Memorandum from the Office of the Inspector General

September 21, 2010

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

FINAL REPORT – INSPECTION 2008-12283-06 – REVIEW OF THE LONG-TERM ENVIRONMENTAL RECOVERY PLAN FOR KINGSTON

Attached is the subject final report for your review and action. Your written comments, which address 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 Gregory R. Stinson, Project Manager, at (865) 633-7367 or Gregory C. Jaynes, Deputy Assistant Inspector General, Inspections, at (423) 785-4810. We appreciate the courtesy and cooperation received from your staff during this review.

Robert E. Martin
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Attachment
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OIG File No. 2008-12283-06

Review of Long-Term Recovery Plans

Dated September 21, 2010

Tennessee Valley Authority Kingston Fossil Plant (KIF)
Harriman, Tennessee

Prepared for:

TVA Office of the Inspector General
Knoxville, Tennessee

Prepared by:

Project No.: TVA104-03

September 2010

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TITLE PAGE

Title of Report

Review of Long-Term Recovery Plans
Tennessee Valley Authority
Kingston Fossil Plant
Harriman, Tennessee

Effective Date of Report

September 21, 2010

Qualified Persons

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EXECUTIVE SUMMARY

Marshall Miller & Associates, Inc. (*Marshall Miller*) was retained to review the long-term recovery plans for the area affected by the December 22, 2008, **Kingston Fossil Plant (*KIF*)** ash spill. Generally, Marshall Miller found no significant deficiencies in any of the proposed alternatives for the restoration of the Swan Pond Embayment, including the selected alternative. The documents prepared by TVA appear to be substantially in compliance with applicable regulatory requirements stated in the Administrative Order and Agreement on Consent between TVA and the **US Environmental Protection Agency (*EPA*)** and meet the removal action objectives outlined in the *Non-Time Critical*[1] *Removal Action Embayment/Dredge Cell Engineering Evaluation/Cost Analysis* or as is more commonly known the EE/CA. There were some discrepancies noted in the Human Health Risk Assessment, with regard to certain selected input parameters, such as toxicity and exposure factors. However, since the selected alternative includes the removal of all ash, any risk associated with leaving the ash in place is reduced, and revisions to the risk assessment are not necessary. TVA has committed to incorporating the findings in future Human Health Risk Assessments.

The selected alternative (3b)[2] calls for all ash to be excavated from the embayment and disposed onsite within the Dredge Cell, which will be closed in place. The selected alternative includes closure of the Ash Pond concurrent with closure of the Dredge Cell. Marshall Miller reviewed each of the proposed remediation alternatives for compliance with the removal action objectives outlined in the Administrative Order and Agreement on Consent. The objectives address the long-term protection of the environment by minimizing the possibility for exposure of humans, plants, animals, and water (ground and surface) to the ash. Therefore, Marshall Miller's review focused on the various exposure pathways including air, surface water, stormwater, sediment, and groundwater.

[1] The non-time critical ash consists of the ash in the embayments and on adjacent land. The time critical ash consisted of ash in the Emory River's main channel and in the waters directly east of the site's ash-storage area.

[2] There were three main alternatives studied for the removal of the non-time critical ash. However, there were slight variations of the three main alternatives denoted by 'a' and 'b' -- e.g. option 3b.

While Marshall Miller found no significant deficiencies in any of the proposed alternatives, the following observations were noted:

- Both the EE/CA and *Non-Time Critical Removal Action Embayment/Dredge Cell Action Memorandum* (Action Memorandum) are intended to provide only a conceptual design of each of the three alternatives. Since alternative 3b has been selected, a more detailed design will be needed, along with revised sampling plans for monitoring potential environmental impacts during excavation of the ash and closure of the Dredge Cell. Additionally, the EE/CA provides limited detail on the long-term monitoring of various media for potential environmental impacts.

- A more detailed understanding of groundwater flow and associated contaminant migration from the Dredge Cell to adjacent surface water is required in order to properly establish locations for long-term monitoring of wells.

To address the observations, the following recommendations are provided to TVA:

- The appropriate sampling plans should be revised to address the modifications necessary due to the selection of alternative 3b for the restoration of the Swan Pond Embayment.

