane, and cesium 137. The results of these analyses indicated no reportable levels of chlordane and PCBs; however, samples from the area near the ash slide (Emory River) showed levels of arsenic up to 150 mg/kg and selenium levels up to about 5-7 mg/kg, presumably reflecting the influence of spill-related ash on sediments in that area. Although samples exhibiting these highest levels exceed some published risk-based (EPA Region 9 Preliminary Remediation Goals) and effects-based values (*Sediment Quality Guidelines* published by **National Oceanic and Atmospheric Administration (NOAA)**), it is important to note that soil background levels for arsenic in Tennessee soils were found to range between 0.1 and 120 mg/kg.<sup>1</sup> Moreover, the higher

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<sup>1</sup> Association for the Environmental Health of Soils, *Study of State Soil Arsenic Regulations*, Amherst, Massachusetts, December 1, 1998.



concentration samples at the KIF release were collected in close proximity to the spill within several days of the event. At this time, there are no state or federal regulatory levels for arsenic, only screening values.

Pre-spill studies had determined that some of these constituents occurred at elevated levels in the Clinch and Emory Rivers and are presumably related to upstream sources associated with the US Department of Energy's Oak Ridge National Laboratory (ORNL) sites. Moreover, independent studies show that one of the metals of concern, arsenic, occurs naturally in soils across the eastern United States including Eastern Tennessee, at levels in excess of those found in most river sediments near the spill site. Distinguishing site-related, ash-bearing sediments from antecedent impacted sediments is a key concern and as a result, EPA issued a memorandum dated March 5, 2010, which indicated that because of the difficulty in removing ash without disturbing native sediment when the ash thickness is less than one foot, some ash will remain in the river. In late 2009, TVA extended its sediment sampling to penetrate greater thicknesses using a commercially available VibraCore™, capable of recovering continuous core samples from up to two meters below the river bottom. This deeper coring technique is being used in combination with high-resolution sub-bottom (seismic) profiling to better define the distribution and thickness of spill-related sediments as dredging progresses. This VibraCore™ method has proven particularly useful in mapping ash thicknesses in areas close to the spill site where thicker accumulations remain and for recovering deeper core samples from background and downstream areas where ash-bearing sediments overlie or may be comingled with earlier deposits of environmentally impacted sediments.

Marshall Miller's assessment is that the current sediment sampling methods are appropriate for mapping the distribution of ash-bearing sediments on the river bottom. Ultimately, these and earlier sampling methods should provide a solid basis for guiding dredging and other clean-up activities as well as complimenting water quality and biological studies directed at monitoring the long-term health of the river system.



## 2.5. GROUNDWATER

Prior groundwater monitoring has been conducted since June 2005 for the KIF facility's solid waste permit. Baseline groundwater monitoring at the site extends back to at least 2003. Unfiltered groundwater samples were previously collected semi-annually from four monitoring wells associated with the ash dredge cell. These particular samples were analyzed for 17 inorganics. Results of arsenic in site groundwater samples collected prior to the ash release indicate that six samples collected from monitoring well KIF-6A exceeded the current maximum contaminant level of 10 micrograms per Liter (ug/L). However, five of those detections occurred prior to November 2008 when the maximum contaminant level was lowered from 50 to 10 ug/L.

However, post-ash release sampling detected one occurrence of arsenic above the maximum contaminant level in samples collected from the on-site monitoring wells.

TVA's data indicate that shallow groundwater discharges directly to the Emory River or its tributaries and, consequently, does not recharge aquifers that are local sources of drinking water. The regional groundwater regime is supported by numerous local springs and upward hydraulic gradients detected in deeper wells.

Private water supply wells were sampled by TVA, TDEC, and EPA immediately following the release. It was jointly determined that it was more appropriate for TDEC to continue monitoring and sampling of the private water supply wells. Subsequently, TDEC continued collecting samples from private water wells within a 4-mile radius of the ash release. TDEC's *Kingston Monthly Update* dated October 16, 2009, reported that over 100 private water wells have been tested, including metals analysis, and no exceedances of maximum contaminant levels have been detected thus far. TVA's preliminary conclusions are that the private water supply wells identified near the spill site are situated upgradient from the release.

Continued groundwater monitoring was proposed at the dredged ash processing area (ball field area) in the *Corrective Action Plan*. One upgradient and two downgradient monitoring wells were proposed with quarterly monitoring. The *Corrective Action Plan* also proposed additional groundwater monitoring wells and sentinel wells for routine monitoring as early

detection of ash chemical migration. Lastly, the *Corrective Action Plan* proposed the installation of a network of background wells to characterize background water quality parameters and observation wells in relevant aquifers to evaluate gradients.

