



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

June 21, 2011

Anda A. Ray, WT 11A-K

**FINAL REPORT – INSPECTION 2009-12991 – TVA'S GROUNDWATER MONITORING  
AT COAL COMBUSTION PRODUCTS DISPOSAL AREAS**

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

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 the audit.

*Robert E. Martin*

Robert E. Martin  
Assistant Inspector General  
(Audits and Inspections)  
ET 3C-K

DDS:FAJ  
Attachment  
cc (Attachment):

Cynthia M. Anderson, LP 5D-C  
Brenda E. Brickhouse, LP 5U-C  
Robert M. Deacy, Sr., LP 5D-C  
Michael B. Fussell, WT 9B-K  
Kimberly S. Greene, WT 7B-K  
Peyton T. Hairston, Jr., WT 7B-K  
Tom Kilgore, WT 7B-K

William R. McCollum, Jr., LP 6A-C  
Richard W. Moore, ET 4C-K  
Emily J. Reynolds, OCP 1L-NST  
John M. Thomas III, MR 6D-C  
Robert B. Wells, WT 9B-K  
Wendy Williams, WT 9B-K  
OIG File No. 2009-12991



Tennessee Valley Authority  
Office of the Inspector General

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# *Inspection Report*

## **TVA'S GROUNDWATER MONITORING AT COAL COMUSTION PRODUCTS DISPOSAL AREAS**

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Inspection 2009-12991  
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## **ACRONYMS AND ABBREVIATIONS**

CCPs	Coal Combustion Products
E&T	Environment & Technology
EPA	Environmental Protection Agency
GWPS	Groundwater Protection Standard
MCL	Maximum Contaminant Level
OIG	Office of the Inspector General
TDEC	Tennessee Department of Environment and Conservation
TVA	Tennessee Valley Authority
UPL	Upper Prediction Limit
USWAG	Utility Solid Waste Activity Group

## **TABLE OF CONTENTS**

EXECUTIVE SUMMARY .....	i
BACKGROUND.....	1
OBJECTIVE, SCOPE, AND METHODOLOGY .....	3
FINDINGS .....	3
TVA IS NOT PERFORMING MONITORING AS REQUIRED BY THE PERMITS IN CERTAIN CASES. ....	4
SEVEN OF EIGHT FOSSIL PLANTS WITH SOLID WASTE REQUIREMENTS TO MONITOR GROUNDWATER HAD EXCEEDANCES .....	6
Two Plants in Tennessee (Cumberland and Gallatin) Had Exceedances That Resulted in Phase III Assessment .....	7
Two Other Plants in Tennessee (Bull Run and John Sevier) Had Exceedances That Resulted in Phase II Assessment.....	10
Three Other Plants (Kingston in Tennessee, Colbert in Alabama, and Shawnee in Kentucky) Had Exceedances That Are Being Monitored by State Officials.....	11
TVA HAS COMMITTED TO GROUNDWATER MONITORING AT ALL FOSSIL PLANTS.....	12
RECOMMENDATIONS .....	13
MANAGEMENT'S RESPONSE.....	13

## **APPENDICES**

- A. OBJECTIVE, SCOPE, AND METHODOLOGY
- B. POTENTIAL HEALTH EFFECTS
- C. ADDITIONAL EXCEEDANCES AT KINGSTON, COLBERT, AND  
SHAWNEE
- D. MEMORANDUM DATED MAY 19, 2011, FROM ANDA A. RAY TO  
ROBERT E. MARTIN



# Inspection 2009-12991 –TVA's Groundwater Monitoring at Coal Combustion Products Disposal Areas

## EXECUTIVE SUMMARY

### Why the OIG Did This Review

This review was initiated because of questions raised during congressional testimony following the Kingston Ash Spill in December 2008.

The objectives of this review were to determine whether the Tennessee Valley Authority (TVA) has (1) performed groundwater monitoring as prescribed by the permits and (2) found levels of constituents monitored that exceeded regulatory limits and, if so, implemented any required corrective actions.

### What the OIG Found

During our review, we found that in some instances TVA was not performing monitoring as prescribed by the permits. Additionally, exceedances were found at eight of the nine fossil plants where monitoring is being conducted. TVA has two plants in Tennessee that have constituents<sup>i</sup> that exceeded health-based limits and are working through the corrective action process described in Tennessee Rule 1200-1-7.<sup>ii</sup> Finally, TVA installed 29 monitoring wells at nine sites in 2010 and has committed to conducting at least one sampling event at each site by the end of fiscal year 2011.

- **TVA is not performing monitoring as prescribed by the permits in certain cases.**
  - ❖ For calendar years 2008 and 2009, TVA was monitoring for the required constituents and testing within the required time frames at ten coal combustion product (CCP) areas at seven fossil plants. However, TVA was not monitoring for all permit-required constituents at Cumberland and Johnsonville Fossil Plants.
- **Exceedances found at multiple fossil plants:**
  - ❖ Gallatin and Cumberland Fossil Plants have had exceedances that placed them in Phase III assessment, which occurs when a health-based groundwater protection standard is exceeded in Tennessee. As detailed in the report, there are multiple phases of assessment depending on the magnitude of the exceedance. Phase III is the most severe phase. TVA is working through the corrective action process, as

<sup>i</sup> A constituent is a chemical component of the coal combustion product that may be present in groundwater and can be analyzed by a lab.

<sup>ii</sup> Tennessee Rule 1200-1-7, Solid Waste Processing and Disposal, contains Groundwater Protection/Monitoring Standards.



## **Inspection 2009-12991 –TVA's Groundwater Monitoring at Coal Combustion Products Disposal Areas**

### **EXECUTIVE SUMMARY**

required by Tennessee Rule 1200-1-7, and as part of the groundwater quality assessment has found that it is highly unlikely a release could impact local water wells.

- ❖ Both the Bull Run and John Sevier Fossil Plants have been placed in Phase II assessment for exceedances. In Tennessee, an exceedance that initiates a Phase II assessment is a statistically significant increase above background levels for a constituent.
- **TVA has committed to monitoring at all fossil plants.**
  - ❖ TVA is a member of the Utility Solid Waste Activity Group (USWAG). USWAG has an action plan focused on all facilities having wells installed for monitoring groundwater related to active CCP disposal areas. In December 2007, TVA notified USWAG of its intent to endorse the voluntary commitments prescribed in the action plan. TVA personnel reconfirmed the commitment during the course of this review.