- A more detailed understanding of groundwater discharge and associated contaminant migration into the surface water is required in order to properly locate monitoring wells. Siting of the groundwater monitoring wells for the closed Dredge Cell should be based on the results of additional hydrogeological evaluation.

TVA management agreed with the recommendations, and we concur with their planned and completed actions. See the Appendix for a complete response.

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APPENDIX

Item 1: INTRODUCTION AND BACKGROUND

Marshall Miller & Associates, Inc. (*Marshall Miller*) was engaged by the **Tennessee Valley Authority (*TVA*) Office of Inspector General** to review the adequacy and completeness of environmental recovery plans prepared by TVA in response to the ash spill that occurred on December 22, 2008, at the **Kingston Fossil Plant (*KIF*)** located in Harriman, Tennessee. The intent of Marshall Miller's 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. On May 11, 2009, TVA entered into an Administrative Order and Agreement on Consent with the **US Environmental Protection Agency (*EPA*)** Region IV on May 11, 2009, 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 humans, plants, and animals. 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.

Marshall Miller reviewed TVA's ongoing response to mitigating the short-term impacts (also reported as "time-critical") and the adequacy and completeness of the environmental monitoring plans, including a review of relevant documentation related to the sampling of various media. Marshall Miller also evaluated the long-term restoration efforts. TVA documents which have been developed to address restoration include the *Non-Time Critical Removal Action Scope and Engineering Evaluation/Cost Analysis Work Plan* (Work Plan) dated October 16, 2009, 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* (Action Memorandum) dated April 12, 2010. The EE/CA was released for an initial 30-day public comment period from

January 19 to February 20, 2010. The public comment was extended an additional 45 days to April 5, 2010, at the request of various public organizations. The draft Action Memorandum was submitted for EPA and **Tennessee Department of Environment & Conservation (TDEC)** review on April 12, 2010, and approved by EPA on May 18, 2010.

The Work Plan provides a summary of the site conditions, describes sampling and monitoring activities, includes a *Human Health Risk Assessment*, Ecological Risk Assessment and a *Screening Level Ecological Risk Assessment*, and offers insight into future data needs for developing long-term monitoring plans with respect to the various media (groundwater, surface water, air, etc.). The Work Plan's recommendations include the need for such items as investigation of human health risk from fish consumption and development of a detailed sampling and analysis plan for the rivers. The development of a pre-ash spill baseline dataset for water quality and fish is hampered by legacy constituents, which resulted in impaired status restrictions of the river systems and fish consumption advisories prior to the ash spill.

The EE/CA is intended to evaluate options for restoring the Swan Pond Embayment area in accordance with the Administrative Order and Agreement on Consent. As recommended in the Work Plan, a separate EE/CA for the river system (including the Emory, Clinch, and Tennessee Rivers) is scheduled to be prepared after additional assessment of the ecological impacts in the rivers is completed. The EE/CA for the river systems is deferred until a unified strategy can be developed based on specific clean-up goals. As the dredging of the Emory River was completed in late May 2010, except for some isolated areas, TVA has begun the preparation of a subsequent EE/CA for the river system.

The EE/CA provides a description of the removal action objectives which are developed based on the results of the Human Health Risk Assessment and Screening Level Ecological Risk Assessment. The removal action objectives are described below:

- Minimize direct contact between ash material in the embayment and water flowing through the embayment area into the Watts Bar Reservoir.
- Minimize the migration of ash and its constituents from the embayment or Dredge Cell into affected water due to erosion.

- Minimize direct contact exposure by human, plants, or animals to any ash on the ground.
- Restore the embayment to pre-spill conditions.
- Close the former Dredge Cell in accordance with Tennessee Solid Waste Rule 1200-1-7.
- Dispose of waste streams from the removal action.

The risk assessments were completed to evaluate potential risks for both human, plants, and animals and identify potential exposure pathways. The Human Health Risk Assessment indicated that there was potential risk due to possible exposure and, therefore, a removal action was needed to mitigate the threat or potential threat. The Screening Level Ecological Risk Assessment indicated that, while potential risk exists, removal of the ash and capping of the Dredge Cell eliminates the exposure pathways and a Baseline Ecological Risk Assessment is not needed.