According to the TDEC Web site, TDEC initially tested over 100 private water wells within a 4-mile radius of KIF. These results did not indicate exceedances of the primary drinking water standards for metals. Through June 2010, TDEC conducted quarterly sampling of an unspecified number of sentinel wells in the area. The results were provided to the well owners but were not provided to the public. According to the *Corrective Action Plan*, other water wells and springs in the groundwater monitoring area are to be tested semi-annually. Tests include field parameters and metals as well as boron and sulphate, which are mobile indicators of ash leachate contamination. Data will be evaluated for (1) concentrations exceeding maximum contaminant levels, (2) above-normal background range, and (3) increasing concentration trends. The *Corrective Action Plan* evaluated alternate water supply options that included (1) connection to the public water system, (2) use of bottled water, (3) well replacement, or (4) installation of localized water treatment system.

Future characterization of groundwater flow in the vicinity of the Dredge Cell is outlined in the *Non-Time Critical Removal Action for the River System Sampling and Analysis Plan* (May 2010). The report outlines a proposed groundwater monitoring well network and the approach for further hydrogeological characterization, including groundwater modelling for fate and transportation of for ash-related constituents. Hydraulic conductivity testing, column leaching tests, geochemical analysis of soils, and other methods are proposed to provide data to support the modelling and future risk assessments.

Marshall Miller's opinion is that the overall approach/strategy appears to be sound relative to groundwater quality evaluation and monitoring. The written plans are appropriate to meet data quality objectives and regulatory requirements for continued groundwater monitoring. Protection of groundwater and drinking water supplies appears to remain a priority to TVA and the stakeholders. The *Corrective Action Plan* is a vital step to characterize groundwater conditions and further evaluate risks to the surrounding community.



One limitation Marshall Miller experienced in reviewing groundwater concerns is the difficulty of finding publically available data and detailed groundwater summaries on the TVA, TDEC, or EPA Web sites. Data of surface water and public water supply intakes appear more readily available. Since TDEC is leading the private water well sampling, Marshall Miller reviewed its sampling plan (*TVA Kingston Response and Monitoring Plan—Water Sampling* updated January 26, 2009) referenced on TDEC's Web site and found that it did not contain detailed water well sampling protocols. In addition, TDEC's plan stated that private water well sampling will be performed upon request within a 4-mile radius but did not specify the level of proactive effort to initiate/obtain these requests. The results of the sampling of private wells (reportedly over 100 wells) by TDEC were only provided to the property owners. The TDEC Web site indicates that there have been no exceedances of the primary drinking water standards for metals.

## **2.6. BIOLOGICAL**

TVA has implemented monitoring efforts to determine the biological impacts due to the ash spill and recovery operations as well as any short- and long-term effects of these actions. The ash spill covered approximately 300 acres of the adjacent Watts Bar Reservoir, including most of the Swan Pond Embayment and reservoir shorelines. It is estimated that approximately 2.51 acres of palustrine wetlands were buried by the ash. The area in the Emory River where the ash spilled was temporarily devoid of benthic life, as benthic invertebrates were smothered during the ash spill. This void minimized the food available to aquatic life, impacting the aquatic environment in the area. The presence of metal constituents in the ash and, if re-suspended, in the water column may also have an effect on the aquatic environment.

Prior to the ash spill, there were preexisting Fish Tissue Advisories in effect for portions of the Emory, Clinch, and Tennessee Rivers within the Watts Bar Reservoir. These advisories are based on the presence of sediments containing PCBs.

Marshall Miller has reviewed several documents regarding biological plans and analysis including, but not limited to, *Emergency Dredging for the Kingston Fossil Plant Ash Dike Failure*, the *Corrective Action Plan*, *Non-Time Critical Removal Action Scope and Engineering*



*Evaluation/Cost Analysis (EE/CA) Work Plan*, US Army Engineer Research and Development Center report and Standard Operating Procedures. These documents were found to provide a comprehensive scope of procedures and analysis related to biological studies.

Tennessee Wildlife Resources Agency (TWRA) began collecting fish for tissue analysis during the week of January 5, 2009. TWRA compared results from its sampling to existing historical data and results of sampling of fish downstream of the spill to an upstream reference site. TVA is collaborating with TWRA, TDEC and ORNL to examine contaminants in the fish tissue. Of the sampling, only two catfish collected by TWRA from January to April 2009 were found to have metals present above human health protection standards for mercury; selenium levels in the fish were below EPA's proposed toxicity standards for protection of fish and other aquatic life. As of June 2010, fish tissue testing has not necessitated a change in the current fish consumption advisories in the area, which pre-date and are unrelated to the ash spill.

TVA has systematically monitored contaminants in fish tissue from four locations on the Tennessee and Clinch Rivers on Watts Bar Reservoir annually since the early 1990s as part of the Vital Signs Monitoring Program. TVA reportedly sampled these locations again in fall 2009 and 2010. ORNL is conducting fish health studies which include measurements that represent short-term responses as well as intermediate- and long-term responses to assess effects as a result of ash exposure. ORNL conducted analysis of fish tissue collected in spring 2009 and found, in general, that fish health below the spill site was similar to a reference site well above the spill site.