### **What the OIG Recommends**

We recommend that the Senior Vice President, Environment & Technology:

- Continue plans to implement monitoring at all active CCP disposal areas.
- Continue with the assessment plan and initiate corrective actions for Cumberland and Gallatin Fossil Plants.

TVA management provided written comments on a draft of this report, which are reproduced in their entirety in Appendix D. TVA management agreed with the recommendations and provided various contextual and clarifying comments, which we evaluated and incorporated into the final report as appropriate. Comments which were not incorporated into the final version of the report are discussed below.

## **BACKGROUND**

The Tennessee Valley Authority's (TVA) coal-fired generating facilities have been the backbone of TVA's power system since the 1950s. TVA has 59 operating units at 11 fossil plant sites in three states in the Tennessee Valley. TVA's coal-fired generating facilities have 15,056 megawatts of capacity and generate nearly two-thirds of the electricity TVA produces for its customers. TVA's fossil plants have produced an average of 95.5 billion kilowatt-hours of electricity per year over the past ten years.

The burning of coal at TVA's fossil plants produces coal combustion products (CCPs). CCPs consist of fly ash, bottom ash, and gypsum. Currently, TVA ash and gypsum are either stored in a landfill or a pond, disposed of off-site, or beneficially used. Examples of beneficial use include using ash in structural fills and gypsum in making wallboard. According to Environment & Technology (E&T), if CCPs are stored in a pond, the CCPs are not governed by solid waste regulations but are governed by National Pollutant Discharge Elimination System permits.

CCPs contain heavy metals and other constituents that can migrate into groundwater. High concentrations of constituents could potentially pose health problems ranging from mild irritation to death, as shown in Appendix B.

If CCPs are stored in a landfill, the CCPs are regulated under solid waste regulations in Tennessee and Kentucky, but not in Alabama. Solid waste regulations in Tennessee and Kentucky require groundwater monitoring.

### **Alabama**

Alabama legislation specifically states that CCPs are not to be regulated as solid waste. Therefore, there are no solid waste permits for CCP disposal areas in Alabama.

### **Tennessee**

In Tennessee, CCPs in landfills are regulated as solid waste. Tennessee Rule 1200-1-7, Solid Waste Processing and Disposal, contains Groundwater Protection/Monitoring Standards. The regulations require that a groundwater monitoring program include consistent sampling and analysis procedures that provide an accurate representation of groundwater quality. Several CCP disposal areas do not require a solid waste permit because they are classified as ponds and not landfills.

Testing is performed to identify background values<sup>1</sup> for selected parameters, or constituents,<sup>2</sup> as required by the permit. Additionally, the facility must monitor

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<sup>1</sup> Background levels of groundwater are constituent levels that are naturally occurring and not impacted by man-made sources.

<sup>2</sup> A constituent is a chemical component of the CCP that may be present in groundwater and can be analyzed by a lab.

semiannually for an approved list of constituents after background values are established. If an exceedance for a constituent is identified during monitoring, the facility can be placed into an assessment, which usually requires increased monitoring, and can result in corrective actions.

According to Tennessee Department of Environment and Conservation (TDEC) guidance,<sup>3</sup> an assessment monitoring program is required whenever a statistically significant increase above background values has been determined for any of the approved list of constituents. The assessment monitoring program has three phases:

- Phase I involves an initial assessment sampling to identify additional constituents that have not been monitored previously and begins background sampling for any newly identified constituents.
- Phase II continues semiannual monitoring for all permitted constituents and any additional constituents identified in Phase I. If the concentrations of any of the approved constituents are above background values, but all concentrations are below the groundwater protection standard (GWPS),<sup>4</sup> the facility must continue assessment monitoring in accordance with this phase.
- Phase III occurs when any constituent is above its groundwater protection standard. Phase III involves both an assessment of groundwater quality and development of corrective actions.

### **Kentucky**

Kentucky regulations specify how groundwater is to be monitored as well as what constituents are to be tested. In Kentucky, CCPs in landfills are to be treated as special waste.<sup>5</sup> The regulations require a groundwater monitoring plan to accurately analyze groundwater quality and characterize regional and local groundwater flow.

Testing is performed to identify background values for selected parameters, or constituents, as required by the regulations. Additionally, the facility must perform monitoring semiannually for an approved list of constituents after background values are established. If an exceedance is identified during monitoring for a constituent, the facility can be placed into an assessment.

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<sup>3</sup> Guidance related to groundwater monitoring can be found in TDEC's Ground Water Monitoring Guidance for Solid Waste Landfill Units Policy (Guidance).

<sup>4</sup> The groundwater protection standard shall be either: (1) the Maximum Contaminant Level for constituents with a Maximum Contaminant Level as listed in the regulations, (2) the background concentration for constituents not assigned a Maximum Contaminant Level, or (3) the background concentration for constituents for which the background level is higher than the established Maximum Contaminant Level or health-based level.

<sup>5</sup> 401 Kentucky Administrative Regulation 45.



In Kentucky, when sampling and analysis identify one or more constituents above the Maximum Contaminant Level<sup>6</sup> or the statistical limit when there is no Maximum Contaminant Level, a groundwater assessment plan should be submitted within 30 days, and corrective action measures must follow once the agency has approved the plan.<sup>7</sup> An extension for the time frame to submit the groundwater assessment plan can be granted.

## **OBJECTIVE, SCOPE, AND METHODOLOGY**

This review was initiated because of questions raised during congressional testimony following the Kingston Ash Spill in December 2008. The objectives of this review were to determine whether TVA has (1) performed groundwater monitoring as prescribed by the permits and (2) found levels of constituents monitored that exceeded regulatory limits and, if so, implemented any required corrective actions.

The scope of our review included groundwater monitoring for calendar years 2008 and 2009 at TVA fossil plant CCP disposal areas. It did not include monitoring of surface discharges at ponds under National Pollutant Discharge Elimination System regulations. This review was conducted in accordance with the "Quality Standards for Inspections."<sup>8</sup>

To achieve our objectives, we interviewed key personnel and obtained and analyzed information related to groundwater monitoring, regulations, and permits. For additional details of work performed, see Appendix A.