Based on these removal action objectives, the EE/CA describes three potential remediation alternatives for restoring the Swan Pond Embayment. Each alternative was evaluated with respect to its effectiveness to meet the removal action objectives, implementability, and overall cost, including yearly operation and maintenance (O&M) costs. A brief description of each alternative is provided below:

- **Alternative 1**: Excavate all ash from the embayment, the test embankment, Dike 2, and the settlement basin and dispose offsite (2.8 million cubic yards). Leave remaining ash in the Dredge Cell and close in place.
- **Alternative 2**: Excavate all ash from the same areas noted above and 3.7 million cubic yards of ash from the Dredge Cell and dispose offsite (6.5 million cubic yards). The remaining ash in the Dredge Cell would be closed in place. The objective of removing additional ash from the Dredge Cell will be to reduce reliance on the dike.
- **Alternative 3**: Excavate all ash from the embayment and dispose onsite within the Dredge Cell, which would be closed in place. Alternative 3b included closure of the Ash Pond concurrent with closure of the Dredge Cell.

Each alternative requires removal of ash either by using mechanical excavation methods such as backhoes and scrapers, or hydraulic dredging for material below the water surface. The ash management systems currently in place for the time-critical removal action will be continued for this phase. Dredged material will be pumped to the Rim Ditch to allow solids to settle, and the solids will then be removed from the ditch, allowed to dry, and loaded onto railcars or trucks for offsite disposal. For alternative 3, ash will be trucked for onsite disposal.

The EE/CA determined that each alternative met the removal action objective, including restoration of the embayment to pre-spill conditions, and would comply with the applicable or relevant and appropriate requirements.

Though not initially included in the EE/CA, the EPA considered public comment and responded with the Action Memorandum dated May 18, 2010. The EPA's approved Action Memorandum provided the rationale for the selection of alternative 3b for the remediation and restoration of the Swan Pond Embayment, which includes placing the excavated ash in the former Dredge Cell. The Action Memorandum provides a discussion of how TVA proposes to implement alternative 3b and addresses comments received during the public comment period for the EE/CA. The Action Memorandum also indicates that TVA will prepare a removal action work plan for the actual implementation of alternative 3b.

Item 2: REVIEW OF THE ENGINEERING EVALUATION/COST ANALYSIS REPORT AND ACTION MEMORANDUM

Marshall Miller was tasked with reviewing the adequacy of the proposed remediation alternatives presented in the EE/CA to provide long-term protection of the environment by minimizing the exposure pathways of humans, plants, animals, and waters (ground and surface) to the ash.

The intent of the EE/CA is to provide a conceptual overview of the proposed alternatives with regard to the ability of each alternative to meet the overall intent of the clean-up program. As such, the EE/CA does not include a detailed design or a discussion of a long-term monitoring program.

2.1. AIR

During excavation of the embayment, one of the primary pathways for off-site exposure is through inhalation of fugitive dust from ash. The EE/CA states that dust will be controlled by seeding and mulching finished graded areas and other disturbed areas promptly, and by wetting haul roads (or other disturbed areas) or applying approved chemicals (such as Flexterra), as needed. These methods were used for the time-critical removal actions, and the air monitoring data indicates that they worked as intended. Additionally, the EE/CA outlines the "Action-specific" applicable or relevant and appropriate requirements for activities causing fugitive dust emissions:

- Use, where possible, of water or chemicals for the control of dust and in demolition of existing buildings or structures, construction operations, grading of roads, or the clearing of land.
- Application of asphalt, oil, water, or suitable chemicals on dirt roads, materials stock piles, and other surfaces, which can create airborne dusts.
- Shall not cause or allow fugitive dust to be emitted in such a manner to exceed 5 minutes/hour or 20 minutes/day beyond property boundary lines on which emission originates.

Neither the EE/CA nor Action Memorandum provides a detailed description of the air-monitoring program during excavation, though the cost estimates provided in Appendix D of the EE/CA include line item costs for continuous air sampling that corresponds with the projected construction schedule for each alternative. The Action Memorandum also indicates that the *Site Dust Control and Air Monitoring Plan* will be revised to address the selected removal action in alternative 3b.

Other exposure pathways identified include adolescent or adult use of the river systems for recreation or fishing, which may lead to exposure to ash-impacted sediment in the Emory, Clinch, and Tennessee Rivers during the winter when the Watts Bar Reservoir is lowered to winter pool. People using the river for recreation may be exposed to residual ash and sediment via incidental ingestion, dermal contact, and external exposure to radionuclides. Inhalation of fugitive dust would be negligible due to the water content of the exposed sediments.