TVA water sampling, as of February 23, 2009, indicated increased levels of metals in the water after the event and subsequent heavy rainfall events. However, all metals concentrations, even for total arsenic results, were below the chronic Tennessee Water Quality Criteria of 0.015 mg/L for dissolved arsenic (III) to protect fish and aquatic wildlife.

The *Revised Surface Water Monitoring Plan for the Emory, Clinch and Tennessee Rivers* includes collection of water samples from the dredge plume which are subjected to acute toxicity testing. Acute toxicity test results showed no difference between controls and the samples.



The US Army Engineer Research and Development Center conducted a study to determine whether continued clean-up of the ash by dredging in the Emory River would promote the release of metals within the ash and pose additional risks to the environment. The report, *Evaluation of Metals Release of Oxidation of Fly Ash during Dredging of the Emory River, TN* dated October 9, 2009, indicated the ash material possesses high stability and is largely resistant to high releases of toxic metals under extreme environmental testing. Of the metals released from the ash during this study, only selenium exceeded EPA regulatory values. Metals released from the ash were found mainly in their less toxic forms. The study provides the basis for continued dredging of the Emory River for removal of the spilled ash.

Biological surveys and samplings to date include reptiles, amphibians, fish, birds and benthic invertebrates, mammals, and grasses. Analyses of tissue from reptiles and amphibians have been reported, and additional sampling will continue next spring. Turtle trapping and collection of blood samples is being conducted by TVA, TWRA, and Virginia Tech. The turtles are marked for future sampling for bioaccumulation studies. Mammal trapping has been initiated in collaboration with the University of Tennessee. The KIF site was known as a birding location for shorebirds and waterfowl, and tissue sampling of birds has been conducted since the spill. As of June 2010, TVA developed Standard Operating Procedures for biological sampling, and monitoring of fauna and flora and were continuing to develop additional Standard Operating Procedures as needed.

Continuation of existing monitoring programs by TVA, TDEC and other agencies, in addition to the existence of historical biological data and the initiation of a number of new programs in response to the ash spill, should provide a comprehensive approach to assess the impacts of the ash spill and provide guidance on the effectiveness of the recovery efforts.



### **Item 3: CONCLUSIONS & RECOMMENDATIONS**

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As of its review completed through June 2010, Marshall Miller finds no significant deficiencies in the plans or procedures used by TVA or its contractors in characterizing impacts resulting from the ash release or recovery efforts. Although the procedures used early in the recovery process could not, in some cases, pass the rigorous QA/QC checks now in place, there is no indication that decisions regarding clean-up were made using data of poor quality. Follow-up planning documents prepared by TVA and its recovery contractors appear to be well conceived and are substantially in compliance with applicable regulatory requirements including those stated in EPA's Administrative Order and Agreement on Consent.

TVA should consider the following recommendations:

- TVA should ensure that Inter-Mountain Labs, the laboratory that is currently performing PM<sub>2.5</sub> and PM<sub>10</sub> air sampling and analyses, is reporting the correct analytical methods.
- Research related to the composition of ash and the potential release of metals from the ash into the surrounding river system, which could be bioavailable and have potential affects to organisms, should continue. As sampling to date has been limited, research on how the ash affects benthic organisms should also be continued. Marshall Miller notes that the EE/CA for the river system is expected to address this issue.
- TVA should consider making more comprehensive air testing results and evaluations of metals data available to the public.
- TVA should consider working with TDEC to provide the public with updated groundwater testing results and evaluations.
- TVA should complete ongoing research designed to understand how river bottom sediments play a role in the overall ecology of the river system by propagating potential spill impacts through the food chain including fish, reptiles, mammals, birds and other biota over the long term. It is Marshall Miller's understanding that this research is ongoing through a collaborative effort between TVA and various research organizations.
- TVA should continue to monitor for the four principal ash components of concern (arsenic, mercury, selenium, and thallium). With respect to selenium, TVA should continue to follow the guidance of the EPA as outlined in the August 18,

*2009, Review of Potential Selenium Issues Following a Coal Ash Spill at the Tennessee Valley Authority Kingston Fossil Plant.*



March 3, 2011

Robert Martin, ET 3C-K

INSPECTION 2008-12283-07 - REVIEW OF ENVIRONMENTAL SAMPLING AND MONITORING PLANS FOR THE KINGSTON ASH SPILL

The Ash Recovery Project staff including members from the Fossil Generation Development & Construction and Environment and Technology organizations appreciates the thoroughness of the review performed by Marshall Miller & Associates and the opportunity to provide comments on this draft report. This response includes both responses to the recommendations made in the report and comments on the content of the report.