## **FINDINGS**

During our review, we found that in some instances TVA has not been performing monitoring as prescribed by the permits. Additionally, exceedances were found at the majority of fossil plants where monitoring is being conducted. TVA has two plants in Tennessee with constituents that have exceeded health-based limits, and the plants are working through the corrective action process described in Tennessee Rule 1200-1-7. Finally, TVA installed monitoring wells at all remaining active CCP disposal areas in 2010.

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<sup>6</sup> The Maximum Contaminant Level is the maximum allowable amount of a contaminant in drinking water that is delivered to the consumer.

<sup>7</sup> 401 Kentucky Administrative Regulation 45:160.

<sup>8</sup> Council of the Inspectors General on Integrity and Ethics' "Quality Standards for Inspections" issued in 2005.

## **TVA IS NOT PERFORMING MONITORING AS REQUIRED BY THE PERMITS IN CERTAIN CASES**

Through 2010, TVA had been conducting groundwater monitoring related to CCP disposal areas only when required by permit or other state requirements, with the exception of voluntary biannual monitoring at Allen Fossil Plant. TVA has nine solid waste permits related to CCP disposal areas, eight of which are monitored (one is for a dredge cell at Johnsonville Fossil Plant that was not constructed). In addition to the eight permitted areas that are monitored, TVA has four nonpermitted areas that are monitored as a requirement of the state in which the facility is located.

For 10 of the 12 monitored areas, we found that TVA was monitoring the required constituents and meeting the required sampling time frames for calendar years 2008 and 2009. However, for the remaining two areas, monitoring was not performed for all permit-required constituents. At Johnsonville, for the Dupont Dredge Cell, neither nitrates nor chemical oxygen demand were included in the monitored constituents. At Cumberland Fossil Plant, chemical oxygen demand was not being monitored. TDEC personnel said that TVA should initiate monitoring for those constituents and request a permit modification to eliminate the testing requirement for those constituents if appropriate. On May 9, 2011, TVA requested a minor modification of the permits at both Cumberland and Johnsonville to remove the constituents that were not being monitored. The Office of the Inspector General (OIG) contacted TDEC personnel, and they indicated the minor modification would be accepted.

Figure 1 details information on required and actual monitoring at the TVA plants.

**Figure 1: Monitoring Requirements and Performance by Plant**

Location	Permit/ Document	Number of Constituents to Be Tested	Current Required Monitoring Frequency	Monitoring Requirements Met
Bull Run Fossil Plant - Dry Stack	IDL 103-808	20	Semi-annual	Yes
Bull Run - Gypsum Area	IDL 01-0208	25	Semi-annual	Yes
Cumberland Fossil Plant - Fly Ash Stack and Gypsum Dredge Cell	IDL 81-102-0086	20	Quarterly	No
Gallatin Fossil Plant - Abandoned Ash Disposal Area	Post Closure Plan	17	Quarterly	Yes
Johnsonville Fossil Plant - Dupont Dredge Cell	IDL 43-0082	20	Semi-annual	No
Johnsonville - South Rail Loop Area	Closure/ Post Closure Plan	17	Semi-annual	Yes
John Sevier Fossil Plant - Fly Ash Stack	IDL 37-097	36	Semi-annual	Yes
Kingston Fossil Plant - Fly Ash Dredge Cell	IDL 73-0094	25	Semi-annual	Yes
Kingston - Gypsum Dredge Cell	IDL 73-0211	17	Semi-annual	Yes
Kingston - Ash Processing Area	Ash Processing Area Construction and Operation Plan	17	Quarterly	Yes
Shawnee Fossil Plant - Dry Ash Stack	073-0041	12	Semi-annual	Yes
Colbert Fossil Plant - Plant Wide	Alabama Risk-based Corrective Action	18	Semi-annual	Yes

Source: Developed by TVA OIG based on information from TVA.

Additional information related to monitoring frequencies is noted below:

- **Bull Run** - For the Dry Stack, quarterly monitoring was performed for calendar year 2009 because a replacement well was added.
- **Cumberland** - The permit requires monitoring at least every six months. However, since Cumberland was placed in Phase III assessment in February 2009, the requirements have changed, and monitoring must be done quarterly.
- **Gallatin** - The Post Closure Plan requires monitoring at least once every 12 months. However, since Gallatin was placed in a Phase III assessment in February 2009, the requirements have changed, and monitoring must be performed quarterly.
- **Kingston** - The Ash Processing Area was not constructed until 2009. Additionally, monthly testing was conducted at the Ash Processing Area for the last several months in calendar year 2009 at the request of the Environmental Protection Agency and TVA personnel on-site.
- **Shawnee** - For the first quarter of 2008, Shawnee's permit required testing for seven constituents. The permit was then modified, which increased the number of constituents to 12. Semiannual testing was required for the first half of calendar year 2008 and then switched to quarterly to determine baseline data for a new well.

Allen does not currently have any landfill permits; however, TVA has been voluntarily testing groundwater for certain constituents since 1988. According to TVA E&T personnel, the city of Memphis' water supply comes from an aquifer that runs under Allen. TVA E&T personnel said that monitoring was conducted biannually at Allen between 1988 and 2008, but beginning in 2011, monitoring will be conducted semiannually.

## **SEVEN OF EIGHT FOSSIL PLANTS WITH SOLID WASTE REQUIREMENTS TO MONITOR GROUNDWATER HAD EXCEEDANCES**

We reviewed groundwater testing provided by TVA E&T personnel to identify plants where constituent levels were above statistical<sup>9</sup>, Maximum Contaminant Level, or groundwater protection standard levels. We found that TVA has had exceedances at seven TVA fossil plants with solid waste requirements to monitor groundwater, as follows:

- Two Tennessee plants, Cumberland and Gallatin, had exceedances that resulted in Phase III assessment, which occurs when a health-based standard is exceeded. Those plants are working through the corrective action process described in Tennessee Rule 1200-1-7.

<sup>9</sup> In Tennessee, TVA is using an upper prediction limit (UPL), which is a method used to statistically evaluate monitoring data to see if current data exceed historical levels.