The Screening Level Ecological Risk Assessment identifies the exposure pathways for fugitive dust for terrestrial and aquatic plants as follows:

- Direct contact, leaf absorption of fugitive dust, leaf absorption of constituents in dust deposited on leaves, root uptake of groundwater, surface water, or porewater.

A discussion on post-closure air monitoring is not included in the EE/CA or the Action Memorandum. Nevertheless, there will be little or no pathways from fugitive dust emissions once the ash is removed from the embayment and the Dredge Cell is closed.

2.2. SURFACE WATER

Two types of water quality impacts resulting from the ash release are from the bulk impact of the ash material itself as well as the suspended and dissolved ash in the water. The metals contained in the ash are of the greatest concern. Of the samples collected from the Swan Pond Embayment, antimony, arsenic and selenium have each exceeded at least one water quality criteria. Arsenic concentrations ranged from 0.0123 to 0.0792 mg/L, which exceeded the EPA's Maximum Contaminant Level for drinking water and TDEC's Ambient Water Quality Criteria, both of which are 0.010 mg/L. For comparison, the average arsenic concentration for samples collected from the Emory River is 0.0315 mg/L, with a maximum concentration of 1.89 mg/L.

The average selenium concentration (0.00913 mg/L) exceeds the various criteria for Fish and Aquatic Life (0.02 to 0.005 mg/L). Maximum concentrations of other metals have also exceeded Ambient Water Quality Criteria. As the Tennessee River is a source for drinking water, TDEC has conducted weekly sampling at the two downstream water treatment plants closest to the spill site. Results do not indicate any levels above regulatory thresholds at the raw water intakes.

Surface water was identified as one of the media with potential exposure pathways for recreational activities (swimming and fishing) and via ingestion or dermal contact from handling or drinking the water without treatment. The Screening Level Ecological Risk Assessment included surface water as a media for aquatic exposures and selected 17 inorganic constituents in the Emory River, 17 constituents in the Clinch River and 17 constituents in the Tennessee River as constituents of potential ecological concern; many were identified as components of fly ash. Based on available evidence, the Screening Level Ecological Risk Assessment concluded that the possibility of adverse ecological risks through surface water exposure "cannot be excluded." However, the Screening Level Ecological Risk Assessment concluded that since "remedies for this area of the site will eliminate the potential exposure pathways" for plants and animals, "a Baseline Ecological Risk Assessment is not warranted…"

Surface water originating upgradient of the embayment is currently routed around the ash by a series of clean water ditches. The alternatives, including the alternative 3b, outlined in the EE/CA all propose to maintain these ditches to the extent possible during the excavation of ash to allow surface water to continue to bypass the ash. Dike 2, which was installed to isolate the non-time critical areas (embayment) from the time-critical removal action, will be left in place until all ash is removed from the embayment and will allow TVA to control and monitor surface water from the embayment.

While the EE/CA does not discuss a proposed surface water-monitoring program during construction, the Action Memorandum states that the existing *Surface Water Monitoring Plan* will be revised to address the chosen alternative 3b. Additionally the cost estimates in Appendix D of the EE/CA contain line-item costs for environmental monitoring that include weekly surface water sampling. The duration corresponds with the projected construction schedule for

each alternative. Any revisions to the *Surface Water Monitoring Plan* should be reviewed prior to implementation.

2.3. STORM WATER

The main concerns regarding storm water management during the removal action include (1) providing sediment and erosion control during the implementation of proposed remedial action alternatives, (2) the integration of storm water management measures into the proposed remedial action alternatives, and (3) complying with National Pollutant Discharge Elimination System requirements.

2.3.1. Sediment and Erosion Control

Although the EE/CA does not appear to specifically mention the facility's *Storm Water Pollution Prevention Plan*, the implementation of temporary and permanent sediment and erosion control measures are discussed throughout the document. The cost estimate in Appendix D of the EE/CA has numerous line item references to temporary and permanent erosion control measures such as silt fencing, vegetative cover, and turf reinforcement mat, indicating that these measures will likely be installed.

