SOUTHERN ENVIRONMENTAL LAW CENTER

Telephone 615-921-9470 | 1033 DEMONBREUN STREET, SUITE 205 NASHVILLE, TN 37203 | Facsimile 615-921-8011

December 4, 2018

Ashley Farless
NEPA Compliance Specialist
1101 Market Street, BR4A-C
Chattanooga, TN 37402

Via email to arfarless@tva.gov

Re: Notice of Intent re: Environmental Impact Statement for Allen Fossil Plant Ash Impoundment Closures: Request for Public Meeting re: Scoping, Extension of Public Comment Period, and Revision of Notice of Intent to Correct Deficiencies

Dear Ms. Farless:

On behalf of Protect Our Aquifer and the Tennessee Chapter of the Sierra Club, we are writing in response to the Notice of Intent to prepare an Environmental Impact Statement for Allen Fossil Plant Ash Impoundment Closures (Scoping Notice)[1] to request that the Tennessee Valley Authority (TVA):

1) Extend the public comment period for at least an additional 45 days to allow adequate time for the community to learn about the environmental conditions at the site and the actions proposed by TVA;

2) Hold a public meeting during the scoping period to inform the community about TVA's ash pond closure process, and collect public comments on the scope of environmental review in person; and

3) Revise the Scoping Notice to include within the scope of the proposed action (1) water withdrawals for the Allen Combined Cycle Plant; and (2) additional information regarding the proposed "beneficial re-use facility" and recirculate the revised Notice of Intent.

We request that TVA extend the public comment period and hold a public meeting during the scoping period regardless of whether TVA revises the Scoping Notice. The basis for each of these requests is set forth below.

[1] Tennessee Valley Authority, Notice of Intent, Environmental Impact Statement for Allen Fossil Plant Ash Impoundment Closures, 83 Fed. Reg. 61708 (November 30, 2018) [Scoping Notice].

Factual Background

The Scoping Notice addresses closure of the coal ash ponds at the Allen Fossil Plant and proposes the preparation of an environmental impact statement under the National Environmental Policy Act (NEPA).[2] TVA seeks input from the public regarding the scope of its environmental analysis.

At the Allen Fossil Plant, extremely high levels of coal ash contamination emanating from the ash ponds are the subject of at least two ongoing state investigations: (1) a remedial investigation overseen by the Tennessee Department of Environment and Conservation (TDEC) Bureau of Remediation,[3] and (2) an environmental investigation being conducted pursuant to the TDEC Commissioner's Order.[4] A report commissioned by TVA to comply with the remedial investigation, and subsequently published by the United States Geological Survey (USGS) and the University of Memphis Center for Applied Earth Science and Engineering Research (CAESER), concluded this year that the contaminated shallow groundwater is connected to the Memphis Sand Aquifer, Shelby County's primary drinking water source.[5]

As we explained in comments submitted on the environmental investigation plan last week, data from the remedial investigation and the USGS/CAESER report demonstrate that there is a current and ongoing risk of coal ash contamination entering the Memphis Sand Aquifer and McKellar Lake.[6] TVA has so far refused to acknowledge these risks. The environmental impact statement must address these impacts to groundwater and surface water quality.

In addition, the high levels of coal ash contamination emanating from the Allen Fossil Plant previously resulted in a reversal of TVA's decision to operate production wells at the Allen Combined Cycle Plant that would have pulled contaminated groundwater into the Memphis Sand Aquifer. Instead, TVA is purchasing water from Memphis Light, Gas, & Water,

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[2] Scoping Notice, 83 Fed. Reg. at 61708.

[3] Letter from Steve Goins, TDEC to TVA (July 18, 2017) (outlining requirements for remedial investigation) [hereinafter TDEC Letter re: RI Requirements].

[4] Tennessee Department of Environment and Conservation, In the Matter of Tennessee Valley Authority, Order No. OGC15-0177, Sec. VII.A.d (Aug. 6, 2015) [Commissioner's Order].

[5] Carmichael, J.K., Kingsbury, J.A, Larsen, Daniel, and Schoefernacker, Scott, 2018 Preliminary evaluation of the hydrogeology and groundwater quality of the Mississippi River Valley alluvial aquifer and Memphis aquifer at the Tennessee Valley Authority Allen Power Plants, Memphis, Shelby County, Tennessee: U.S. Geological Survey Open-File Report 2018-1097, 66 p., https://doi.org/10.3133/ofr20181097 [USGS/CAESER Report].

[6] Att. 1, Letter from Amanda Garcia, Southern Environmental Law Center, on behalf of Protect Our Aquifer and Sierra Club to TDECorder@tva.gov, re: Tennessee Department of Environment and Conservation Commissioner's Order: Environmental Investigation Plan, Revision 2, Allen Fossil Plant (November 28, 2018) [POA/SC Comments on EIP], submitted together with Douglas J. Cosler, Risk of Contamination of the Memphis Sand Aquifer, Allen Fossil and Combined-Cycle Combustion Turbine Plants: Review and Analysis of the Environmental Investigation Plan, Remedial Investigation, and Interim Remedial Action (November 26, 2018) [Cosler Report].

which in turn is extracting Memphis Sand Aquifer water from the Davis well field. The analysis we submitted to TVA and TDEC last week shows that extracting Memphis Sand Aquifer water from the Davis well field will result in additional long-term drawdown of contaminated shallow groundwater under the Allen Fossil Plant into the Memphis Sand Aquifer.[7] We previously submitted comments to TVA demanding that the utility prepare a supplemental environmental assessment and environmental impact statement analyzing the impacts of its use of MLGW water on groundwater quality.[8] To date, TVA has not responded to our letter and has not prepared additional environmental documentation under NEPA to address impacts to groundwater quality from its use of MLGW water.

Our comments on the environmental investigation plan and our comments demanding supplemental environmental analysis regarding cooling water for the Allen Combined Cycle Plant are attached and incorporated into this letter by reference.

Requests

Based on the foregoing factual background, we request that TVA:

1) Extend the public comment period for at least an additional 45 days.

The regulations implementing the National Environmental Policy Act require "an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a proposed action."[9] TVA's regulations implementing NEPA further provide:

> There will normally be a public input period of 30 days from the date of publication of the Notice of Intent in the Federal Register to allow other interested agencies and the public an opportunity to review the action alternatives and probable environmental issues identified by the scoping committee.[10]

[7] POA/SC Comments on EIP, 6; Cosler Report, 19-20.

[8] Att. 2, Letter from Amanda Garcia and Anne Passino, Southern Environmental Law Center, on behalf of Protect Our Aquifer and Sierra Club, to Ashley Farless, TVA, re: TVA Must Prepare an Environmental Impact Statement for the Allen Fossil Plant Emission Control Project (Project Nos. 2013-33 & 2015-28) to Consider New and Omitted Information Regarding Risk of Arsenic Contamination to Memphis Sand Aquifer 41 (February 21, 2018) [Letter Demanding EIS].

[9] 40 C.F.R. § 1501.7.

[10] Tennessee Valley Authority, Procedures for Compliance with the National Environmental Policy Act § 5.4.3 (1983) [TVA NEPA Procedures].

One of the primary purposes of scoping is to ensure that the agency will obtain the input of the public and affected federal, state and local government entities early in the NEPA process.[11] As the Council on Environmental Quality explains, "Scoping does not create problems that did not already exist; it ensures that problems that would have been raised anyway are identified early in the process."[12] For this reason,"'[s]coping will be effective only if people who are, or may become, interested in the proposed action are involved.'"[13]

TVA's proposed timeframe for public comment will not accomplish this basic purpose of the scoping process. TVA published the Scoping Notice in the Federal Register on November 30, 2018, indicating that the public must submit comments by January 4, 2019. The comment period thus spans two major federal and state holidays: Christmas and New Year's Day.[14] In addition to these federal and state holidays, the comment period also spans Hanukkah (December 2-10) and Kwanzaa (December 26-January 1). Although TVA technically provides 30 days for public comment, the proposed comment period places an unreasonable burden on interested public agencies and the public to participate in a shortened timeframe due to the intervening holidays.

The proposed limited timeframe is particularly egregious given the high level of engagement by TDEC, the Shelby County Health Department, and other federal, state, and local officials at the Allen Fossil Plant. TVA's proposed timeframe threatens to stifle participation by important regulatory agencies that are charged with protecting the public's drinking water resources and the public health. There has also been significant participation by the public at the handful of public meetings TDEC and TVA have convened, including at a public meeting on the environmental investigation plan that was not timely or properly noticed and was held in the middle of a forest at T.O. Fuller State Park. Thus, it is likely that public agencies, officials, and the public generally would participate in this scoping process if provided with a meaningful opportunity to do so.

In addition, as the comments we have submitted in other processes show, TVA has not been straightforward with the community regarding the risk its coal ash management poses at the Allen Fossil Plant, and therefore has placed the burden of understanding this risk on the public.

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[11] Council on Environmental Quality, Memorandum for General Counsels, NEPA Liaisons and Participants in Scoping 3 (April 30, 1981), *available at* https://ceq.doe.gov/guidance/guidance.html.

[12] *Id.*

[13] *Nw. Coal. For Alternatives To Pesticides v. Lyng*, 673 F. Supp. 1019, 1022 (D. Or. 1987), *aff'd sub nom. Nw. Coal. for Alternatives to Pesticides (NCAP) v. Lyng*, 844 F.2d 588 (9th Cir. 1988).

[14] E.g., https://www.tn.gov/hsda/hsda-state-holidays.html; https://www.opm.gov/policy-data-oversight/snow-dismissal-procedures/federal-holidays/#url=2018.

The public needs additional time to engage with and understand the multiple regulatory investigations underway at the Allen Fossil Plant in order to provide substantive input into the scoping process.

2) Hold a public meeting during the scoping period.

The regulations implementing the NEPA also recommend that an agency may "[h]old an early scoping meeting or meetings which may be integrated with any other early planning meeting the agency has."[15] The regulations observe that "[s]uch a scoping meeting will often be appropriate when the impacts of a particular action are confined to specific sites."[16] TVA's implementing regulations further provide:

> The scoping committee will determine the need, nature, and format for the various scoping sessions. Session type and format will be selected to facilitate timely and meaningful public input into the EIS process.[17]

Both the CEQ regulations and TVA's implementing regulations suggest that holding meetings may be appropriate in order to "facilitate meaningful public input" and where the impacts of a proposed action center around a specific sites—here, the Allen Fossil Plant, McKellar Lake, the shallow aquifer, the Memphis Sand Aquifer, and communities that live near the site and/or the proposed beneficial reuse site.