- Two other Tennessee plants, Bull Run and John Sevier, had exceedances that resulted in Phase II assessment, which occurs when there is a statistical exceedance.
- Three other plants (Kingston in Tennessee, Colbert in Alabama, and Shawnee in Kentucky) had exceedances that are being monitored by state officials.

While Allen does not have a solid waste requirement for monitoring, voluntary testing has been performed at Allen, and some elevated levels of constituents have been found. At the time of the last testing, Allen's arsenic levels did not exceed the Maximum Contaminant Level (MCL), which was 50 ug/L.<sup>10</sup> The Maximum Contaminant Level for arsenic was lowered to 10 ug/L later that year and remains at 10 ug/L today. According to TVA's groundwater monitoring report, Allen has had a history of arsenic levels above the Maximum Contaminant Level of 10 ug/L, dating back to 1988, but no levels exceeded the Maximum Contaminant Level in place at the time of the testing. Testing has not been performed at Allen since the Maximum Contaminant Level was lowered. Specifically, when comparing Allen's arsenic to the current Maximum Contaminant Level of 10 ug/L, levels in two of the last five biannual sampling events met or exceeded the current Maximum Contaminant Level. Elevated levels of boron and sulfate indicated probable ash impoundment releases and migration. Concentrations of arsenic, boron, and sulfate in that well have been historically higher than the background data. According to TVA personnel, these levels have not been reported to TDEC because the testing was not required.

### **Two Plants in Tennessee (Cumberland and Gallatin) Had Exceedances That Resulted in Phase III Assessment**

As noted above, TVA has two plants, Cumberland and Gallatin, that have been placed in a Phase III assessment<sup>11</sup> by TDEC. These assessments were based on sampling that occurred in September 2008 as a follow-up confirmation of results from the July 2008 sampling for Cumberland and August 2008 sampling for Gallatin.

TDEC's Guidance states that Phase III assessment requires the development of a Groundwater Quality Assessment Plan, which should be submitted no later than 45 days after a constituent exceeds the groundwater protection standard. Also, an assessment of corrective measures is to be initiated within 90 days. The policy also states that TDEC will issue a Notice of Violation at the time the assessment is initiated. However, TDEC personnel noted that the above policy has room for discretion and that it would be impossible to meet the 45- and 90-day requirements. TDEC personnel also noted that they were not required to issue a Notice of Violation and chose not to as long as TVA was cooperative and working toward making a quality plan.

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<sup>10</sup> ug/L is micrograms per liter.

<sup>11</sup> TVA received official notification on February 23, 2009, that an Assessment for Groundwater Contamination Program would be required within 90 days, indicating that both plants were being placed into Phase III assessment.



As shown in Figure 2, Gallatin's Groundwater Quality Assessment Plan took approximately 17 months to complete.

**Figure 2: Information Regarding Groundwater Quality Assessment Plans at Cumberland and Gallatin**

Locations	Target Date for Groundwater Quality Assessment Plan <sup>12</sup>	Actual Date of Groundwater Quality Assessment Plan	TVA Determination	Corrective Actions	Other Information
Cumberland	August 28, 2009	At this time a formal draft has not been submitted to TDEC. <sup>13</sup>	Highly unlikely a release could impact any local groundwater well or spring users.	Not yet identified.	Two nearby wells are to be monitored.
Gallatin	July 30, 2009	August 6, 2010	Highly unlikely a release could impact any water wells in the vicinity.	Not yet identified. <sup>14</sup>	

Source: Developed by TVA OIG based on information from TVA.

<sup>12</sup> Target dates identified in a March 31, 2009, letter from TVA to TDEC.

<sup>13</sup> According to E&T personnel, an informal draft of the Cumberland Groundwater Assessment Plan was submitted on November 9, 2010. Also, E&T personnel stated that it was agreed with TDEC to delay submittal of Cumberland's Groundwater Assessment Plan until Gallatin's was finalized.

<sup>14</sup> TVA E&T personnel told us the likely corrective action at Gallatin would be to implement a full cap for the pond.

Figures 3 and 4 note the exceedances found at both plants for calendar years 2008 and 2009.

**Figure 3: Cumberland Exceedances (Calendar Years 2008 and 2009)**

Cumberland Exceedances for Dry Ash and Gypsum Disposal Areas			
Constituent	Report Dates	# Wells	Type of Exceedance
Arsenic	January 2009	1 of 7	UPL and MCL
	July 2009	3 of 7	UPL, MCL, and GWPS
	October 2009	2 of 7	UPL, MCL, and GWPS
Selenium	January 2008	1 of 7	UPL and MCL
	July 2008		
	January 2009		
	April 2009	1 of 7	UPL, MCL, and GWPS
	July 2009		
Vanadium	April 2009	1 of 7	UPL, MCL, and GWPS
	July 2009		

Source: Developed by TVA OIG based on information from TVA.

**Figure 4: Gallatin Exceedances (Calendar Years 2008 and 2009)**

Gallatin Exceedances for the Inactive Ash Disposal Area			
Constituent	Report Dates	# Wells	Type of Exceedance
Beryllium	February 2008	1 of 3	MCL
	August 2008		
	February 2009		
	April 2009	1 of 3	GWPS
	July 2009		
Cadmium	October 2009	1 of 4	GWPS
	August 2008	1 of 3	MCL
	April 2009	1 of 3	GWPS
	October 2009	1 of 4	GWPS
	February 2008	1 of 3	MCL
Nickel	August 2008		
	February 2009		
	April 2009	1 of 3	GWPS
	July 2009		
Vanadium	October 2009	1 of 4	GWPS
	April 2009	1 of 3	GWPS
	July 2009		
	October 2009	1 of 4	GWPS

Source: Developed by TVA OIG based on information from TVA.

As noted in Figure 3, the January 2008 report for Cumberland had a Maximum Contaminant Level exceedance for selenium that should have triggered an assessment. Additionally, Gallatin had Maximum Contaminant Level exceedances in February 2008 for beryllium and nickel that should have triggered assessments. These exceedances did not result in assessments.