2.3.2. Storm Water Management

The EE/CA does not appear to discuss how the proposed remediation alternatives would alter the site's storm water hydrology. The conceptual design provided in Appendix C of the EE/CA is noted to have included the installation of a perimeter ditch for storm water management. However, the design did not identify if hydrologic goals, such as achieving target peak flow rates or reducing runoff volume, exist for each of the design alternatives. The EE/CA does not discuss if the proposed alternatives would alter or improve storm water conditions (flow rates, volumes, and velocities), especially when compared to pre-existing site conditions. It is assumed that this information would be provided in the final design document per the recommendation of the Action Memorandum for the *Stormwater Management Plan* to be revised to address the selection of alternative 3b.

Both the EE/CA and Action Memorandum discuss the importance of the timing of the embayment and dredge cell decision since "although the clean water ditches have been designed for a 25-year recurrence interval, some of the drainage features in the embayment (sediment basins) have been sized for a storm event having only a 2-year recurrence interval; a delay in the decision would increase the risk of future ash releases during greater storm events."

2.4. NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM COMPLIANCE

TVA has three National Pollutant Discharge Elimination System permits associated with KIF including the facility permit (Permit No. TNR0005452) and two general permits, the Tennessee Storm Water Multi-Sector Permit for Industrial Activities (Permit No. TNR050000), and the Tennessee General National Pollutant Discharge Elimination System Permit for Discharges of Stormwater Associated with Construction Activities (Permit No. TNR100000).

The EE/CA mentions discharging settling water through National Pollutant Discharge Elimination System points in several places and continuation of compliance with National Pollutant Discharge Elimination System water quality limits. The EE/CA also discusses compliance with an *Aquatic Resource Alteration Permit*, which also has requirements for water quality protection, site stabilization, and sediment and erosion control. The Action Memorandum notes that the current National Pollutant Discharge Elimination System monitoring program will be continued during restoration of the embayment.

2.5. SEDIMENT

TVA is using a combination of grab and Vibracore sampling devices designed to retrieve recent and historic deposition, respectively, to characterize ash and sediment in the Emory and Clinch Rivers. The grab samples provide an opportunity to analyze recently deposited sediments impacted by the spill while the deeper Vibracore sampler allows access to recent and pre-spill deposition. Additionally, TVA is using a sub-bottom profiler to create a survey of ash distribution in the rivers. There is no indication that TVA has attempted to characterize the sediment or extent of ash in the Swan Pond Embayment; however, since the ash spill completely filled the embayment and the proposed alternatives are intended to completely remove all ash from the embayment, a characterization of the sediment is not warranted at this time.

The EE/CA indicates that the removal of the ash from the Swan Pond Embayment would remove "metals and radionuclides that could produce toxic effects on the health and safety of humans and animals. Water quality would be restored to meet Ambient Water Quality Criteria in surface water within the embayment." Both the EE/CA and Action Memorandum note that dredging will be necessary in certain areas of the embayment.

Beyond sampling and analysis of sediments, planning for long-term river recovery efforts is affected by the nature of the ash and natural sediments along with their interactions in the natural system. Both the EE/CA and the Action Memorandum note that additional evaluation of the river system will be completed under a separate EE/CA. The EE/CA reports that TVA has retained the **US Army Corps of Engineers, Engineering Research and Development Center at Waterways Experiment Station** to develop and run a computer model called Adaptive Hydraulics to assist in the assessment of ash behavior in the Emory and Clinch Rivers and to conduct laboratory flume experiments (SedFlume) to evaluate the resistance of this material to erosion on the river bottom. This information is considered vital to formulating a long-term clean-up strategy for the river sediments. As previously stated, the EE/CA for the river system, which will address the long-term clean-up strategy, will be completed at a later date and will address the results of the study.

2.6. GROUNDWATER

Currently there are six monitoring wells around the Dredge Cell and the Ash Dewatering area. The EE/CA presents a discussion of the results of a sampling event conducted in June 2009. Arsenic was detected in one well (KIF-AD2) at a concentration of 0.0297 mg/L which is above the Maximum Contaminant Level of 0.010 mg/L. Historical concentrations are not available for this well as the well was relatively recently installed. Arsenic was detected in two other wells but at concentrations below the Maximum Contaminant Level. A review of the historical data indicates that arsenic concentrations occasionally exceeded the Maximum Contaminant Level in monitoring well KIF-6A.