The same reasons that warrant extension of the comment period also support convening a public scoping meeting to obtain the input of the local communities that will be affected by TVA's proposed action. Local community members, including members of Protect Our Aquifer and the Sierra Club, have been deeply engaged in protecting their drinking water resources from the threat of coal ash contamination at Allen for several years. They have shown up for meetings at the TDEC field office, the public library, and even in the middle of a forest in a public park to learn more about TVA's activities at the Allen Fossil Plant. The community deserves to hear from TVA directly and to provide input to TVA directly—on a schedule that is not interrupted by four major holidays.

In addition, based on our experience at previous community meetings, TVA has made little to no effort to make technical information accessible to the community most likely to be adversely affected by its decisions. We therefore also respectfully request that at public meetings and in written materials or other communications efforts related to the Allen Fossil Plant, TVA provide plain-language summaries of the information being presented in more

[15] 40 C.F.R. § 1501.7(b)(4).

[16] *Id.*

[17] TVA NEPA Procedures, § 5.4.3.

technical documents, including information related to the contaminated condition of the Allen Fossil Plant, risk to the Memphis community, alternatives being considered, and implications for the community. This information should not include acronyms and technical terms that are not accessible to the general public. Such materials could include short videos that explain, for example, the connection between the shallow and deep aquifers and the downward flow of groundwater toward the deep aquifer at the site. Depending on the communities that may be affected, this information may need to be presented in both English and Spanish.

3) Revise the Scoping Notice to address water withdrawals for the Allen Combined Cycle Plant and the Beneficial Re-Use Facility.

The scope of a proposed action "consists of the range of actions, alternatives, and impacts to be considered in an environmental impact statement."[18] "The scope of an individual statement may depend on its relationships to other statements."[19] Actions that should be included in a single EIS include connected actions, such as interdependent actions, and cumulative actions.[20] TVA's implementing regulations require a scoping notice to "briefly describe the action, reasonable alternatives thereto, and potential environmental impacts associated with the action."[21] Without an adequate description of the proposed action and alternatives in the scoping notice, the public and public agency stakeholders cannot provide meaningful input into the development of the EIS, including key action alternatives, significant environmental issues to be addressed in detail, and related environmental documents.[22]

The Scoping Notice fails to include within the scope of the proposed action TVA's decision to purchase water from MLGW, even though the withdrawal of water from the Memphis Sand Aquifer at the Davis well field to cool the Allen Combined Cycle Plant is a connected and cumulative action that must be studied in the EIS. Withdrawing water from the Memphis Sand, even three miles away, threatens to pull coal ash-contaminated water from the Allen Fossil Plant into the Memphis Sand.[23] TVA has not analyzed the groundwater quality impacts associated with its decision to purchase water from MLGW and must do so here because the action is connected and cumulative to the closure options for the coal ash ponds at the Allen Fossil Plant. Moreover, the Scoping Notice should identify reasonable alternatives to the use of

[18] 40 C.F.R. § 1508.25

[19] *Id.*

[20] *Id.* at § 1508.25.

[21] TVA NEPA Procedures , § 5.4.3.

[22] *See* TVA NEPA Procedures, § 5.4.3 (describing required outcomes of the scoping process).

[23] Cosler Report, 19-20.

MLGW water, including the use of gray water from the nearby Maxon wastewater treatment facility.[24]

The Scoping Notice refers to an alternative that would include "closure of the Metal Cleaning Pond and closure-by-removal of the East Ash Pond Complex, the West Ash Pond, and the CCR surrounding the Metal Cleaning Pond to a beneficial re-use facility & offsite landfill location…."[25] However, the Scoping Notice includes no detail regarding the beneficial reuse facility. The Scoping Notice is inadequate to solicit meaningful input from the public and affected public agencies. At a minimum, TVA must include information that (1) identifies the type of "beneficial re-use" proposed (encapsulated or unencapsulated); (2) the proposed methods of storage of coal ash at the proposed reuse facility; and (4) potential locations for the proposed facility (e.g., whether TVA is considering constructing the facility on-site, in Frank Pidgeon Park, or elsewhere in Memphis).

Thank you for considering these requests. We look forward to hearing from you and to participating in the process.

Sincerely,

Amanda Garcia
Senior Attorney
Southern Environmental Law Center

/s with permission
Ward Archer
President
Protect Our Aquifer

/s with permission
Scott Banbury
Conservation Program Coordinator
Tennessee Chapter Sierra Club

[24] Letter Demanding EIS, 37-41.

[25] Scoping Notice, 83 Fed. Reg. at 61708.

Attachments

Att. 1, Letter from Amanda Garcia, Southern Environmental Law Center, on behalf of Protect Our Aquifer and Sierra Club to TDECorder@tva.gov, re: Tennessee Department of Environment and Conservation Commissioner's Order: Environmental Investigation Plan, Revision 2, Allen Fossil Plant (November 28, 2018), submitted together with Douglas J. Cosler, Risk of Contamination of the Memphis Sand Aquifer, Allen Fossil and Combined-Cycle Combustion Turbine Plants: Review and Analysis of the Environmental Investigation Plan, Remedial Investigation, and Interim Remedial Action (November 26, 2018).

Att. 2, Letter from Amanda Garcia and Anne Passino, Southern Environmental Law Center, on behalf of Protect Our Aquifer and Sierra Club, to Ashley Farless, TVA, re: TVA Must Prepare an Environmental Impact Statement for the Allen Fossil Plant Emission Control Project (Project Nos. 2013-33 & 2015-28) to Consider New and Omitted Information Regarding Risk of Arsenic Contamination to Memphis Sand Aquifer 41 (February 21, 2018).

ATTACHMENT 1

SOUTHERN ENVIRONMENTAL LAW CENTER

Telephone 615-921-9470 | 1033 DEMONBREUN STREET, SUITE 205 NASHVILLE, TN 37203 | Facsimile 615-921-8011

November 28, 2018

Submitted via TDECorder@tva.gov

Re: Tennessee Department of Environment and Conservation Commissioner's Order: Environmental Investigation Plan, Revision 2, Allen Fossil Plant

On behalf of Protect Our Aquifer and the Tennessee Chapter Sierra Club, the Southern Environmental Law Center respectfully submits the following comments on the draft Environmental Investigation Plan, Revision 2, for the Allen Fossil Plant (EIP). In support of our comments, we also submit the attached analysis of Douglas J. Cosler, Ph.D., Chemical Hydrogeologist, Adaptive Groundwater Management, LLC (Cosler Report).[1]

Our comments are focused on TVA's failure to properly interpret and incorporate the data it obtained through the Remedial Investigation (RI) and related United States Geological Survey and University of Memphis Center for Applied Earth Science and Engineering Research (USGS/CAESER) pumping test. The RI was required by the Tennessee Department of Environment and Conservation (TDEC) after TVA disclosed arsenic levels at 300 times the groundwater protection standard under its East Ash Pond at the Allen Plant. The RI and USGS/CAESER data indicate that there is a current risk of ongoing coal ash contamination in the Memphis Sand Aquifer and McKellar Lake due to TVA's storage of coal ash in the leaking, unlined East Ash Pond and consequent coal ash contamination of the alluvial aquifer. Neither the RI itself nor the EIP acknowledge

[1] Att. 1, Douglas J. Cosler, Risk of Contamination of the Memphis Sand Aquifer, Allen Fossil and Combined-Cycle Combustion Turbine Plants: Review and Analysis of the Environmental Investigation Plan, Remedial Investigation, and Interim Remedial Action (November 26, 2018) [Cosler Report]; Att. 2, Resume of Douglas J. Cosler, Ph.D.

this current and ongoing risk, and therefore do not outline appropriate next steps in the ongoing investigation of coal ash contamination at the Allen Plant site.

TVA's failure to properly interpret the RI and USGS/CAESER data and characterize the current and ongoing risk of coal ash contaminant transport into the Memphis Sand Aquifer and McKellar Lake casts serious doubt on whether the EIP will achieve the stated objective of the Commissioner's Order to "fully identify the extent of soil, surface water, and ground water contamination by CCR."[2] This failure is deeply concerning because TVA's coal ash contamination threatens pollution of the Memphis Sand Aquifer, the primary drinking water source for the City of Memphis and Shelby County. TVA's coal ash pollution also further burdens McKellar Lake, a water body that struggles with legacy and current pollution from many sources. Rather than addressing TVA's contribution to this pollution, the EIP proposes to simply decline to look for it.

The ultimate goal of the process set forth in the Commissioner's Order is to remediate "unacceptable risks, resulting from the management and disposal of coal combustion residuals…."[3] Ostensibly, the RI shares this goal at the Allen Plant. However, based on the analysis presented in the RI and EIP, we have little confidence that the process will achieve its goal of remediating the risk of coal ash pollution in the Memphis Sand Aquifer and McKellar Lake. Instead, the RI and the EIP appear to be designed *not* to acknowledge the implications of the existing data or to accurately characterize the scope and extent of the contamination that is already occurring on the site.

To restore the public's trust and to meaningfully address the coal ash contamination at the Allen Plant, TVA must acknowledge the implications of the data gathered through the RI and USGS/CAESER report and redesign the RI and EIP accordingly.

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[2] Att. 3, Tennessee Department of Environment and Conservation, In the Matter of Tennessee Valley Authority, Order No. OGC15-0177, Sec. VII.A.d (Aug. 6, 2015) [Commissioner's Order].
[3] *Id.* Preamble.

Data Already Gathered Through the RI and USGS/CAESER Should Be Disclosed and Appropriately Analyzed in the EIP.