Response to recommendations:

1. With the exception of one station, Inter-Mountain Labs (IML) is no longer performing filter-based PM 2.5 and PM 10 analyses for TVA. TVA has moved to continuous monitoring of PM 2.5 and PM 10 using instruments that are qualified as Federal Equivalent Methods with one redundant filter-based sampler location at Station 7. IML is EPA's referee lab for the filter-based methods. TVA and EPA have conducted audits of this facility to ensure that correct analytical methods are being used.
2. The River Sampling and Analysis Plan which was developed to support the data needs of the River Engineering Evaluation/Cost Analysis is currently ongoing. The research being conducted evaluates the potential release of metals from the ash into the surrounding river system and whether the ash affects organisms in the river. The ecological risk assessment which will be included in the River EE/CA will evaluate the potential effects of ash-related constituents through direct and food chain exposure pathways.
3. TVA is currently reviewing the way that data is being made available to the public. Changes will be made to ensure that results and evaluations are available.
4. TVA will work with the Tennessee Department of Environment and Conservation (TDEC) to provide updated groundwater results.

The comments are organized into four categories:

- General comments
- Corrections of factual errors
- Supplemental information, current status updates, and suggested clarifying language
- Typographical or grammatical errors

General comments

Overall, this is a very complimentary report on the design and implementation of the various environmental sampling and monitoring programs developed by TVA to evaluate potential environmental or public health impacts of the ash spill.

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1. Descriptions in the report are based on situations as they existed when Marshall Miller & Associates conducted the information-gathering, interviews, and review of available data and documents. As a result, some descriptions do not accurately reflect the current status of the environmental sampling and monitoring program. Readers may mistakenly assume descriptions in the report are accurate as of the February 2011 publication date.

It is impossible to complete such an extensive review and prepare a report quickly enough to avoid some information becoming outdated. However, it also is important to clearly identify the timeframe of the investigation and provide relevant updates, where appropriate. This is particularly important where readers may construe the descriptions as criticisms of the adequacy of the environmental sampling and monitoring program.

We recommend adding language in both the Executive Summary and the Introduction and Background sections making it clear that the report is based on conditions as they existed at the time of the reviews. In addition, we recommend providing TVA-supplied updates as footnotes at a few points in the report. This would provide current information as of the report's publication date, but would identify each update as provided by TVA, thus not implying Marshall Miller & Associates has investigated the information in the update.

Suggested language and information that could be used in footnotes are offered in several items in the comments under Supplemental information, current status updates, and suggested clarifying language.

2. Several places in the report refer to difficulty in finding publicly-available data for monitoring results for different types of media. TVA recognizes that it is important to make as much environmental data as possible available as quickly as possible, and in easily accessible and understandable forms.

TVA currently is reviewing its website presentations of environmental results for this project. Improvements have been developed for water quality data that currently are undergoing internal review. Air and biological data will be the next two data types reviewed, and TVA will discuss with TDEC and EPA appropriate ways of presenting groundwater information in understandable forms.

It would help TVA in addressing this need if Marshall Miller could clarify for each instance whether the problem was timing (i.e., data not yet available due to time required for sample analysis and results verification and validation), lack of intuitive navigation on the website, data simply not being publicly available, or some other factor.

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3. Several paragraphs and statements in the groundwater section of the draft report focus on sampling of private wells and springs. TVA and TDEC jointly decided during the first week following the spill that it was more appropriate for TDEC to perform all of that type of monitoring. TVA had sampled less than 10 private wells and springs prior to that decision. We suggest that rather than the descriptions of TDEC's well and spring monitoring program and the results of that monitoring, it would be more appropriate for this review of TVA's environmental sampling and monitoring plans simply to comment on the appropriateness of TVA's decision to defer to the State in that aspect of public health impact assessment. We recommend Marshall Miller & Associates carefully revise the groundwater section of the report to reflect that approach.
4. The groundwater section of the draft report provides very little information on TVA's plans for post-failure monitoring and modeling of groundwater in and around the former dredge cell. This is an important part of TVA's environmental sampling and monitoring plans that should be covered in this review. Those plans were still undergoing changes at the time of the review, which may be why they received less emphasis. We recommend Marshall Miller & Associates review the post-failure groundwater monitoring plans and incorporate conclusions and recommendations about those plans if they revise the groundwater section of the report as suggested above.

#### Corrections of factual errors

1. Page 3, bullet 4: The legacy contaminant that resulted in the decision not to dredge ash in the lower end of the Emory River was cesium-137, not metals. TVA was aware of PCBs and mercury contamination in that part of the Emory River, but the decision driver was the presence of cesium-137.

It is suggested that the language in the first part of the bullet be revised using more general terminology and being more specific about the location: "Due to legacy contaminants in the sediment in the lower 1.8 miles of the Emory River..."