The EE/CA further acknowledges that since there is no liner beneath the Dredge Cell, constituents in groundwater could impact the river; however, surface water sampling has not

shown exceedances of the surface water quality criteria in the river (not associated with dredging operations). While the surface water quality in the river system may be adequate with respect to the Tennessee Fish and Aquatic Life Criteria, it may be more appropriate to discuss groundwater impacts related to the Swan Pond Embayment since groundwater from the Dredge Cell likely discharges to the embayment. Surface water quality data collected from the embayment indicates that antimony, arsenic, and selenium have exceeded at least one water quality criteria.

TVA recognizes the need for a hydrological assessment of KIF and is developing detailed plans to determine the potential long-term impact that groundwater beneath the Dredge Cell and Ash Pond may have on surface water in the Watts Bar Reservoir. This hydrological assessment will be conducted as part of a subsequent EE/CA prepared for the river system, not as part of the EE/CA for the Swan Pond Embayment reviewed in this report. Both the EE/CA and the Action Memorandum state that groundwater remediation was not identified as a removal action objective and provide the following rationales: lack of an identified contaminant plume, no evidence of leaching of metals from the ash, and a low permeability, silty clay layer that inhibits groundwater flow. However, without a detailed hydrogeologic assessment that identifies how groundwater moves from the Dredge Cell to the adjacent surface waters, it is difficult to determine whether the existing monitoring wells are properly located within the correct lithological unit or fracture zone.

The EE/CA identifies the potential exposure pathways in groundwater to include the following scenarios.

- **Adult and Child Resident**: Exposure parameters for this scenario will be the default values established by the EPA. Future on-site residents may be exposed to groundwater used for household water supply through ingestion, inhalation of water vapor, and dermal contact. The residential exposure scenario is appropriate due to current use of surrounding properties.

- **Indoor Worker (office or light industrial worker)**: Future indoor workers involved in office or light industrial work at KIF may be exposed to groundwater as a potable supply. Exposure parameters for this scenario will be the default values established by the EPA. Indoor workers may be exposed to groundwater through ingestion. Dermal contact and inhalation of water vapor are not

considered to be significant pathways of exposure for indoor workers due to the limited use of water in industrial or office settings.

Although groundwater is included in the Human Health Risk Assessment, groundwater is excluded in the *Ecological Conceptual Site Model* portion of the Work Plan. That model excludes groundwater as a source of contamination due to the lack of exposure pathway in this site setting. Instead, surface water is included as an exposure medium for both ecological and human health risks.

Alternative 3b chosen for the closure of the Dredge Cell includes a foundation treatment zone (soil-cement columns installed to bedrock) with lower permeability than the sandy alluvium soils beneath the site to provide support for reconstruction of the dike and will also serve to retard groundwater transport. The final cap for the Dredge Cell will serve to reduce leachate generation in compliance with TDEC regulations. Additionally, TVA will develop a plan for long-term groundwater monitoring to ensure that contaminants are discovered before reaching drinking water wells or sensitive plants or animals. The Action Memorandum outlines a monitoring program that includes quarterly sampling for the first year and then, if supported by analytical data, reduction of the sampling frequency to semi-annually for the remainder of the 30-year, post-closure period.

2.7. BIOLOGICAL

An evaluation is underway to identify the pre-spill conditions of the Emory and Clinch Rivers to assist in determining damages to the natural resources resulting from the spill. Existing data from TVA and the **Tennessee Wildlife Resources Agency (TWRA)** surveys is being utilized in this effort. Ash deposits resulting from the KIF spill may physically degrade or eliminate the habitat for bottom dwelling organisms. Approximately 2.51 acres of palustrine wetlands were affected by the ash spill in addition to ash deposition in open water areas. Fish have been collected from the Emory and Clinch Rivers by TWRA for tissue chemical analyses. An ongoing, fish-sampling program will continue on an annual or semi-annual basis. Collections of amphibians, tree swallow eggs and hatchlings were performed during a three-month period for metals analyses. Surveys and sampling for amphibians and birds are ongoing, and long-term impacts will not likely be known for some time.