In the summer of 2017, TDEC publicly disclosed that groundwater under TVA's East Ash Pond at the Allen Plant was exceeding the groundwater protection standard for arsenic by more than 300 times, as well as standards for lead and fluoride. Alarmed by the high levels of a cancer-causing toxin, TDEC required TVA to perform the RI, with a particular focus on the potential for the contaminated groundwater to be pulled into the Memphis Sand Aquifer, the primary drinking water source for the City of Memphis and Shelby County. As part of the RI, TVA engaged USGS and CAESER to conduct a pumping test to evaluate the hydraulic connectivity between the shallow, contaminated aquifer and the Memphis Sand Aquifer. After months of delay, TVA submitted the RI to TDEC in March 2018.[4] The USGS/CAESER portion of the RI, which was subsequently independently published by USGS and CAESER, concludes that the shallow, contaminated groundwater is connected to the Memphis Sand Aquifer.[5]

Meanwhile, despite the ongoing RI, early versions of the EIP submitted by TVA to TDEC contained no meaningful discussion of the RI or the condition of contamination that led to TDEC requiring it.[6] The current version of the EIP, revision 2, which was submitted to TDEC after USGS and CAESER made their findings, references the RI, but does not incorporate any data from the RI or the USGS/CAESER findings into the baseline characterization of the Allen site or the EIP investigation design. Nor does the EIP acknowledge the central finding of USGS/CAESER, which is that the contaminated shallow aquifer is hydraulically connected to the Memphis Sand Aquifer.

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[4] Att. 4, Stantec, Draft TVA Allen Fossil Plant-East Ash Disposal Area-Remedial Investigation Report (March 6, 2018) [RI Report].

[5] *Id.*, App. E; *see also* Att. 5, Carmichael, J.K., Kingsbury, J.A, Larsen, Daniel, and Schoefernacker, Scott, 2018 Preliminary evaluation of the hydrogeology and groundwater quality of the Mississippi River Valley alluvial aquifer and Memphis aquifer at the Tennessee Valley Authority Allen Power Plants, Memphis, Shelby County, Tennessee: U.S. Geological Survey Open-File Report 2018-1097, 66 p., https://doi.org/10.3133/ofr20181097 [USGS/CAESER Report].

[6] See EIP at p. 1, Section 1.0 (describing revisions of EIP).

Indeed, although the EIP includes the RI Work Plan as an appendix, it does not include the RI itself, or the USGS/CAESER report. Instead, TVA states: "Based on the similarities between the RI activities and the TDEC Order EI objectives, TVA plans to provide the results of the investigations in the TDEC Order EAR."[7] According to TVA's proposed schedule, it will not submit a draft EAR to TDEC until late August 2020.[8]

Rather than disclosing the crucially important implications of the RI and USGS/CAESER data, the EIP alternately ignores or obfuscates it. For example, section 1.2 of the EIP, which purports to set forth "a summary of events related to the TDEC Order," completely omits the disclosure of high levels of arsenic and other coal ash pollution at the Allen Plant, TDEC's requirement that TVA conduct the RI, and other significant milestones in the RI, including its submission to TDEC and TDEC's requirement that TVA implement a supplemental RI and interim remedial action. Similarly, section 1.3 of the EIP, which purports to set forth "a summary of the proposed EIP process" for Allen, includes no discussion of any additional activities to be performed under the RI or how the data and results of the RI will be integrated into the EIP process. Section 3.3.1 of the EIP, to which several other sections of the EIP refers, contains a bare description of activities conducted under the RI and states that the results of these activities "will provide information to address many of TDEC's requests for the TDEC Order EIP."

As discussed in detail below and in the attached Cosler Report, data already gathered through the RI and USGS/CAESER research reveal conditions at the Allen site that indicate a current and ongoing risk of coal ash contamination of the Memphis Sand Aquifer and McKellar Lake. To achieve the objectives of the RI and the Commissioner's Order, the RI and EIP design must be revised to disclose and meaningfully integrate these data.

[7] *See* EIP at p. 18, Section 3.3.1.
[8] *Id.* App. A (Proposed EIP Schedule).

The RI and USGS/CAESER Data Indicate a Current and Ongoing Risk of Contamination of the Memphis Sand Aquifer, Which Should Form the Basis for Further Investigation in the RI and EIP.

Despite the key finding of USGS/CAESER that the contaminated alluvial aquifer and the Memphis Sand Aquifer are hydraulically connected,[9] the RI erroneously concludes that there is no risk of coal ash contamination migrating to the Memphis Sand Aquifer.[10] The RI also fails to accurately characterize the extent of the existing coal ash contaminant plume by selectively including only data for arsenic, fluoride and lead, and by failing to take into account additional indicators of downward groundwater flow at the site.[11]

Our independent review of the data from the RI and USGS/CAESER support the following key findings:

- There is a hydraulic connection between the Mississippi River Valley Alluvial (MRVA) Aquifer and the Memphis Sand Aquifer;

- The areal extent of the breach in the confining layer that is causing the hydraulic connection may be much larger than the USGS-CAESER report initially indicated;

- The degree of hydraulic connection, based on pumping-induced water-level reductions in the MRVA Aquifer, may be much stronger than the USGS-CAESER report initially indicated;

[9] USGS/CAESER Report, 44 ("The aquifer-test results indicate that the MRVA and Memphis aquifers are hydraulically connected in the TVA plants area.").
[10] RI, ES-i ("The north and south areas of affected groundwater are not impacting the Memphis aquifer or the public drinking water supply.")
[11] *Id.*, ES-i ("Sampling confirmed the highest concentrations of arsenic, fluoride and lead were limited to the north and south areas, primarily within the upper 40 feet of the shallow Alluvial aquifer. The aquifer is over 100 feet thick. Groundwater flow in the aquifer is essentially horizontal and is not moving downward.")

- There are significantly elevated concentrations of boron and sulfate, CCR indicator constituents, deep in the MRVA Aquifer at the Allen Plant;

- These boron and sulfate tracer concentration distributions indicate that long-term downward groundwater flow has been occurring in the Alluvial aquifer in the Allen Plant area;

- Shallow and deep vertical hydraulic gradients within the MRVA Aquifer, as well as significantly higher hydraulic heads in the MRVA aquifer compared to the Memphis Sand, also indicate downward groundwater flow;

- Age dating of groundwater (e.g., tritium analyses by USGS, 2018) and elevated sulfate concentrations in Memphis-Sand Production Well 5 indicate that mixing of MRVA Aquifer groundwater with Memphis Sand Aquifer water is occurring in the vicinity of the Allen Plant and that potential ongoing transport of CCR constituents from the MRVA into the Memphis Sand Aquifer is occurring; and

- TVA's extraction of Memphis Sand Aquifer groundwater from the Davis well field will result in long-term drawdown in the Memphis Sand under the Allen Plant and increase downward vertical hydraulic gradients from the MRVA to the Memphis Sand.

The technical bases for these findings are set forth in the Cosler Report, which is incorporated into these comments by reference.

Based on these findings, we recommend the following significant changes in the RI and EIP:

- Require TVA to incorporate the conclusions of the USGS-CAESER report (USGS, 2018, page 44) into the RI and EIP;

- Require TVA to implement the recommendations of the USGS-CAESER report for future data collection and analysis (USGS, 2018, page 44), including more accurate characterization of the location(s) and extent(s) of leakage/breach features in the confining unit and more accurate quantification of the fluxes of groundwater and dissolved CCR constituents from the MRVA Aquifer to the Memphis Sand Aquifer;

- Install monitoring well clusters (shallow, intermediate, and deep) within the footprint of the East Ash Pond and within the footprint of the West Ash Pond to adequately assess the spatial distribution of CCR contamination (including all Appendix III and IV constituents required to be monitored under the federal Coal Combustion Residuals Rule),[12] the true groundwater velocity distribution (vertical and horizontal), and chemical transport rates;

- Properly average water-level measurements for monitoring wells, McKellar Lake, and the East Ash Basin water surface to allow construction of accurate mean hydraulic head maps that can reliably be used to analyze long-term chemical transport in the subsurface;

- Engage in site-specific characterization of the soil-water partition coefficient for the various CCR constituents (including boron, sulfate, and all other Appendix III and IV constituents) so that chemical transport rates can be estimated;

[12] 40 C.F.R. § Pt. 257, App. III (Boron, Calcium, Chloride, Fluoride, pH, Sulfate, Total Dissolved Solids (TDS)); *id.* App. IV (Antimony, Arsenic, Barium, Beryllium, Cadmium, Chromium, Cobalt, Fluoride, Lead, Lithium, Mercury, Molybdenum, Selenium, Thallium, Radium 226 and 228 combined).

- Implement three-dimensional groundwater flow and chemical transport modeling that takes into account the above data (including all Appendix III and IV constituents); and

- Redesign the interim remedial action as further discussed in the Cosler Report.

Without these significant changes, the RI and EIP risk allowing TVA's leaking, unlined coal ash pits at Allen to pollute public drinking water resources and nearby surface water now and far into the future. This result is contrary to the intent of the Commissioner's Order as well as state and federal laws that protect our clean water from coal ash pollution.

The EIP Must Include Investigation of Coal Ash Pollution in McKellar Lake and Other Surface Water Bodies.

Data presented in the EIP, RI and USGS/CAESER report strongly indicate that coal ash pollution is moving from the East Ash Pond and groundwater beneath the East Ash Pond into McKellar Lake. As described in the Cosler Report, the RI underestimates the transport rate of coal ash pollution into McKellar Lake because it does not properly characterize the groundwater flow. In addition, the EIP describes historic and current seeps through the berms of the East Ash Pond and West Ash Pond.[13] Despite these data, in the EIP TVA states that it is not planning to undertake investigation of surface water or sediment impacts in McKellar Lake or other surface water bodies including Nonconnah Creek.[14] TVA's primary justification for omitting investigation of the impacts its coal ash pollution is having on McKellar Lake is that the lake is polluted by many sources.[15] The fact that McKellar Lake may be polluted by other sources does not give TVA a free

[13] EIP, p. 24, Sec. 3.42 (West Ash Pond); pp. 29-31, Sec. 3.5.5 (East Ash Pond).
[14] EIP, pp. 62-67.
[15] *Id.* at 63-64.

pass to add to its pollutant load additional arsenic, lead, boron and other coal ash contaminants.

The Commissioner's Order requires investigation and remediation of surface water impacts.[16] TVA must investigate the full extent of its contamination of McKellar Lake, Nonconnah Creek, and other nearby surface water bodies.

The Timeline to Begin Remediation Is Unacceptable.