In addition, TVA and TDEC personnel disagree on an issue regarding statistical calculations that would include both Gallatin and Cumberland. TVA and TDEC have been working together to resolve this issue, but TDEC personnel have said that TVA has been slow to address the issue. A meeting between TVA and TDEC led TDEC to believe that TVA would hire a third party to independently evaluate the issue. TVA personnel, however, have stated they were writing a letter to TDEC in an effort to resolve the issues before bringing in a third party. TVA personnel told us that if TDEC issues a written notification requiring them to conform to TDEC's opinion on the statistical issue, they will comply. Subsequently, TVA hired an independent third party to evaluate the issue.

### **Two Other Plants in Tennessee (Bull Run and John Sevier) Had Exceedances That Resulted in Phase II Assessment**

TDEC has placed TVA in Phase II assessment at Bull Run and John Sevier. TVA received official notification on July 17, 2009, that Bull Run was being placed into Phase III due to a groundwater protection standard exceedance for cobalt at the Gypsum/Coal Ash Landfill Area. However, TVA provided TDEC with a Cobalt Investigation Report that satisfied TDEC that the cobalt exceedance was related to a legacy condition that was ongoing prior to the establishment and operation of the Gypsum/Coal Ash Landfill Area. TVA was taken out of Phase III and placed into Phase II based on statistical exceedances for cadmium and nickel. Additionally, on January 7, 2010, Bull Run received notification that the Dry Ash Disposal Area was being placed in Phase II assessment due to an arsenic exceedance.

TVA received official notification on April 5, 2007, that John Sevier was being placed into Phase II due to statistical exceedances for alkalinity, pH, specific conductance, and strontium. This decision was based on a confirmation sampling event that took place on December 8, 2006, after which TVA requested that John Sevier be placed into Phase II.



As Figure 6 shows, John Sevier has had groundwater protection standard exceedances for cadmium. Discussions with E&T personnel noted that for each time, the resampling that followed within a month did not have the same results and may have been caused by analytical interferences. In addition, the resampling for the arsenic exceedance did not show levels above the Maximum Contaminant Level.

Figures 5 and 6 note the exceedances found at both plants for calendar years 2008 and 2009.

**Figure 5: Bull Run Exceedances (Calendar Years 2008 and 2009)**

Bull Run Exceedances for Gypsum/Coal-Ash Landfill			
Constituent	Report Dates	# Wells	Type of Exceedance
Cadmium	May 2009	2 of 5	UPL
Cobalt	May 2009	1 of 5	UPL and GWPS
	November 2009	1 of 5	GWPS
Fluoride	May 2009	1 of 5	UPL
Nickel	May 2009	1 of 5	UPL

Source: Developed by TVA OIG based on information from TVA.

**Figure 6: John Sevier Exceedances (Calendar Years 2008 and 2009)**

John Sevier Dry Ash Landfill Exceedances			
Constituent	Report Dates	# Wells	Type of Exceedance
Alkalinity	April 2008	1 of 6	UPL
	October 2008		
	April 2009		
	October 2009		
Arsenic	April 2009	In the Leachate <sup>15</sup> Collection System	MCL
Barium	April 2008	1 of 6	UPL
Cadmium	October 2008	1 of 6	GWPS
	April 2009		

Source: Developed by TVA OIG based on information from TVA.

### Three Other Plants (Kingston in Tennessee, Colbert in Alabama, and Shawnee in Kentucky) Had Exceedances That Are Being Monitored by State Officials

Additional exceedances have been found at Kingston, Colbert, and Shawnee. Currently, all three locations are continuing to be monitored, and results are reported to state officials. Elevated levels of arsenic have also been found at Allen.

<sup>15</sup> Leachate is the water that flows through (and out of) the ashfill, plus the material and/or chemical compounds that get caught up in that water.

At Kingston, there was a Maximum Contaminant Level exceedance for arsenic in June 2009. However, additional monitoring on a monthly basis from September through December was performed, and the exceedance was not repeated. Because the exceedance was not repeated, it did not result in any of TDEC's three levels of assessment.

Alabama does not require a solid waste permit for CCP disposal areas. However, according to E&T, site-wide monitoring at Colbert has been conducted due to prior issues with a sink hole. TVA began an Alabama Risk-based Corrective Action process to determine if contamination from the metal cleaning pond at Colbert has affected human health or the environment. The October 2009 monitoring report noted that groundwater monitoring in the vicinity of coal ash disposal areas showed limited evidence of contamination by ash leachate. This report was completed as part of the Alabama Risk-based Corrective Action process. The report identified exceedances of ammonia, iron, and manganese at a well located within former Ash Pond 1 and noted that the iron and manganese exceedances at the well could result from ash leachate or natural sources.

Shawnee had Maximum Contaminant Level exceedances for boron repeated throughout the two years of monitoring reports that were reviewed. However, the monitoring reports noted that the data used in computing the mean boron value is over 17 years old. Additionally, E&T personnel have said that background data has been insufficient to monitor for statistical exceedances. According to E&T, TVA has installed new monitoring wells at Shawnee and developed background levels. Background levels are required by Kentucky regulations and are used to determine exceedances. The exceedances for boron did not result in an assessment.

More information related to these exceedances can be found in Appendix C.

## **TVA HAS COMMITTED TO GROUNDWATER MONITORING AT ALL FOSSIL PLANTS**

TVA is a member of the Utility Solid Waste Activity Group (USWAG).<sup>16</sup> USWAG created a Utility Industry Action Plan for the Management of Coal Combustion Products in October 2006. The focus of USWAG's action plan was to make sure that utilities had installed wells for monitoring. In December 2007, TVA notified USWAG of its intent to endorse the voluntary commitments prescribed in the action plan. TVA personnel confirmed its commitment to follow the action plan as demonstrated by TVA installing 29 wells at nine sites in 2010. TVA plans to conduct at least one sample event at all sites by the end of 2011.

<sup>16</sup> USWAG is an association of the Edison Electric Institute, the American Public Power Association, the National Rural Electric Cooperative Association, and approximately 80 electric utility operating companies.

USWAG's Action Plan describes the industry's commitment to:

- Adopt groundwater performance standards at facilities that manage CCPs.
- Implement a comprehensive monitoring program to measure conformance with the groundwater performance standards at CCP facilities.
- Ensure that CCPs are not placed in sand and gravel pits without appropriate engineering controls.
- Consider the option of using dry-handling technology prior to constructing a new landfill or surface impoundment to manage fly ash on their property.