2. Page 3, bullet 4: Delete "presumably" or replace it with "primarily." There is no question about the source of the legacy contaminants; these facts are well-documented by results of investigations performed for the Upper Watts Bar NRDA over a period of several years.
3. Page 6: "(1) evacuate nearby residents from the path of the spill" is incorrect. One house was swept off its foundation; TVA's response to that resident house might be characterized as "evacuating a resident from the path of the spill." We suggest a more accurate characterization is that TVA took measures to "(1) identify residents whose property was adversely affected by the spill and provide temporary housing for those most impacted by the spill and recovery efforts."

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4. Page 6: "(4) rescue wildlife" is incorrect. A more correct wording is "(4) assess immediate impacts to wildlife and wildlife habitat."
5. Page 8, last paragraph: "Although Marshall Miller found that most of these documents were not prepared, approved, and issued until many months after the spill" suggests delay on TVA's part in documenting procedures. We suggest deleting "prepared" from that statement.

TVA began preparing and implementing plans and SOPs for all environmental monitoring in January, 2008. The QAPP was prepared in March, 2009. Documents were submitted for regulatory agency review as they were prepared. In some cases regulatory agency review and approval took several months.

6. Page 12, last paragraph, through the end of the first full paragraph on page 13: As written, these two paragraphs imply that EPA first discovered the problem with Bureau Veritas' method for weighing the filters to measure PM<sub>2.5</sub> and PM<sub>10</sub> as a result of their January, 2010 air audit.

The actual sequence of events was that Bureau Veritas self-reported problems with filter weights; TVA conducted a site visit at Bureau Veritas as part of their investigations in early December, 2009 prior to EPA's January, 2010 audit and notified EPA about these issues.

Most of the issues reported in the EPA's January 25, 2010 memorandum, "Evaluation of the Perimeter Air Monitoring Strategy and Identification of Corrective Actions at the TVA Kingston Fly Ash Release Time-Critical Removal" that resulted in the disqualification of this data were discovered by the TVA and Environmental Standards auditors.

7. Page 13: In regard to the discussion of Marshall Miller's review of the Bureau Veritas data in the EQUIS database maintained by Environmental Standards and the comment that PM<sub>2.5</sub> and PM<sub>10</sub> "...are not valid modes of identifying sampling methods. As such, there was no mechanism in place for a data reviewer...to determine if the correct methods were utilized."

Review of available literature and the Federal Reference Method indicates that the terms "PM<sub>2.5</sub> and PM<sub>10</sub>" are correct means of referencing the FRM and are distinguishable from NIOSH or OSHA methods. When noted as sampling and analysis methods, that notation includes the inherent assumption that both the sampling and analysis methods adhere to the published volume, equipment, and analytical requirements of the FRM.

TVA requested PM<sub>2.5</sub> and PM<sub>10</sub> analyses from Bureau Veritas. Bureau Veritas failed to adhere to the FRM requirements and incorrectly reported the data as PM<sub>2.5</sub> and PM<sub>10</sub>. The data are maintained in the TVA EQUIS database as rejected data for these two analytes.

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Had TVA requested NIOSH methods for analysis, these data would have been maintained in the database with the analytical method shown as NIOSH, and the data qualifier would not indicate the data status as rejected. The "rejected" data qualifier is the method by which reviewers can determine whether the data meet the methods requirements.

8. Page 13: "however, Bureau Veritas does continue to analyze samples for metals and silica" is incorrect. The responsibility for analysis of air samples for metals and silica was shifted to Inter-Mountain Laboratories (IML) on March 24, 2010. Suggested revision: "...Bureau Veritas *continued* to analyze samples for metals and silica *through March 24, 2010.*"
9. Page 23, first paragraph under Groundwater: "...prior to the release were below the drinking water maximum contaminant level of 10 parts per billion."

There actually were six different occasions when the 10 ppb threshold was exceeded. Only one resulted in an exceedance of the MCL because the MCL was 50 ppb during much of that period.

10. Page 23, same paragraph, last sentence: While technically correct, this sentence is misleading. There were two sets of duplicate samples from one well (AD-2) that exceeded 10 ppb that were subsequently determined likely to be an artifact of well installation. These four samples from two sampling events involving one well are the only arsenic exceedances observed in the ash pond/dredge cell area out of dozens of samples from multiple wells over a period exceeding two years.
11. Page 23, second paragraph: The Human Health Risk Assessment was actually completed and presented in the October 16, 2009 Engineering Evaluation/Cost Analysis, rather than proposed in it.

The risk assessment did include the groundwater exposure scenarios mentioned. As a worst-case scenario, the assessment used analytical data from an existing on-site monitoring well (13B), which extends through the ash to bedrock to evaluate potential future exposures to groundwater. Cancer risk estimates ranged from 2E-05 for indoor workers to 3E-05 for adult residents. The cancer risk estimates are driven by ingestion of arsenic.

There is no possibility that the site will be developed for residential uses, so even this low level of increased cancer risk is overly conservative. Results of the TDEC monitoring and groundwater flow modeling clearly indicate that even the closest off-site private water wells have very little risk of contamination from the site.