The Commissioner signed the Order on August 7, 2015. By the time TVA and TDEC respond to comments and finalize the EIP, it will have taken more than three years to delineate the scope and terms of the environmental investigation at the Allen Plant. The timeline proposed by TVA and TDEC includes an additional two years until TDEC approves any Environmental Assessment Report prepared by TVA, and even longer before TDEC requires TVA to actually implement a corrective action plan at the site. In other words, it will have taken at least five years since the issuance of the Order to even *begin* a discussion about appropriate corrective action to address pollution we already know has occurred and is occurring at the site.

The record shows that TVA has repeatedly submitted manifestly inadequate EIP drafts, despite the relatively clear mandate of the Order to comprehensively investigate and address coal ash contamination at the Allen Fossil Plant. The record of TDEC's comments and TVA's successive draft EIP revisions speaks for itself.[17]

TDEC should not countenance continued foot-dragging by TVA, at either the Allen Fossil Plant or the other six sites covered by the Order, including Cumberland Fossil Plant, Bull Run Fossil Plant, Kingston Fossil Plant, Johnsonville Fossil Plant, John Sevier Fossil Plant, and Watts Bar. The citizens of

[16] Commissioner's Order, Sec. VII.A.d ("Each EIP shall include a schedule of the work to be performed to fully identify the extent of soil, *surface water*, and groundwater contamination by CCR.")(emphasis added); *id.* Sec. VII.A.f ("As appropriate for the site, the final approved CARA plan shall include:…(ii) the method(s) TVA will employ to remediate CCR contaminated soil, *surface water*, and ground water at the site.") .")(emphasis added)).
[17] *See* EIP, App. B (regulatory correspondence).

Tennessee have waited nearly a decade since the catastrophic Kingston coal ash for TVA to fulfill its promise to clean up its coal ash and protect our clean water. Another decade of waiting is unacceptable.

The EIP Lacks Analysis of Existing Information.

As discussed above and in the Cosler Report, TVA already has significant existing data in its possession regarding issues such as hydrogeology, groundwater contamination, and other subjects it is required to study under the Order. Setting aside the vitally important omission of data from the RI and USGS/CAESER, the EIP in general simply identifies and lists existing data sources and states that TVA plans to analyze this existing data over the next year. It should not have taken TVA three years to simply identify existing sources of information. Instead, TVA should have analyzed and discussed what it already knows based on existing data and identified discrete areas for additional investigation. TVA's apparent refusal to date to analyze data already in its possession has resulted in unnecessary delay and will continue to do so with respect to the EIP for the Allen site.

In this EIP and EIPs for the other six sites, TDEC should require TVA to analyze and synthesize data it already possesses *in the EIP itself*, rather than deferring such analysis until later in the process. To the extent that TDEC is concerned about the quality of TVA's existing data, TDEC can identify such concerns as a basis for requiring further investigation. This process should happen at the outset of the EIP, not after the EIP has already been adopted and is being implemented by TVA.

The EIP Artificially Segregates Data and Information Obtained in Other Regulatory Processes.

One of the stated purposes of the Order is to ensure that TVA implements the federal Coal Ash Rule in a manner that ensures coordination and compliance with Tennessee laws governing the management and disposal of coal ash, including the Tennessee Solid Waste Disposal Act, and the Tennessee Water Quality Control Act. But the EIP makes little to no effort to analyze and synthesize data and analysis TVA is required to produce under the federal Coal Combustion Residuals Rule (Coal Ash Rule). The Order includes provisions for

TVA to notify TDEC when TVA posts Coal Ash Rule information pursuant to the Rule. Why isn't this information being incorporated into the EIP? Again, if TDEC has concerns about the quality of TVA's Coal Ash Rule data and its adequacy to comply with TVA's obligations under state law, those concerns should be explicitly identified in the EIP and dealt with through additional investigation. The potentially relevant data sets and analysis from TVA's implementation of the Coal Ash Rule should not simply be ignored or segregated as irrelevant to the project of evaluating the scope of the impacts of TVA's coal ash management practices.

The EIP also does not explain how data and corrective action processes required by the Remedial Investigation will interact with the EIP and corrective action requirements in the Order. Nor does the EIP explain how information TVA discloses and analyzes under NEPA will be considered or integrated into these requirements.[18]

[18] TVA issued a record of decision for closure of the West Ash Pond in July 2016. *See* https://www.tva.gov/file_source/TVA/Site%20Content/Environment/Environmental%20Stewardship/Environmental%20Reviews/Closure%20of%20Coal%20Combustion%20Residual%20Impoundments/2016-0729%20Ash%20Impoundment%20Closure%20Final%20ROD.pdf; *see also* TVA, Final Ash Impoundment Closure Programmatic EIS, Part II Site-Specific Review, Allen Fossil Plant (June 2016), https://www.tva.gov/file_source/TVA/Site%20Content/Environment/Environmental%20Stewardship/Environmental%20Reviews/Closure%20of%20Coal%20Combustion%20Residual%20Impoundments/Final%20EIS%20Part%20II-Allen%20Fossil%20Plant.pdf. TVA has indicated in recent SEC filings that it also intends to prepare NEPA documents related to the closure of the East Ash Pond. *See* Att. 6, Tennessee Valley Authority, U.S. Securities and Exchange Commission, Form 10-Q, 24 (August 2, 2018) ("TVA is expected to begin a NEPA review process at Allen Fossil Plant in October 2018 to analyze closure alternatives to support a final TVA decision on the appropriate closure methodology.")

The Commissioner's Order Process Lacks Transparency and Accessibility of Information.

A stated purpose of the Order is to develop a *transparent* process for investigating and remediating coal ash contamination at the seven sites that are subject to the Order. But most of the correspondence, data, and other information that has been or will be generated is not easily available to the general public.[19] Both TVA and TDEC have well-established websites for hosting large amounts of information. TVA has a CCR Rule compliance website. TDEC Division of Solid Waste has a data viewer. Either of these platforms could be used to post correspondence and comments exchanged between these two public entities regarding implementation of the Order, as well as data that is generated as part of the investigation. Such a publicly-accessible site could also host important technical documents that serve as protocols for TVA's implementation of the Order. This is important because, in response to a recent open records request, the Southern Environmental Law Center learned that not even TDEC appears to have all of the relevant protocols TVA will employ in its investigation.[20] TDEC provided only ten of the seventeen technical protocols we requested, and did not have TVA's protocols for, among other things, sediment sampling and obtaining biological samples, such as mayflies and fish.

The EIP also states that TVA will submit periodic EIP progress reports. These reports are described as providing updates on timelines and milestones. To keep the public and TDEC adequately informed of current environmental conditions at the site, the reports should include interim analytical results and data. Such periodic technical updates are imperative to ensure public health and environmental quality. For example, TVA withheld from TDEC and the public for several months disclosure of arsenic contamination at 300 times the groundwater protection standard at the Allen Fossil Plant, even though the contamination put the

[19] Despite the stated intent of the Commissioner's Order to provide a transparent process, to date, Protect Our Aquifer and Sierra Club have obtained access to most information related to the RI and EIP through public records requests independent of the Commissioner's Order process itself.
[20] Att. 7, Letter from Christina Reichert, SELC, to Joe Sanders, TDEC, re: Tennessee Open Records Act Request for Documents Cited in TVA Cumberland Environmental Investigation Plan, Revision 3 (May 8, 2018); Att. 8, Email from Melanie Vanderloop, TDEC, to Christina Reichert, SELC, re: Public Records Request (May 10, 2018).

City of Memphis's drinking water source at risk. We strongly urge TDEC to prevent this type of behavior from recurring by requiring greater transparency in the EIP process.

Sincerely,

Amanda Garcia
Senior Attorney
Southern Environmental Law Center

/s with permission
Ward Archer
President
Protect Our Aquifer

/s with permission
Scott Banbury
Conservation Program Coordinator
Tennessee Chapter Sierra Club

Attachment 1, Cosler Report, attached to this letter.

Additional attachments available via ShareFile at the following link:
https://southernenvironment.sharefile.com/d-s45c309aecc543f1a

ATTACHMENT 1

Risk of Contamination of the Memphis Sand Aquifer Allen Fossil and Combined-Cycle Combustion Turbine Plants: Review and Analysis of the Environmental Investigation Plan, Remedial Investigation, and Interim Remedial Action

Memphis, Tennessee

Douglas J. Cosler, Ph.D.

Chemical Hydrogeologist
Adaptive Groundwater Solutions LLC
Charlotte, North Carolina

November 26, 2018

Executive Summary

The Environmental Investigation Plan, revision 2, for the Allen Fossil Plant (EIP) repeatedly refers to data collected and analyses performed pursuant to the Remedial Investigation (RI). See, for example, Sections 3.3 (Groundwater Monitoring), 3.8 (Migration of Constituents via Groundwater and Identification of Uppermost Aquifer), 4.3.3, 4.3.4, 4.3.5, 4.3.6, and 4.3.7 (Groundwater Monitoring and Mapping Requests). The RI data and analyses are not, however, included in the EIP. Instead, in the EIP, TVA states: "Based on the similarities between the RI activities and the TDEC Order EI objectives, TVA plans to provide the results of the investigations in the TDEC Order EAR." [EIP at page 18 in Section 3.3.1]. This report addresses fundamental flaws in the RI that also affect data collection and analyses referenced in the EIP.

The RI was conducted pursuant to the request of the Tennessee Department of Environment and Conservation (TDEC) after Tennessee Valley Authority (TVA) reported elevated concentrations of arsenic and other Coal Combustion Residual (CCR) constituents in the Mississippi River Valley Alluvial (MRVA) aquifer at the Allen Fossil (ALF) Plant, adjacent to the new Allen Combined Cycle (ACC) Plant in southwest Memphis, Shelby County, Tennessee (Figure 1). In particular, TDEC requested that TVA evaluate the effects of pumping the five new Memphis aquifer production wells installed at the ACC Plant to evaluate potential hydraulic interconnection of the MRVA and Memphis Sand aquifers and possible leakage of groundwater from the overlying MRVA aquifer into the Memphis Sand. As a result, TVA requested that the U.S. Geological Survey (USGS) and the University of Memphis' Center for Applied Earth Science and Engineering Research (CAESER) jointly investigate the hydrogeology and groundwater conditions in the area. TVA also retained Stantec to conduct a Remedial Investigation (RI) and prepare a RI Report (Stantec, 2018a) for the TVA ALF Plant that discusses the nature and extent of potential contamination in the MRVA aquifer.