Reference data for metals in fish were collected after the spill and are being utilized along with historical samples in the Human Health Risk Assessment. However, use of the Emory River is primarily recreational. Currently there are fish consumption advisories in place for the Emory River and Watts Bar Reservoir; however, both were in place prior to the ash spill. The Screening Level Ecological Risk Assessment identified multiple exposure routes for terrestrial and aquatic organisms to be exposed or experience uptake of constituents related to the ash. Findings of the Screening Level Ecological Risk Assessment indicate there are significant uncertainties remaining for river systems. Human health risks for eating fish need to be defined. The Screening Level Ecological Risk Assessment indicates a potential ecological risk, but the risk needs to be better defined to determine if further action is needed after the ash is removed.

2.8. RISK ASSESSMENT

The process of assessing the human health risk is a very significant decision making tool used to estimate site-specific carcinogenic and non-carcinogenic risks due to potential exposure to chemicals. The results of a risk assessment can be used to decide whether site clean up is required, and if so, to develop site-specific clean-up levels. These clean-up levels can then be used to design and implement effective remediation systems.

The process generally consists of the following steps:

- **Step 1**: Compilation of all available relevant data, an evaluation that sufficient data are available to undertake a risk assessment, and the identification of chemicals of concern.
- **Step 2**: Development of an exposure model that considers the current and future land use to identify how human may be exposed to chemicals. This step identifies the manner, termed "exposure pathways," by which a receptor may come in contact with the chemicals. For each exposure pathway, this step involves an estimation of the uptake or dose.
- **Step 3**: Identification of quantitative and qualitative toxicity of the chemicals of concern. These values are typically obtained from EPA-published sources or peer reviewed, open source literature.
- **Step 4**: Use of information collected in the above three steps to estimate site-specific risk. In particular, risk is calculated by combining the site-specific exposures calculated in Step 2 and the toxicity values obtained in Step 3.

> Typically, a risk assessment is of interest to numerous stakeholders, many of whom do not have a formal background or familiarity with the risk assessment process. Therefore, the Human Health Risk Assessment should be clearly documented so that it is transparent, all assumptions are clearly presented and the implications on the overall conclusions are discussed.

The KIF Human Health Risk Assessment follows the process outlined by the EPA and in other documents referenced in the subject risk assessment, and in this regard, it is a well-developed risk assessment.

The process of assessing the human health risk also requires several inputs, models that describe the quantitative relationship between the various inputs, and calculations. Inputs include the representative concentration, exposure factors (e.g. the amount of air a person breathes in a day), and toxicity values. Several of these inputs are typically not measured at a site and have to be obtained from literature sources. At times, selection of the input parameters requires considerable professional judgment. Clearly, the results of the risk assessment critically depend on the input parameters selected, assumptions used to select these values, and the models used to perform the calculations. Any errors in the selection of the inputs, the calculation of representative concentrations, or the application of the models will result in errors in the risk assessment.

The RAM Group[3] reviewed the KIF Human Health Risk Assessment, and identified some discrepancies in the Human Health Risk Assessment. However, the selected remediation option includes the removal of all ash from the Swan Pond Embayment, the associated risk is reduced and correction of these discrepancies would not alter the overall selection of alternative 3b. Review comments were submitted to the TVA who indicted that these comments would be considered during development of the Human Health Risk Assessment for the river system.

The RAM Group's review of the Screening Level Ecological Risk Assessment determined that the ecological risk assessment follows the procedure described in the referenced EPA documents and compares the site concentrations with the appropriate screening levels. The selected screening levels were found to be accurate, and comparison of the site concentrations

[3] Marshall Miller retained the RAM Group, for its expertise with risk assessments.

with these screening levels had been performed correctly and the conclusions drawn are reasonable and supported by the analysis. Therefore, no revisions or changes to the Screening Level Ecological Risk Assessment are recommended.

Item 3: CONCLUSIONS

Generally, Marshall Miller finds no significant deficiencies in any of the proposed alternatives for the restoration of the Swan Pond Embayment, including the selected alternative 3b. The documents prepared by TVA appear to be substantially in compliance with applicable regulatory requirements stated in the Administrative Order and Agreement on Consent and meeting the removal action objects outlined in the EE/CA.