12. Page 26, same paragraph, last sentence: Delete "reportedly," since those SOPs are available on the TVA Kingston website. (<http://www.tva.gov/kingston/sap/>)

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Supplemental information, current status updates, and suggested clarifying language

1. Page 2: Suggest deleting “through June, 2010,” from the second sentence and inserting two new sentences after it: “Because of the number of different sampling and monitoring programs, the review spanned a period of several months, ending in June, 2010. Different parts of the review were completed at varying times during that period.”
2. Page 3, bullet 2: Suggested revisions: “Through June, 2010, there had been limited research on how the ash and metals associated with ash may affect the various organisms in the river. Additional investigations covering a broad range of organisms and approaches and involving efforts by a variety of research organizations are underway, primarily in support of the River System Engineering Evaluation/Cost Assessment (River EE/CA).

Basis: As written, this bullet does not accurately reflect the magnitude of the monitoring and research effort, part of which was launched within weeks following the spill. That program has matured into a carefully planned integrated biological, toxicological, and geochemical research program involving TVA, ORNL, ORAU, USACE, TWRA, USGS, and several universities (Brigham Young, Virginia Tech, Duke, Illinois-Urbana, Kentucky, NC State, Colorado, Old Dominion, Appalachian State, and Middle Tennessee State—all funded directly or indirectly by TVA. In addition, Duke, Appalachian State, and the Tennessee Aquarium obtained funding from the National Science Foundation and private donors for additional ecological research projects. The types of research range from investigation of basic geochemical process and kinetics, to bioaccumulation and biomagnification throughout the food chain, to evaluation of potential effects of fly ash exposure at the sub-cellular, organ, individual, and population levels. Results have been presented at the 2009 and 2010 annual meetings of the Society of Environmental Toxicology and Chemistry and at a March, 2010 Kingston Fly Ash Release Environmental Research Symposium sponsored by TVA, and additional presentations on the research program are scheduled for the 2011 Tennessee Water Resources Symposium and the 2011 World of Coal Ash Conference.

3. Page 4, bullet 3: See comment #2 in this section.
4. Page 6, first paragraph: See comment #1 in this section and comment #2 in the General Comments section.
5. Page 6, bullet 3: Suggest re-wording: “Storm water (runoff from ash-impacted areas and from the ash dewatering area).”
6. Page 9: Following the sentence ending in “...much of this data was invalidated due to unrecoverable deficiencies” we suggest inserting the following:

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"TVA immediately retrieved from the analytical laboratories all samples for which there was any retained portion and submitted those for re-analysis by a laboratory that could adhere to the project's QA/QC requirements. All parameters for which holding times were still valid (i.e., all metals except mercury) were re-analyzed and the deficient data were replaced with defensible results."

As currently written, the report does not fully reflect TVA's response to discovery of this problem and could be interpreted to mean that all data for that initial period are invalid. In reality, TVA's quick action prevented loss of all but a small fraction of that data.

7. Page 9, second paragraph: Suggest replacing "...had used the incorrect method for PM<sub>2.5</sub> and PM<sub>10</sub>..." with "...had used *inadequate humidity controls for measurement of PM<sub>2.5</sub> and PM<sub>10</sub>*..."

While Bureau Veritas did use the incorrect analytical method, the analytical parts of the NIOSH methods and the Federal Reference Methods are indistinguishable except for the tight humidity controls specified in the FRMs. The end result is that the procedure, specifically the inadequate humidity control, used by Bureau Veritas resulted in data that was not valid for reporting as PM<sub>2.5</sub> and PM<sub>10</sub>. It is a fine point, but it seems appropriate at some point in the review to identify the specific shortcoming of the method Bureau Veritas used that ultimately resulted in invalid data.

8. Page 10, second paragraph: Suggest inserting a new sentence following the fourth sentence: "The goal of nearly all of Environmental Standards' procedures in support of this project is to review data to EPA's National Functional Guidelines for CERCLA sites."
9. Page 11, Second paragraph: Suggested revision of first part of paragraph:

"During the emergency response, TVA deployed readily-available stationary industrial hygiene-type monitors at several temporary monitoring stations around the perimeter of the site and located a portable air monitoring trailer with FRM samplers between the ash ditch and remnant of the dredge cell. On December 29, 2008, TVA began deploying contractors with portable industrial hygiene-type monitors in vehicles to obtain air quality data throughout the community. Because of the need to begin preparing the dewatering site for operation, the air monitoring trailer was removed in mid-January 2009.

Locations of the fixed monitoring stations were adjusted slightly during this time, and FRM samplers were ordered to replace the industrial hygiene-type samplers. In March, 2009, FRM were received and installed. The resulting network consisted of five air monitoring stations encircling and proximal to the site, and one background station at Harriman High School.

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March 3, 2011

Sampling at these locations was performed on a 12-hour and 24-hour frequency and analyzed for particulates less than 2.5 micrometers and less than 10 micrometers in diameter (PM<sub>2.5</sub> and PM<sub>10</sub>--at one station; PM<sub>10</sub> at the other stations), total suspended particulates..."