As TVA acknowledges in the EIP, the RI and the data upon which it is based are vitally important to accomplishing the objectives outlined in the Commissioner's Order. These objectives include to (1) fully identify the extent of soil, surface water, and groundwater contamination by CCR constituents (Section VII.A.d); (2) adequately characterize the extent of CCR contamination in soil, surface water, and groundwater at [Allen] (Section VII.A.e); (3) remediate CCR-contaminated soil, surface water, and groundwater at [Allen] (Section VII.A.f.ii); and (4) protect public and private water supplies from CCR contamination (Section VII.A.f.v). In my opinion, to achieve the stated objectives of the EIP—to fully identify the extent of soil, surface water and groundwater contamination by CCR constituents at Allen—it is vitally important to disclose and understand the data provided through the RI process and its implications.

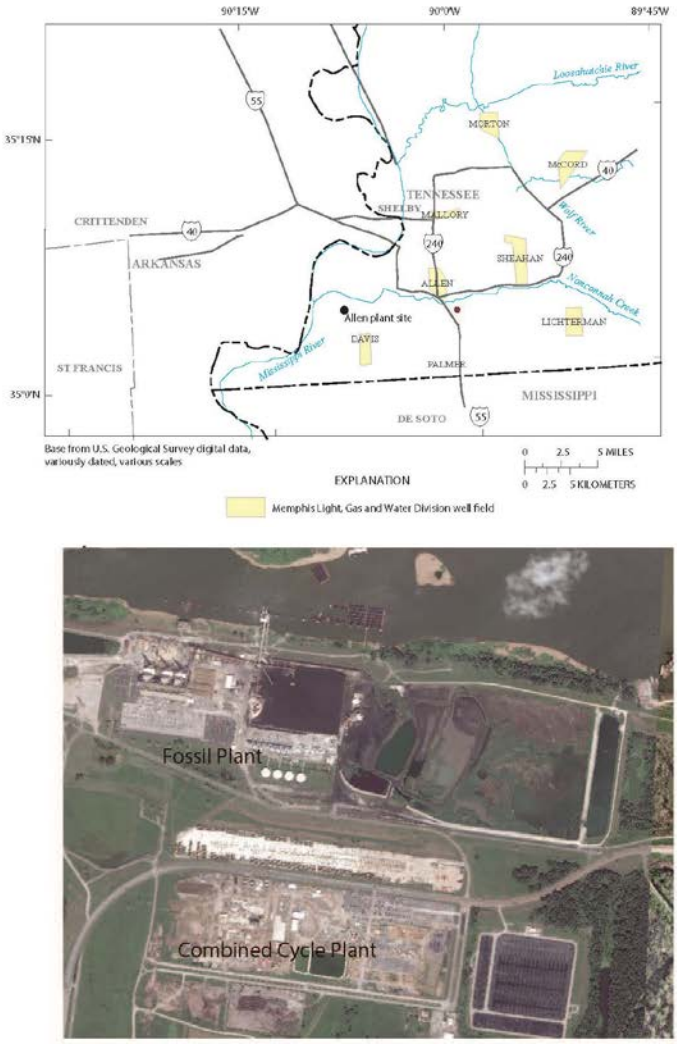

Figure 1
Locations of the ALF and ACC Plants in Southwest Memphis, Tennessee (Stantec, 2018a)

In the report that follows, I describe my independent review of the data collected and analyses performed pursuant to the RI and the related USGS-CAESER pumping test in the Memphis Sand. In particular, I evaluate the implications of the data for the risk of contamination of the Memphis Sand Aquifer by CCR constituents present in the MRVA aquifer at the Allen Plant. I also evaluate the risk of contamination of McKellar Lake via groundwater transport of CCR constituents. Data sources that I evaluated include the RI report, USGS-CAESER pumping test report (USGS, 2018), and various referenced USGS regional groundwater investigations and groundwater modeling studies.

My independent evaluation of the RI and USGS-CAESER data leads me to make the following findings:

- There is a hydraulic connection between the MRVA Aquifer and the Memphis Sand Aquifer;
- The areal extent of the breach in the confining layer that is causing the hydraulic connection may be much larger than the USGS-CAESER report initially indicated;

- The degree of hydraulic connection, based on pumping-induced water-level reductions in the MRVA Aquifer, may be much stronger than the USGS-CAESER report initially indicated;
- There are significantly elevated concentrations of boron and sulfate, CCR indicator constituents, deep in the MRVA Aquifer at the Allen Plant;
- These boron and sulfate tracer concentration distributions indicate that long-term downward groundwater flow has been occurring in the Alluvial aquifer in the Allen Plant area;
- Shallow and deep vertical hydraulic gradients within the MRVA Aquifer, as well as significantly higher hydraulic heads in the MRVA aquifer compared to the Memphis Sand, also indicate downward groundwater flow;
- Age dating of groundwater (e.g., tritium analyses by USGS, 2018) and elevated sulfate concentrations in Memphis-Sand Production Well 5 indicate that mixing of MRVA Aquifer groundwater with Memphis Sand Aquifer water is occurring in the vicinity of the Allen Plant and that potential ongoing transport of CCR constituents from the MRVA into the Memphis Sand Aquifer is occurring;
- TVA's extraction of Memphis Sand Aquifer groundwater from the Davis well field will result in long-term drawdown in the Memphis Sand under the Allen Plant and increase downward vertical hydraulic gradients from the MRVA to the Memphis Sand;

Based on these findings, I recommend the following significant changes in the RI and EIP:

- Require TVA to incorporate the conclusions of the USGS-CAESER report (USGS, 2018, page 44) into the RI and EIP;
- Require TVA to implement the recommendations of the USGS-CAESER report for future data collection and analysis (USGS, 2018, page 44), including more accurate characterization of the location(s) and extent(s) of leakage/breach features in the confining unit and more accurate quantification of the fluxes of groundwater and dissolved CCR constituents from the MRVA Aquifer to the Memphis Sand Aquifer;
- Install monitoring well clusters (shallow, intermediate, and deep) within the footprint of the East Ash Pond and within the footprint of the West Ash Pond to adequately assess the spatial distribution of CCR contamination (including all Appendix III and IV constituents), the true groundwater velocity distribution (vertical and horizontal), and chemical transport rates;
- Properly average water-level measurements for monitoring wells, McKellar Lake, and the East Ash Basin water surface to allow construction of accurate mean hydraulic head maps that can reliably be used to analyze long-term chemical transport in the subsurface;
- Engage in site-specific characterization of the soil-water partition coefficient for the various CCR constituents (including boron, sulfate, and all other Appendix III and IV constituents) so that chemical transport rates can be estimated;
- Implement three-dimensional groundwater flow and chemical transport modeling that takes into account the above data (including all Appendix III and IV constituents); and
- Redesign the interim remedial action as further discussed in this report.

Investigations of Leakage from MRVA Aquifer into Memphis Sand

The USGS has conducted multiple hydrologic investigations which evaluate the potential for vertical groundwater flow and chemical transport between the MRVA and the Memphis Sand Aquifer (i.e., inter-aquifer exchange of groundwater) in the vicinity of the Allen plants (USGS, 1986; USGS, 1990; USGS, 1992; USGS, 1995; USGS, 2016; USGS, 2018). [Note: Vertical geologic cross-sections showing the alluvial and Memphis Sand aquifers, separated by a confining unit (absent in some areas), are presented below]. This issue is the subject of EIP Sections 3.3.5, 3.3.6, 4.3.3, 4.3.6, 4.3.7, and 4.4.2.

The 1986 USGS investigation analyzed the following types of data in the Memphis area: geologic information; groundwater-level data; carbon and hydrogen isotope concentration data; and groundwater temperature data. One of the key findings of the 1986 USGS study was that the hydraulic head (i.e., groundwater "driving force") in the uppermost water-table aquifers (including the MRVA) is greater than or equal to the hydraulic head in the Memphis Sand Aquifer in the Memphis urban area (Figure 2), including