USWAG recommends that each CCP impoundment have at least one background water quality point and three downgradient sampling sites.

## **RECOMMENDATIONS**

We recommend that the Senior Vice President, E&T:

1. Continue plans to implement monitoring at all active CCP disposal areas.
2. Continue with the assessment plans and initiate corrective actions for Cumberland and Gallatin.

## **MANAGEMENT'S RESPONSE**

TVA management provided written comments on a draft of this report, which are reproduced in their entirety in Appendix D. TVA management agreed with the recommendations and provided various contextual and clarifying comments, which we evaluated and incorporated into the final report as appropriate. Comments which were not incorporated into the final version of the report are discussed below.

TVA management recommended a change in three sections of the report that detailed the OIG's finding regarding all required constituents at Cumberland and Johnsonville not being monitored. While the OIG has added information to the report showing that TVA has taken actions to have the permits modified for both plants, the OIG did not make all recommended wording changes suggested by TVA management. TVA management suggested adding wording stating that for the two plants, "monitoring was according to TDEC agreed parameters and the regulations." The OIG was unable to obtain any documentation for either of these two plants showing an agreement between TDEC and TVA to reduce the permit-required constituents. Additionally, while the regulations do require a minimum of 17 specific constituents to be monitored, the regulations also require that the groundwater monitoring program established in the permit be followed. The constituents not being monitored by TVA were part of the permit requirements for each site.

TVA management suggested changing the number of constituents to be tested for Cumberland and Johnsonville to 17. However, as discussed above, the OIG maintains that both plants should have been testing for all permit-required constituents.

TVA management suggested additional wording related to the amount of time it took to develop Gallatin's Groundwater Quality Assessment Plan. TVA management's suggested change states, "While an agreement was made with TDEC to submit both of the Assessment Plans, TDEC later required 'Groundwater Detection Monitoring Plans' to be completed for both facilities, and approved prior to submitting the Assessment Plans (AP)." However, according to documentation provided to the OIG, TVA was notified on February 23, 2009, that both Cumberland and Gallatin were being placed into assessment. In a follow-up letter on March 31, 2009, TVA outlined completion dates for both the Assessment Plans and Groundwater Monitoring Plans at that time.

TVA management stated that they did not know where we got the information that "two nearby wells are to be monitored" as part of the groundwater quality assessment plan at Cumberland. After a follow-up from the OIG, E&T personnel stated they had previously misunderstood the comment and agreed that two off-site wells near Cumberland will be sampled at least once.

## **OBJECTIVE, SCOPE, AND METHODOLOGY**

This review was initiated because of questions raised during congressional testimony following the Kingston Ash Spill in December 2008. The objectives of this review were to determine whether the Tennessee Valley Authority (TVA) has (1) performed groundwater monitoring as prescribed by the permits and (2) found levels of constituents monitored that exceeded regulatory limits and, if so, implemented any required corrective actions.

To achieve our objectives, we:

- Interviewed key personnel to identify information related to groundwater monitoring, regulations, and permits.
- Reviewed solid waste regulations for Alabama, Tennessee, and Kentucky to identify testing requirements.
- Reviewed all solid waste disposal permits related to coal combustion product (CCP) disposal areas to determine required testing.
- Reviewed Groundwater Monitoring Reports for all TVA fossil plant CCP disposal areas for calendar years 2008 and 2009 to:
  - Determine if the groundwater is being monitored for all required constituents.
  - Identify potential exceedances and corrective actions.

The scope of our review included groundwater monitoring for calendar years 2008 and 2009 at TVA fossil plant CCP disposal areas. It did not include monitoring of surface discharges at ponds under National Pollutant Discharge Elimination System regulations. This review was conducted in accordance with the "Quality Standards for Inspections."

The following chart shows the potential health effects of any constituent where an exceedance was identified in calendar years 2008 and 2009 monitoring reports. The information in the chart was found on the Environmental Protection Agency (EPA) and Centers for Disease Control and Prevention Web sites.

**Potential Health Effects**

<b>Constituent</b>	<b>Health Effects</b>
Aluminum	Only very small amounts of aluminum that a person may inhale, ingest, or have skin contact with will enter the bloodstream. Some people with kidney disease store a lot of aluminum in their bodies and sometimes develop bone or brain diseases, which may be caused by the excess aluminum. Some studies show that people exposed to high levels of aluminum may develop Alzheimer's disease, but other studies have not found this to be true. It is uncertain whether aluminum causes Alzheimer's disease.
Ammonia	Exposure to high levels of ammonia can cause irritation and serious burns on the skin and in the mouth, throat, lungs, and eyes. Exposures to very high levels can cause death.
Antimony	Chronic exposure well in excess of the Maximum Contaminant Level (MCL) may cause increases in blood cholesterol and decreases in blood sugar.
Arsenic	Arsenic has been linked to cancer of the bladder, lungs, skin, kidney, nasal passages, liver, and prostate. It has also shown noncancer effects, including thickening and discoloration of skin, stomach pain, nausea, vomiting, diarrhea, numbness in the hands and feet, partial paralysis, and blindness.
Barium	Barium has been found to potentially cause gastrointestinal disturbances and muscular weakness when people are exposed to it at levels above the EPA drinking water standards for relatively short periods of time. Some people who drink more barium than background levels found in food and water for a short period may experience vomiting, abdominal cramps, diarrhea, difficulties in breathing, increased or decreased blood pressure, numbness around the face, and muscle weakness. Drinking very large amounts of barium compounds that easily dissolve can cause changes in heart rhythm or paralysis and possibly death.
Beryllium	Swallowing beryllium has not been reported to cause effects in humans because very little beryllium is absorbed from the stomach and intestines.
Boron	Exposure to large amounts of boron over short periods of time can affect the stomach, intestines, liver, kidney, and brain and can eventually lead to death.
Cadmium	EPA has found that cadmium can potentially cause a variety of effects from exposure above the Maximum Contaminant Level for short periods of time, including nausea, vomiting, diarrhea, muscle cramps, salivation, sensory disturbances, liver injury, convulsions, shock, and renal failure. Cadmium has the potential to cause kidney, liver, bone, and blood damage from lifetime exposures above the Maximum Contaminant Level.
Chromium	Some people who use water containing chromium well in excess of the Maximum Contaminant Level over many years could experience allergic dermatitis or skin ulcers. An increase in stomach tumors was observed in humans exposed to certain chromium compounds in drinking water.