10. Page 12, first paragraph: Suggested revision of first paragraph:

"The EPA and TDEC conducted reviews of the initial plan for monitoring, the draft Air Monitoring Plan developed in January, 2009, and the Quality Assurance Plan, and performed subsequent site visits to monitor on-site air sampling techniques. Following these reviews, TVA revised the draft Air Monitoring Plan and submitted it for regulatory approval in June, 2009. TVA operated under the draft plan and its subsequent revisions until the final plan was approved as an appendix to the Site Dust Control Plan in August, 2009.

11. Page 13, last paragraph: In response to Marshall Miller's comment on the difficulty of finding publicly available air sample metals analyses, see General Comment # 3.
12. Page 14, last paragraph: EPA's preference for posting metals data in air has been EPA's AQS database. TVA intends to comply promptly with EPA's request to post data there as soon as EPA configures the database to accept the data.
13. Page 16, bullet 1: Suggest adding another sentence at the end: "From January, 2009, until approval of the Revised Surface Water Monitoring Plan on August 26, 2009, TVA collected samples from these locations three days per week." This more accurately reflects TVA's river water monitoring program than the bullet as written.
14. Page 23, first paragraph under Groundwater: Suggest inserting a new second sentence: "Baseline groundwater monitoring at the site extends back to at least 2003, and a small number of wells were sampled for internal purposes since 1989."
15. Page 23, same paragraph: "...arsenic appears to be the main constituent of concern in groundwater."

TVA's evaluation of groundwater quality prior to the spill included closely monitoring arsenic levels, but the results would not characterize arsenic as a main constituent of concern during that period. There was only one exceedance of the arsenic drinking water MCL during that time.

16. Page 23, last paragraph: In response to Marshall Miller's comment on the difficulty of finding publicly available groundwater data, see General Comment #3.

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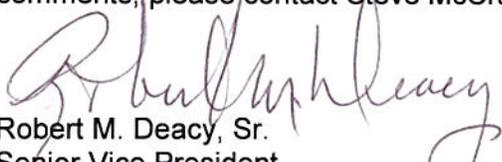
17. Page 25, first full paragraph, last line: Suggest re-wording as follows: "As of the date of this report, fish tissue testing has not necessitated a change in the fish consumption advisories in the area that pre-date and are unrelated to the ash spill." As the report is currently written, a reader could mistakenly think that the current advisories are somehow related to the ash spill.

Suggested minor wording changes & typographical errors

1. Page 9, second paragraph, line 5: "fail-safe" should be hyphenated.
2. Page 12, fourth bullet: Insert "electronically" ("...started submitting data *electronically* to EPA...").
3. Page 14, last paragraph, first line: insert "of" at the end of the line.
4. Page 21, middle of page: "In late 2009, TVA extended its sediment sampling to penetrate greater thicknesses using a custom-built Vibracorer..." Change "custom-built" to "commercially-available."
5. Page 21, middle of page: VibeCore™ and Vibracorer™ are registered trademarks of competing companies. Change each of the four "Vibracorer" references on this page to "VibeCore™."
6. Page 25, line 6: change "corroborating" to "collaborating."
7. Page 26, second paragraph, end of first line: Suggest revising to "...include reptiles, amphibians, fish, birds, *benthic invertebrates*, *mammals*, and *grasses*." (i.e., replace "fauna" with "benthic invertebrates, mammals, and grasses.")

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Once again, the Ash Recovery Project Staff appreciates the thoroughness of the review and the opportunity to comment on this draft report. Should you have any questions concerning these comments, please contact Steve McCracken at 865-717-1649.



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OIG File No. 2008-12283-07

June 27, 2011

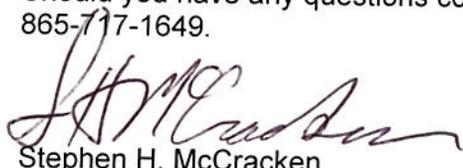
D. D. Scoggins, EB 2G-C

INSPECTION 2008-12283-07 - REVIEW OF ENVIRONMENTAL SAMPLING AND MONITORING PLANS FOR THE KINGSTON ASH SPILL - CLARIFICATION OF RESPONSE TO RECOMMENDATIONS

In response to your question concerning responses to recommendation # 5, the study described in Response #2 which is being conducted under the River EE/CA will address potential future impacts through the food chain including fish, reptiles, mammals, birds and other biota over a long future period. In addition, TVA has funded researchers at USACE-ERDC, ORNL, and several universities to conduct investigations of dissolution rates and oxidation-reduction rates for selenium, arsenic, and other contaminants of concern in fly ash that may be released to the environment under conditions characteristic of river sediments. TVA also is modeling groundwater transport of ash-related contaminants as a potential source of contaminants to the river system.