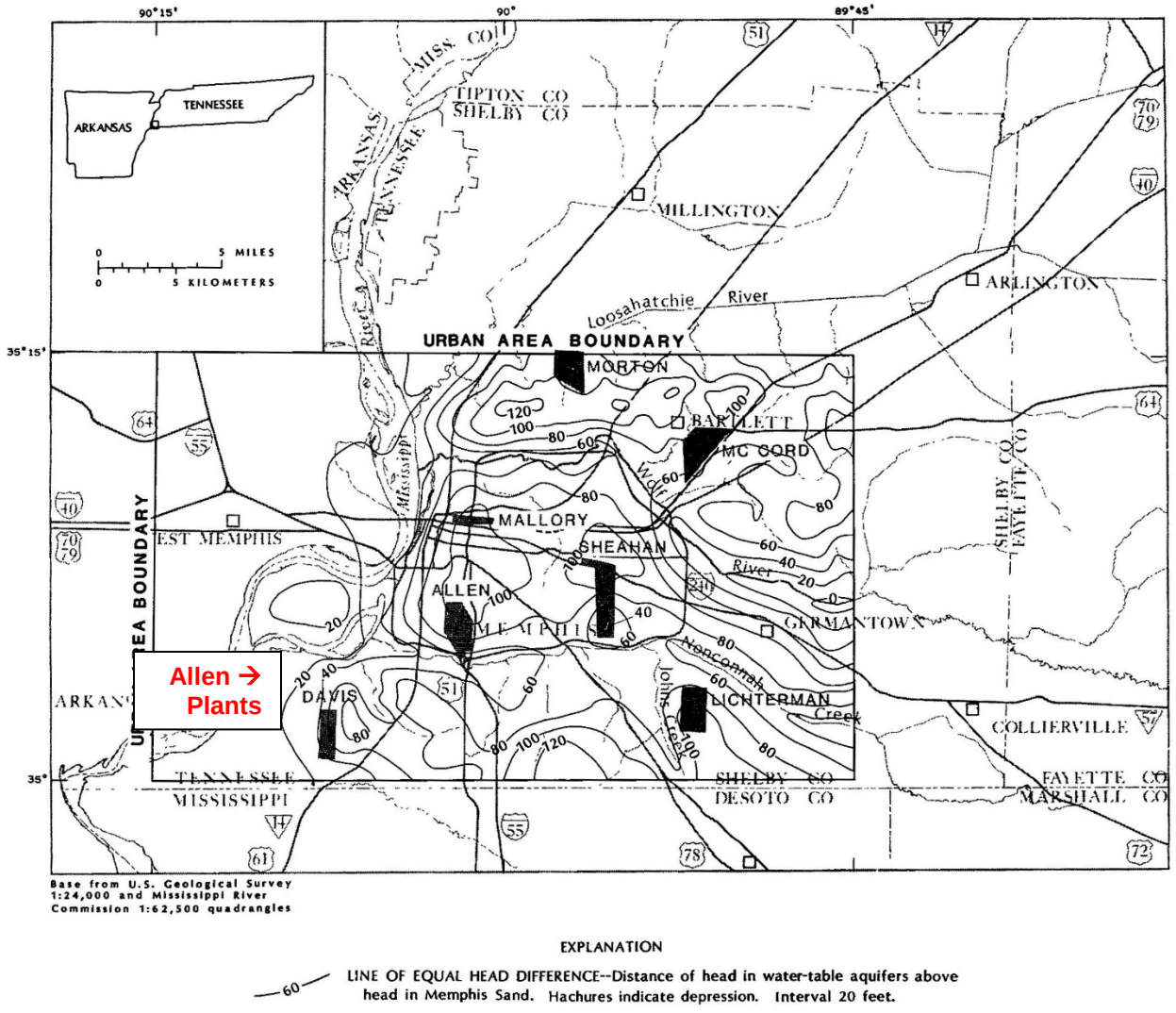

Figure 2
Hydraulic Head Differences between the Water-Table Aquifers and the Memphis Sand in the Memphis Urban Area, Fall 1984 (from USGS, 1986; locations of Memphis Light, Gas, and Water well fields are shown as black-filled polygons)

the Allen site. Specifically, the water-table aquifer hydraulic heads range from about 20 feet (e.g., near the Allen site) to 130 feet greater than the heads in the Memphis Sand. Therefore, throughout this area the vertical hydraulic gradient is downward toward the Memphis Sand, as is the associated vertical direction of groundwater flow. The hydraulic-head differences are greater in areas where water-supply

wells extract significant amounts of groundwater from the Memphis Sand and generally smallest near the Mississippi River and major streams, where the water-table elevation (e.g., MRVA aquifer near the Allen plants) is lower. The USGS (1986) has also identified localized reductions in hydraulic head in the upper alluvial aquifers due to Memphis-Sand groundwater extraction in areas where breaches in the confining layer (separating the alluvial and Memphis Sand aquifers) have been identified (further discussed below). Geothermal gradients computed from groundwater temperature data confirm that vertical leakage occurs from the water-table aquifers through the Jackson-upper Claiborne confining unit to the Memphis Sand. This groundwater leakage rate is greatest in areas where the hydraulic head in the Memphis Sand is depressed due to groundwater extraction. The vertical distribution of carbon-14 concentrations in groundwater generally confirm this vertical-leakage pattern.

The 1990 and 1995 USGS investigations identified "windows", or discontinuities, in the upper Claiborne confining unit separating the MRVA and Memphis aquifers (Figure 3). One inferred window is located

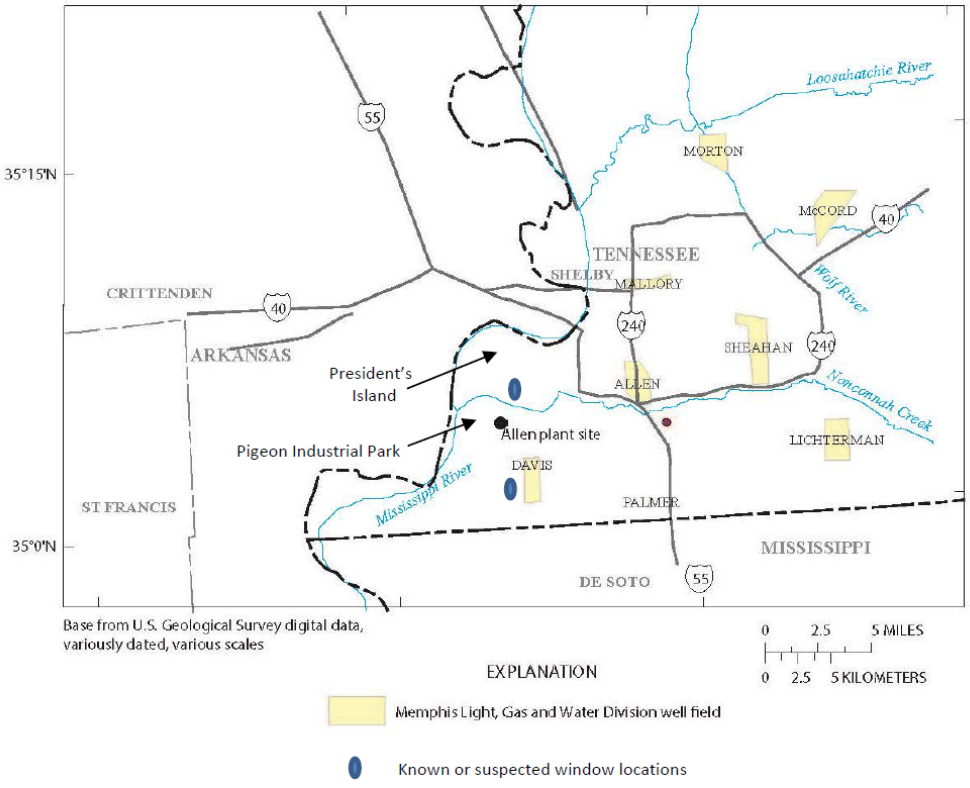

Figure 3
Known or Suspected Windows in Upper Claiborne Confining Unit
(from Appendix E of RI Report)

beneath President's Island one mile northeast of the Allen plants. A second window was identified about three miles south of the Allen plants and west of the Davis Well Field, where downward groundwater leakage from the MRVA to the Memphis aquifer was documented (USGS, 1995; Koban et al., 2011). As summarized in Appendix E of the Remedial Investigation report (Stantec, 2018a), downward leakage

from the shallow water-table aquifers into the Memphis Sand Aquifer has been identified at several other locations in the Memphis area based on shallow-aquifer water-table lowering, water-quality changes in the Memphis aquifer, and/or hydrologic tracer studies (USGS, 1986; USGS, 1992; Larsen et al., 2003; Gentry et al., 2005; Gentry et al., 2006; Ivey et al., 2008; Larsen et al., 2013; Larsen et al., 2016).

The 2016 USGS report summarizes the results of a regional groundwater modeling study in which the USGS Mississippi Embayment Regional Aquifer Study (MERAS) groundwater-flow model (Clark and Hunt, 2009) was used to simulate the potential effects (i.e., hydraulic-head decreases caused by pressure reductions related to pumping) of future groundwater withdrawals from the Memphis Sand Aquifer at the proposed Allen combined-cycle plant (potential groundwater-quality changes were not analyzed). The groundwater extraction scenario for the simulation was a 30-year average withdrawal of 2,500 gallons per minute (gpm), followed by a 30-day maximum expected withdrawal rate of 5,000 gpm. The simulated hydraulic head reduction (Figure 4) in the Memphis Sand after the average 30-year period was as large

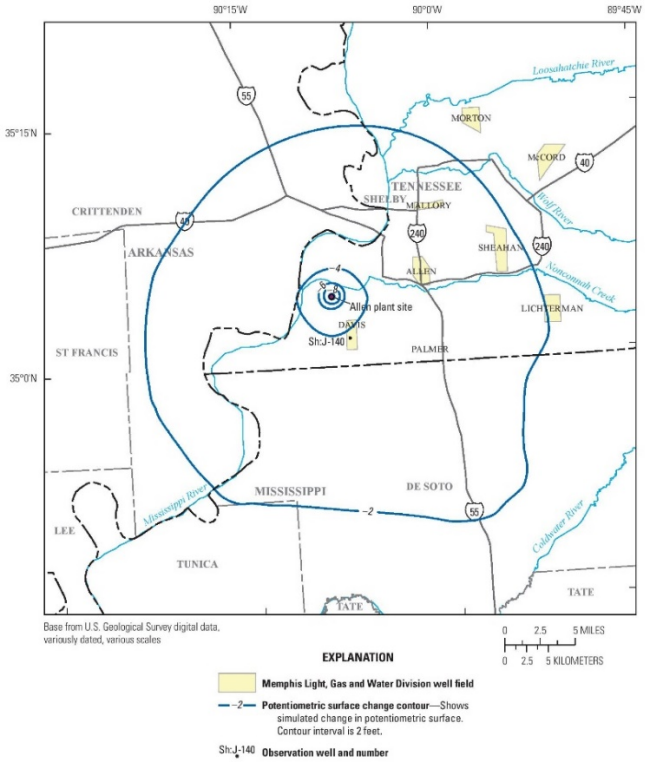

Figure 4
Simulated Hydraulic Head Change in Memphis Sand Aquifer
at End of TVA Withdrawal Scenario for ACC Plant (from USGS, 2016)

as 7 feet; the Memphis-Sand head reductions after the 30-day maximum-withdrawal period were up to 11 feet. Hydraulic head reductions in the shallow MRVA aquifer did not exceed one foot. Note that the MERAS model did not incorporate recent hydrogeologic information from the RI or the 2018 USGS-CAESER study (USGS, 2018).