**Potential Health Effects (cont.)**

<b>Constituent</b>	<b>Health Effects</b>
Cobalt	Exposure to high levels of cobalt can result in lung and heart effects and dermatitis.
Fluoride	In adults, exposure to high levels of fluoride can result in denser bones. However, if exposure is high enough, these bones may be more fragile and brittle and therefore at greater risk of breaking.
Iron	None identified.
Manganese	Reports of adverse effects in humans from ingestion of excess manganese are limited.
Nickel	The most common harmful health effect of nickel in humans is an allergic reaction.
Selenium	Short-term oral exposure to high concentrations of selenium may cause nausea, vomiting, and diarrhea. Chronic oral exposure to high concentrations of selenium compounds can produce a disease called selenosis. The major signs of selenosis are hair loss, nail brittleness, and neurological abnormalities (such as numbness and other odd sensations in the extremities).
Strontium	Exposure to low levels of stable strontium has not been shown to affect adult health, but may harm children. Breathing or ingesting low levels of radioactive strontium has not been shown to affect health. High levels of radioactive strontium can damage bone marrow and cause anemia and prevent the blood from clotting properly.
Sulfate	The collective evaluation of the noncancer data in humans suggests that acute exposures to sulfate exert a laxative effect and sometimes diarrhea following acute exposures to high concentrations. However, these effects are not observed for longer-term exposures.
Vanadium	The health effects in people of ingesting vanadium are unknown; however, animals that ingested very large doses have died.
Zinc	If large doses of zinc are taken by mouth even for a short time, stomach cramps, nausea, and vomiting may occur. Ingesting high levels of zinc for several months may cause anemia, damage the pancreas, and decrease levels of high-density lipoprotein cholesterol.



Figure C-1 identifies additional exceedances at Kingston, Colbert,<sup>1</sup> and Shawnee Fossil Plants. The figure indicates the plant, constituent, and the number of times the exceedance was repeated during the scope of our testing.

**Figure C-1: Additional Exceedances at Kingston, Colbert, and Shawnee**

Plant	Constituent	Number of Exceedances
Kingston	Arsenic	1
Colbert	Aluminum	3
	Ammonia	3
	Antimony	4
	Arsenic	4
	Chromium	1
	Iron	3
	Manganese	3
	Nitrite + Nitrate	1
	Strontium	2
	Sulfate	2
	Vanadium	3
	Zinc	1
Shawnee	Boron	4

The Allen Fossil Plant does not have required monitoring constituents, but the February 2008 monitoring report noted that while no Maximum Contaminant Level exceedances had occurred, one well had an arsenic level equal to the current Maximum Contaminant Level. The report also noted that levels of arsenic for that well have typically exceeded the Maximum Contaminant Level. Also, a different well had an arsenic level equal to or greater than the Maximum Contaminant Level for two of the last five biannual sampling events. The report concluded that the arsenic levels are potentially due to contamination associated with ash leachate from the inactive West Ash Pond.

<sup>1</sup> Colbert is being monitored due to prior issues with a sinkhole that developed in a coal combustion product landfill. Colbert has undergone the Alabama Risk-based Corrective Action process and is undergoing sitewide monitoring. Many of the exceedances are related to a Metal Cleaning Pond.



May 19, 2011

Mr. Robert E. Martin, ET 3C-K

OFFICE OF INSPECTOR GENERAL (OIG) – DRAFT INSPECTION REPORT 2009-12991 –  
TVA'S GROUNDWATER MONITORING AT COAL COMBUSTION PRODUCTS DISPOSAL  
AREAS – COMMENTS

Attached is the response from Compliance Interface and Permits staff to the request for comments on the OIG Draft Inspection Report, TVA's Groundwater Monitoring at Coal Products Disposal Areas, Inspection 2009-12991.

The attachment addresses each recommendation and states agreement or disagreement with the facts, conclusions and recommendations. Rationales are provided where appropriate, as well as recommended changes. Additionally, where remediation has been initiated or completed, the actions taken and the associated dates are documented.

Note that the TVA groundwater monitoring programs are ongoing. Due to the limited nature of this inspection report, we have not provided additional information on any recent status changes for the sites. Likewise, we have not provided updates or potential changes in EPA or state regulations that may affect our sites.

If you have questions about our comments, or need additional information, please let me know.

Sincerely,



Anda A. Ray  
Senior Vice President  
Environment and Technology  
WT 11A-K

CMA:JJW

Attachment

cc: (Attachment)

Cynthia M. Anderson, LP 5D-C  
Brenda E. Brickhouse, LP 5U-C  
Robert M. Deacy, Sr., LP 5D-C  
Michael B. Fussell, WT 9B-K  
Kimberly S. Greene, WT 7B-K  
Peyton T. Hairston, Jr., WT 7B-K  
William R. McCollum, Jr., LP 6A-C  
John M. Thomas III, MR 6D-C  
Robert B. Wells, WT 9B-K  
Wendy Williams, WT 9B-K  
OIG File no. 2009-12991

**Response to Request for Comments: OIG Draft Inspection 2009-12991; Groundwater Monitoring at Coal Combustion Sites**

	REFERENCE	STATEMENT	COMMENTS	RECOMMENDED CHANGE
<b>RECOMMENDATIONS</b>	- Page ii, first bullet under "What the OIG Recommends"  - Page 13, "Recommendations" Item # 1	Initiate monitoring for all required constituents at areas where needed. Specifically, initiate monitoring at the Johnsonville Dupont Dredge Cell for nitrates and chemical oxygen demand, and at Cumberland for chemical oxygen demand.	Disagree. EP&C's understanding from TDEC was different than OIG's. Alan Spear with TDEC told Ronda Hooper with EP&C that there was no need to add the specified parameters to those being sampled according to the regulations. To confirm this, Ms. Hooper discussed this again with Mr. Spear in a meeting on April 14, 2011, and confirmed the conversation in two letters dated May 9, 2011, signed by Cynthia Anderson.  The Cumberland Groundwater Detection Monitoring Plan, which was approved by TDEC via a letter dated March 20, 2010, becomes a part of the permit, and specifies the parameters TVA has been monitoring.	Remove Recommendation
	- Page ii, second bullet under "What the OIG Recommends"  -Page 13, "Recommendations" Item # 2	Continue plans to implement monitoring of all CCP disposal areas.	Agree. Caveat: USWAG voluntary program agreement is only for "Active" CCP disposal areas.	Continue plans to implement monitoring of all active CCP disposal areas.
	- Page ii, third bullet under "What the OIG Recommends"  -Page 13, "Recommendations" Item # 3	Continue with the assessment plan and initiate corrective actions for Cumberland and Gallatin Fossil Plants.	Agree.	None