Both the EE/CA and Action Memorandum are intended to provide only a conceptual design of each of the three alternatives. Since alternative 3b has been selected, a more detailed design should be completed, along with plans for monitoring potential environmental impacts during excavation of the ash and closure of the Dredge Cell. Additionally, the EE/CA provides limited detail on the long-term monitoring of various media for potential environmental impacts. The EE/CA does state that a long-term monitoring plan will be developed once a final remedy is selected and that a detailed hydrogeological evaluation of the area will be completed as part of a subsequent EE/CA prepared for the rivers. TVA should continue to follow the monitoring programs for the various media already in place until plans are updated to reflect the selections of alternative 3b. To date, these programs have proven effective in assessing any environmental impacts from the removal of the ash.

Marshall Miller's concern with the selected alternative is the evaluation of groundwater contamination and an understanding of the fate and transport of contaminants within the underlying aquifers. Ash remaining in the Dredge Cell has been and will remain in contact with groundwater, thus remaining a potential source of contamination. The EE/CA includes a brief discussion on post-closure groundwater monitoring and makes the assumption for cost estimating purposes that up to four monitoring wells will be installed and monitored quarterly. Insufficient information is currently available to assess whether this is an adequate number of wells or whether the wells are screened at the correct depth. The EE/CA notes that a more detailed monitoring plan will be developed for the selected alternative. Additional characterization of site geology is proposed for the EE/CA for the river to evaluate the

interaction between groundwater and surface water and the fate and transport of ash related constituents.

The following recommendations are provided to TVA:

- The appropriate sampling plans should be revised to address the modifications necessary due to the selection of alternative 3b for the restoration of the Swan Pond Embayment.

- A more detailed understanding of groundwater discharge and associated contaminant migration into the surface water is required in order to properly locate monitoring wells. Siting of the groundwater monitoring wells for the closed Dredge Cell should be based on the results of additional hydrogeological evaluation.

Management's Response – The Senior Vice President and Executive, Kingston Ash Recovery Project, provided comments on a draft of this report and agreed to implement the recommendations.

In response to the recommendations, management provided the following comments:

- The Surface Water Monitoring Plan for the Emory, Clinch and Tennessee Rivers was updated and approved by the regulators on July 23, 2010.

- The Site Dust Control and Ambient Air Monitoring Plan was updated and approved by the regulators on July 23, 2010.

- The Non-Time-Critical Removal Action for the River System Sampling and Analysis Plan includes a groundwater study. Results of the modeling will be used to support the selections of appropriate locations for groundwater monitoring wells for the closed Dredge Cell.

The complete text of TVA management's response is provided in the Appendix.

Auditor's Comments – We concur with TVA management's planned and completed actions.

September 17, 2010

Robert E. Martin, ET 3C-K

COMMENTS – DRAFT INSPECTION 2008-12283-06 – REVIEW OF THE LONG TERM ENVIRONMENTAL RECOVERY PLAN FOR KINGSTON

The Kingston Ash Recovery Project is in agreement with the facts, conclusions and recommendations presented in this draft report. Regarding the recommendations which were presented, the project has completed the following actions:

- The Surface Water Monitoring Plan for the Emory, Clinch and Tennessee Rivers was updated and approved by the regulators on July 23, 2010. The update incorporated changes which were made in response to the transitioning of site activities required by the Action Memorandum for Non-Time-Critical Removal Action for the Embayment/ Dredge Cell.
- The Site Dust Control and Ambient Air Monitoring Plan was updated and approved by the regulators on July 23, 2010. The update incorporated changes which were made in response to the transitioning of site activities required by the Action Memorandum for Non-Time-Critical Removal Action for the Embayment/Dredge Cell.
- The Non-Time-Critical Removal Action for the River System Sampling and Analysis Plan includes a groundwater study which will analyze the groundwater transport of ash-related constituents to the Watts Bar Reservoir. Six existing monitoring wells, three permanent new monitoring wells, seven temporary well points, and fifteen temporary boreholes will be sampled to collect data to support the proposed modeling. Results of this modeling will be used to support the selection of appropriate locations for groundwater monitoring wells for the closed Dredge Cell.

As the closure of the dredge cell progresses, the Site Storm Water Management Plan, Surface Water Monitoring Plan for the Emory, Clinch and Tennessee Rivers, and Site Dust Control and Ambient Air Monitoring Plan will be periodically reviewed and updated as needed to match the ongoing work and site conditions.

Thank you for the opportunity to provide comments on the draft inspection report. Please do not hesitate to call if you need further information.

Robert M. Deacy
Senior Vice President and Executive
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