USGS-CAESER Hydrogeologic Investigation and Groundwater-Pumping Test

Introduction

The objectives of the USGS-CAESER investigation were to evaluate (i) the potential for hydraulic connection between the MRVA and Memphis Sand aquifers and (ii) the potential for water-quality impacts in the Memphis Sand Aquifer due to groundwater leakage from the MRVA aquifer. In addition to the MRVA-aquifer monitoring wells installed by Stantec for the RI, four deep stratigraphic borings were also drilled into the upper Memphis aquifer to determine the thickness of the confining unit. USGS-CAESER correlated geophysical logs from TVA production wells, and other historical wells in the study area, with site boring logs to develop a conceptual hydrogeologic model of the study area. Field investigations also included groundwater sampling and a 24-hour pumping test during which as much as 5,000 gpm was extracted from the Memphis aquifer. The results of the USGS/CAESER investigation are presented in Appendix E of the RI report (Stantec, 2018a) and by USGS (2018). The following is my discussion of specific investigation results that are particularly relevant to the evaluation of the risk of groundwater contamination in the Memphis Sand Aquifer by CCR constituents present in the MRVA aquifer in the vicinity of the Allen plants.

Results

The most important finding of the USGS/CAESER investigation is that the MRVA and Memphis Sand Aquifers are hydraulically interconnected in the Allen plant area due to the presence of a window or breach in the confining (upper Claiborne) unit separating the two aquifers. Significantly, during the Memphis-aquifer pumping test hydraulic head reductions (drawdown) were observed in several overlying MRVA monitoring wells at both Allen plants. Figure 5 is a contour map of estimated maximum drawdown in MRVA wells related to the pumping test. Drawdown in the MRVA aquifer ranged from 0.1 feet near McKellar Lake to 0.5 feet in the southeastern part of the ALF Plant and along the eastern part of the ACC Plant. It is important to note, per my discussion below, that no drawdowns at any MRVA monitoring wells should have been measured if the confining unit was continuous across the site. Therefore, as USGS/CAESER conclude, these Alluvial aquifer drawdowns indicate that an area of downward leakage from the MRVA to the Memphis Sand aquifer is present in this general vicinity.

Figure 5
Estimated Drawdown in MRVA Aquifer Monitoring Wells During Memphis Aquifer Pumping Test (values in black, contours in blue; from USGS, 2018)

The hydraulically-identified window, or breach, in the confining unit is consistent with the findings of the refined site geologic conceptual model developed by USGS/CAESER. Figure 6 shows the locations of geologic cross-sections developed as part of the conceptual model for the ALF and ACC Plants area. Cross-sections A-B, C-B, and D-E are presented in Figures 7, 8, and 9 respectively. As shown, the Claiborne confining unit thins in an east-southeasterly direction across the site (e.g., questionable thickness at boring location ALF-212). As shown in Figure 6 the investigation also identified two geologic faults (a discontinuity in geologic units across which a significant vertical displacement has occurred), one which extends southwest to northeast across the site and may contribute to the hydraulic connection between the MRVA and Memphis aquifers.

Discussion

To further illustrate why the Claiborne confining unit would hydraulically isolate the MRVA and Memphis Sand aquifers if it was continuous across the site I used an analytical (exact mathematical) solution for one-dimensional groundwater flow (Crank, 1975) through a homogeneous porous medium to compute the transient, vertical hydraulic head reduction (drawdown) in a clay layer (hydraulic conductivity of 1E-7 cm/sec) in response to a 10-foot drawdown (head reduction) in the underlying aquifer (Memphis Sand).

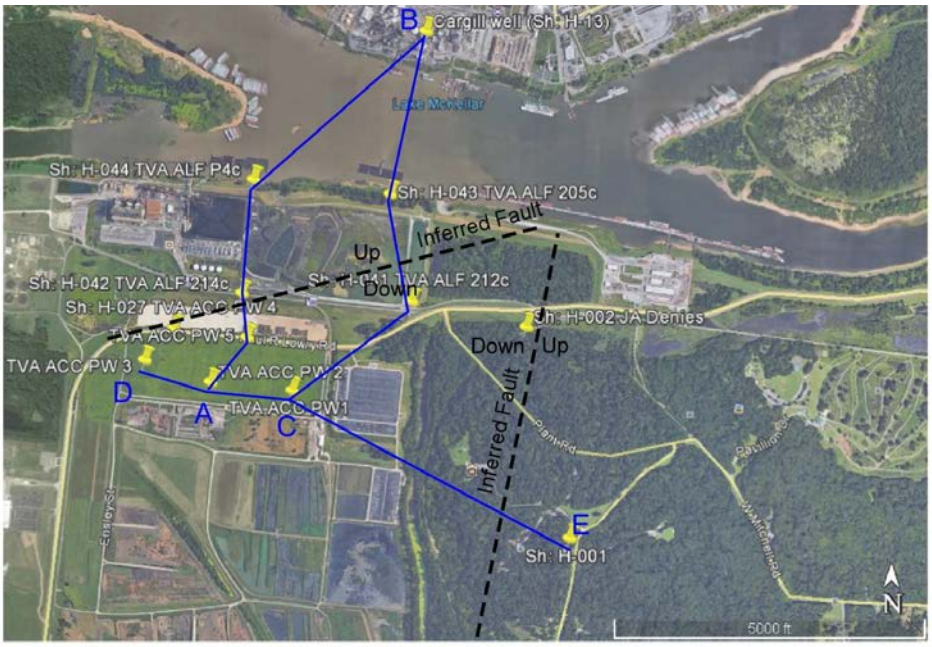

Figure 6
Geologic Cross-Section Locations and Inferred Faults in ALF and ACC Plants Area
(from USGS, 2018)

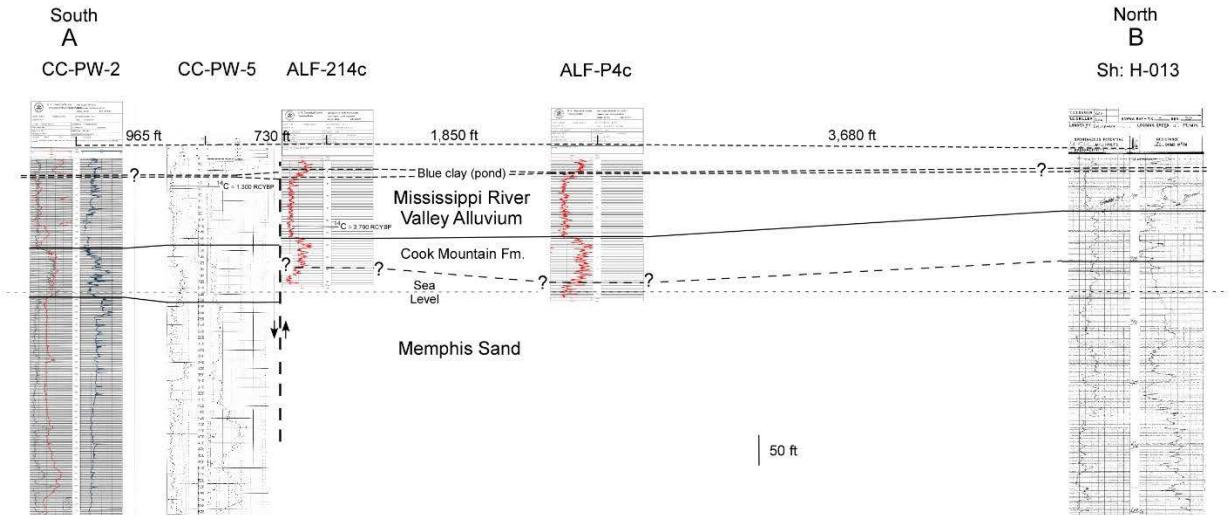

Figure 7
Geologic Cross-Section A-B in ALF and ACC Plants Area
(from USGS, 2018)

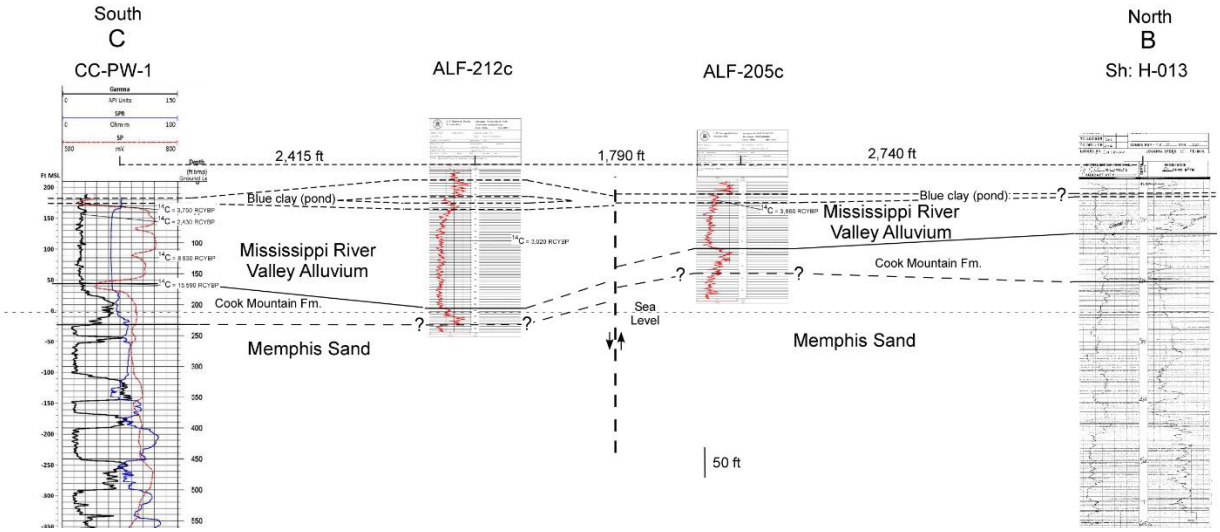

Figure 8
Geologic Cross-Section C-B in ALF and ACC Plants Area
(from USGS, 2018)