Regarding recommendation #6, TVA's ongoing monitoring program include studies described in all three Tiers recommended in the Review of Potential Selenium Issues Following a Coal Ash Spill at the Tennessee Valley Authority Kingston Fossil Plant, including histological effects, reproductive success, occurrence of abnormalities, Se concentration in eggs and sampling of water, fish and birds.

Once again, the Ash Recovery Project Staff appreciates the thoroughness of the review. Should you have any questions concerning these comments, please contact me at 865-717-1649.



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Kingston Ash Recovery

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June 30, 2011

Mr. Greg Stinson  
**Tennessee Valley Authority, Office of Inspector General**  
 400 West Summit Hill Drive, ET 3C  
 Knoxville, Tennessee 37902-1401

**Re: *Response to Comments***  
***Review of Environmental Sampling and Monitoring Plans for the Kingston Ash Spill***  
***Kingston Fossil Plant • Harriman, Tennessee***

Dear Greg:

**Marshall Miller & Associates, Inc. (MM&A)** has reviewed the comments submitted by **Tennessee Valley Authority (TVA)** in their letters dated March 3, 2011 and June 27, 2011. These comments were submitted in response to TVA's review of the above-mentioned report. Following is MM&A's response to those comments. Comments were provided to address MM&A's recommendations and in four additional categories. MM&A's responses are provided by comment category and number rather than repeating each comment in its entirety. Responses were included only when additional information was needed.

### **Response to Recommendations**

MM&A agrees that TVA is addressing the recommendations. However, in the response to recommendations #2 and #5, TVA notes that the research to complete the River EE/CA is still ongoing. This report should be reviewed in detail once it is available. Additionally, in the response to recommendations #3 and #4, TVA notes that they are taking steps to address the availability of air and groundwater monitoring data to the public. It doesn't appear that this has been completed as of yet.

### **General Comments**

1. While the Executive Summary does indicate that MM&A's review only included those documents available thru June 2010, this section and the Introduction and Background have been modified to clarify the timeframe in which the review occurred.

2. In some cases, analytical data may not have been available for review due to the time required for the validation process. In other areas, data may have been available, but in various locations. For instances, for air quality data, the TVA website contained the PM<sub>2.5</sub>, PM<sub>10</sub>, and arsenic data, while the TDEC website contained a more extensive data including all the metals. Groundwater data was not and still is not available.
3. Portions of the Groundwater section of the report have been revised in response to this comment.
4. Portions of the Groundwater section of the report have been revised in response to this comment.

### Corrections of Factual Errors

6. Additional comments have been included indicating that a review of a recently obtained document (January 5, 2010 memorandum) indicates that Bureau Veritas reported a problem to TVA on December 7, 2009 and that TVA and Environmental Standards personnel conducted an audit on December 15, 2009.
8. A review of the EQUIS database indicates that Bureau Veritas analyzed samples for metals until March 2010, at which time Inter-Mountain Laboratories assumed responsibility. Galson Laboratories had maintained responsibility for silica analysis since December 2008. The text has been revised accordingly.
9. According to information provided by TVA, 6 samples from monitoring well KIF-6A exceeded 10 ug/L, the current MCL for arsenic. However, 5 of those detections occurred prior to January 2006 when the MCL was lowered from 50 to 10 ug/L. The text has been revised to reflect this information.
10. TVA states that the only post-ash release arsenic exceedances of the MCL occurred in monitoring well AD-2 and the detections were determined to be an artifact of well installation. No documentation has been provided to support this statement. The EE/CA (October 16, 2009) notes that arsenic was detected in one of the wells at 14 ug/L. The graph of arsenic concentration over time provided by TVA seems to indicate that the arsenic concentration in KIF-6A exceeded the MCL immediately following the spill. Though due to the scale of the graph, it is difficult to determine the exact date the sample was collected.
11. Agree with this comment. This portion of the report had been written prior to review of the EE/CA report. The paragraph has been deleted.
12. Technically the sentence in the report is correct. While TVA had developed a number of SOPs for biological sampling prior to June 2010, TVA issued at least 5 SOPs after June. TVA provided a URL link to the available SOPs in their response. However, I was

unable to determine how to access that link from the TVA home page. Without the link provided in TVA's response, I would not have been able to access this page.

**Suggested minor wording changes & typographical errors**

5. Agree with proposed revision. Only two references to Vibracorer were identified however, not four as stated in the comments.

MM&A appreciates the opportunity to provide these services to TVA OIG. If there are any questions, or if we can be of further assistance, please do not hesitate to contact us.

Sincerely,

**MARSHALL MILLER & ASSOCIATES, INC.**



Timothy D. Grant, P.G.  
Senior Project Manager

cc: Mr. Ben R. Wagner, Deputy Inspector General, TVA OIG  
Mr. Robert E. Martin, Assistant Inspector General (Audits & Inspections), TVA OIG