	REFERENCE	STATEMENT	COMMENTS	RECOMMENDED CHANGE
GENERAL COMMENTS	Overall document		Groundwater programs are ongoing. Due to the limited nature of this report, we have not provided additional information on any recent status changes for the sites. Likewise, we have not provided updates or potential changes in EPA or state regulations that may affect our sites.	
	- Page i, fourth paragraph	TVA is not performing monitoring as prescribed by the permits in certain cases. However, TVA was not monitoring for all required constituents at Cumberland and Johnsonville Fossil Plants.	EP&C's understanding from TDEC was different than OIG's. Alan Spear with TDEC told Ronda Hooper with EP&C that there was no need to add the specified parameters to those being sampled according to the regulations. To confirm this, Ms. Hooper discussed this again with Mr. Spear in a meeting on April 14, 2011, and confirmed the conversation in two letters dated May 9, 2011, signed by Cynthia Anderson.	TVA was not monitoring for all permit-required constituents at Cumberland and Johnsonville Fossil Plants, but monitoring was according to TDEC agreed parameters and the regulations.
	-Page 3, last paragraph	During our review, we found that in some instances TVA has not been performing monitoring as prescribed by the permits.	The Cumberland Groundwater Detection Monitoring Plan, which was approved by TDEC via a letter dated March 20, 2010, becomes a part of the permit, and specifies the parameters TVA has been monitoring.	During our review, we found that in some instances TVA has not been performing monitoring as prescribed by the permits, but monitoring was performed according to TDEC agreed parameters and the regulations.
	- Page 4, last paragraph	However, for the remaining two areas, monitoring was not performed for all required constituents.  TDEC personnel said that TVA should initiate monitoring for those constituents and request a permit modification to eliminate the testing requirement for those constituents if appropriate.		However, for the remaining two areas, monitoring was not performed for all permit-required constituents.  TVA EP&C has submitted letters dated May 9, 2011 to TDEC confirming their agreement not to monitor COD and nitrate at these two facilities.

	REFERENCE	STATEMENT	COMMENTS	RECOMMENDED CHANGE
	- Page i - Page 1, bottom of page.	A constituent is an individual compound that is analyzed.	"Constituent" needs fuller definition.	A constituent is a chemical component of the CCP that may be present in groundwater and can be analyzed by a lab.
	- Page ii, second full paragraph, second sentence - Page 3, last paragraph	USWAG has an action plan focused on all facilities having wells installed for monitoring groundwater related to CCPs. Finally, TVA installed monitoring wells at all remaining CCP disposal areas in 2010.	USWAG voluntary program agreement is only for "Active" CCP disposal areas.	USWAG has an action plan focused on all facilities having wells installed for monitoring groundwater related to active CCPs.  Finally, TVA installed monitoring wells at all remaining active CCP disposal areas in 2010.
	- Page 1, second paragraph -Page 1, sixth paragraph;	According to E&T, if CCPs are stored in a pond, the CCPs are not governed by solid waste regulations.	Statement is true, but CCPs are covered under other regulations in addition to Solid Waste regulations.	Add, "While in ponds, the CCPs are governed by the water (NPDES) regulations."
	- Page 3, first paragraph	In Kentucky, when sampling... constituents above the Maximum Contaminant Level, a groundwater assessment plan should be submitted within 30 days...	Other sample results may trigger assessment in addition to exceeding the MCL. Assessment is also triggered by constituent levels above statistical limits determined by TVA background monitoring. Plans should be submitted within 30 days, except in those cases where TVA is directed differently by the regulator.	In Kentucky, when sampling and analysis identify one or more constituents above the statistical limit or the Maximum contaminant Level, a groundwater assessment plan should be submitted within 30 days, or as directed by the regulator, and corrective action measures must follow, once the agency has approved the Plan.
	- Page 5 table	Cumberland's permit number is IDL 81-0082.	Historical documentation reflected permit number error.	Cumberland's permit number is IDL 81-0086.
	- Page 5 table	Number of Constituents to be tested at Cumberland and Johnsonville is 20.	Constituents for CUF and JOF should be 17, not 20. Agreement with TDEC was different than stated. See Comments in first bullet under Recommendations.	Number of Constituents to be tested at Cumberland and Johnsonville is 17.

	REFERENCE	STATEMENT	COMMENTS	RECOMMENDED CHANGE
	Page 6, Paragraph beginning with "Allen"	TVA E&T personnel said that monitoring is currently conducted biannually at Allen.	This was the case between 1988 and 2008. Beginning in 2011, groundwater will be monitored semi-annually for TDEC's Appendix I parameters.	TVA E&T personnel said that monitoring was conducted biannually at Allen, between 1988 and 2008, but beginning in 2011 will be sampled semi-annually.
	Page 8	As Shown in Figure 2, Gallatin's Groundwater Quality Assessment Plan took approximately 17 months to complete.	Statements are true, but not complete. See recommended changes.	As Shown in Figure 2, Gallatin's Groundwater Quality Assessment Plan took approximately 17 months to complete. While an agreement was made with TDEC to submit both of the Assessment Plans, TDEC later required "Groundwater Detection Monitoring Plans" to be completed for both facilities, and approved, prior to submitting the Assessment Plans (AP). Additionally, TDEC required the Gallatin AP to be approved prior to submitting the Cumberland AP. The Gallatin AP was approved by TDEC in a letter dated April 19, 2011.
	Page 8 –Table	Under Cumberland, "Two nearby wells are to be monitored."	Not sure where this statement comes from. No off-site wells are to be monitored. Impacted groundwater is only on-site.	Four additional wells will be installed on-site to delineate plume.