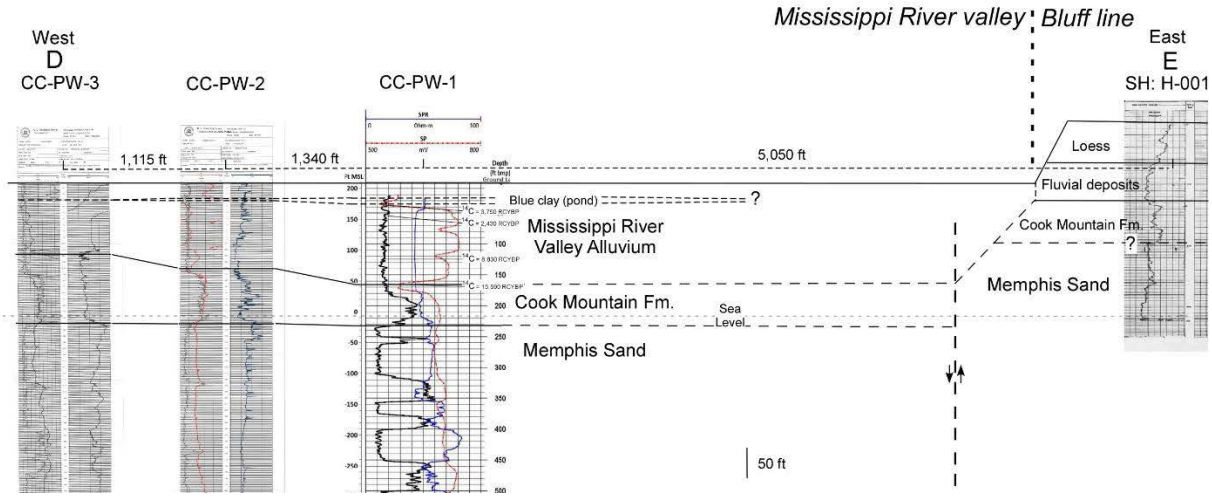

Figure 9
Geologic Cross-Section D-E in ALF and ACC Plants Area
(from USGS, 2018)

The simulated confining-unit drawdown as a function of distance above the base of the clay layer (Figure 10) shows that the drawdown after 24 hours (USGS pumping test duration) would be less than about 0.01 inch at a distance of two inches into the clay due to a constant 10-foot drawdown at the base of the clay layer. This simple example illustrates why the drawdown in the MRVA aquifer in response to groundwater withdrawal from the Memphis aquifer should have been zero.

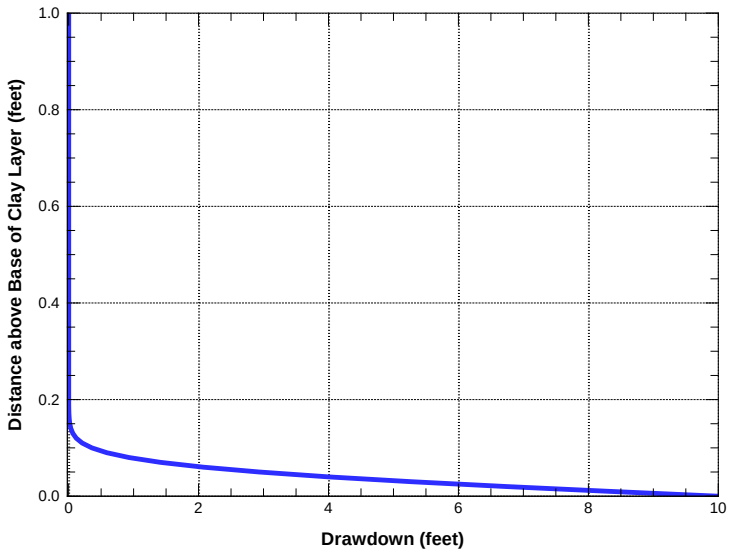

Figure 10
Drawdown in Clay Confining Layer after 24 Hours

I also further analyzed the magnitudes of the measured MRVA pumping-test drawdowns based on their locations relative to the Mississippi River, McKellar Lake, and ponded water in the East Ash Disposal Area. It is well-know that drawdown is reduced in the vicinity of a constant-head or leaky-type boundary (e.g., river, lakes, and/or impoundments) due to recharge from the waterbody in response to hydraulic head reductions in the aquifer (Bear, 1979; Freeze and Cherry, 1979). For example, as shown in Figure 5 a large portion of the area with measurable pumping-test drawdown in the MRVA aquifer is either located close to McKellar Lake or underlies impoundments in the East Ash Disposal Area. Therefore, depending on the distance of an MRVA monitoring well from one of these waterbodies, it is expected that the true hydraulic interconnection (as measured by MRVA drawdown) between the MRVA and Memphis aquifers is greater than that suggested by Figure 5.

To illustrate this point I computed drawdown versus distance and time in a hypothetical confined aquifer with similar hydraulic conductivity and thickness (i.e., transmissivity) as the Memphis aquifer due to a groundwater extraction rate of 5,000 gpm (similar to the USGS-CAESER pumping test). I used the Theis solution for drawdown due to groundwater from a fully-penetrating pumping well located in an infinite homogeneous confined aquifer (Bear, 1979). Figure 11 is a plot of the simulated drawdowns versus time and distance from the pumping well for two scenarios: with and without a constant-head boundary at a distance of 2,600 feet from the extraction well. Figure 11 also contains a graph of the ratio of drawdown without the waterbody to the drawdown with the hydraulic effects of the waterbody (constant-head in this case, which reduces the drawdown). This hypothetical scenario is designed to approximately mimic the 24-hour pumping test and the hydraulic effects of McKellar Lake (with the assumption that the lake acts as a constant-head boundary for illustration purposes). The drawdown ratio graphs show that at about

the midpoint between the pumping well and waterbody (~1,300 feet) the hydraulic impacts of pumping (as measured by drawdown) would be almost twice as large if the assumed waterbody was not present. Moreover, the hydraulic effects of the waterbody significantly increase as the distance between the waterbody and the monitoring point decreases. For example, at a distance of 300 feet from the waterbody (2,300 feet from the extraction well) the measured drawdown would be expected to be on the order of five times greater without the hydraulic impact of the waterbody. Therefore, it is very possible that (i) the areal extent of MRVA drawdown during the Memphis-aquifer pumping test is larger than that indicated in Figure 5 (i.e., the window in the confining unit may be much larger than Figure 5 suggests) and (ii) the drawdown values shown in Figure 5 may have been much larger if the waterbodies and impoundments were not present (i.e., the hydraulic interconnection between the MRVA and Memphis Sand aquifers may be stronger than the Figure 5 results indicate).

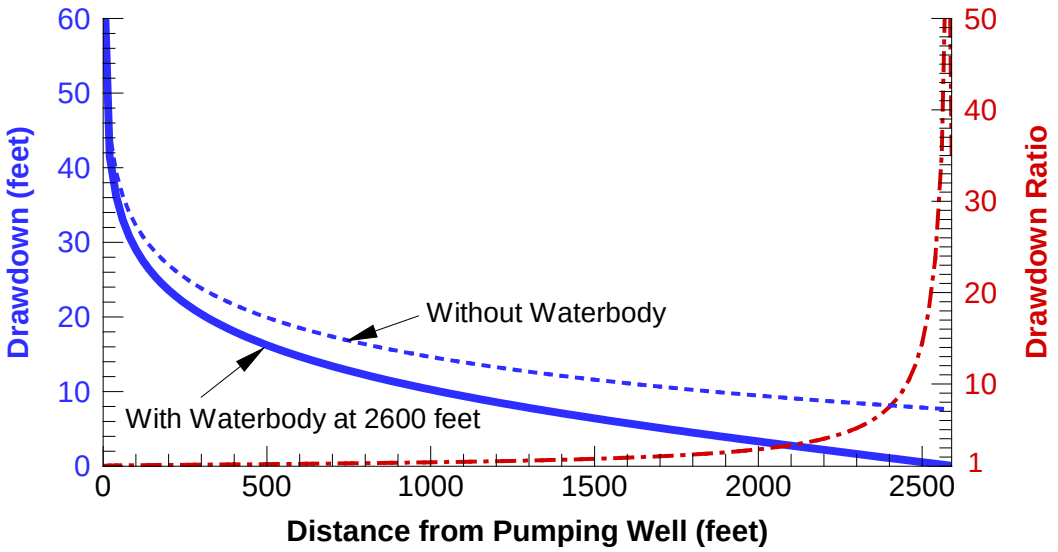

Figure 11
Drawdown vs. Distance from Pumping Well with and without Constant-Head Boundary Condition at 2,600 Feet

Boron and Sulfate Transport in the MRVA and Memphis Sand Aquifers

Introduction

Boron and sulfate are commonly used as environmental tracers to monitor the fate and transport of CCR constituents in groundwater (Ruhl et al., 2014). The reasons for this are primarily because these two constituents are present at high concentrations in CCR source areas, and they are very mobile in groundwater relative to other CCR constituents. In contrast, most metals (e.g., arsenic and lead) migrate much slower (e.g., 10-100 times, or more) than the groundwater pore velocity due to a very strong

tendency of the metals to bind, or adsorb, to immobile soil grains (Hemond and Fechner, 1994). The fact that boron and sulfate concentrations in CCR source areas are typically large leads to more reliable detection of the leading edge of a CCR plume despite dilution mechanisms (e.g., mixing and dispersion) that reduce groundwater concentrations as a function of transport distance and time. Environmental tracers such as boron and sulfate are also excellent tools for accurately determining the long-term (e.g., decades), average three-dimensional groundwater flow directions in an aquifer and the relative importance of horizontal and vertical flow because their aqueous-phase concentration distributions are the direct result of the mean groundwater velocity field. This tracer attribute is particularly useful at the ALF and ACC Plants site where (i) short-term hydraulic-head variations in the MRVA aquifer, induced by stage fluctuations in McKellar Lake and the Mississippi River, have made it difficult to determine the true mean groundwater flow directions based on the limited hydraulic data set and (ii) the potential for leakage and chemical transport from the MRVA aquifer to the Memphis Sand are relevant questions that are currently being evaluated. This issue is the subject of EIP Sections 3.3.5, 3.3.6, 4.3.3, 4.3.6, 4.3.7, and 4.4.2.

Boron and Sulfate Transport within the MRVA Aquifer in the ALF and ACC Plants Area

In Figures 12 and 13 I have plotted the measured boron and sulfate concentrations based on filtered groundwater samples from several MRVA monitoring wells (MW) and Direct-Push Technology (DPT) borings along east-west cross-sections on the northern and southern parts of the ALF-ACC Plants area, respectively. These figures also show arsenic concentration data and interpreted contours developed for the RI report. Notably, high boron and/or sulfate concentrations extend from shallow source areas down to the bottom (or near-bottom) of the MRVA aquifer (e.g., MWs ALF-203A, ALF-204A, ALF-205A, P-4, ALF-202A, ALF-201A). In the northern cross-section (Figure 12) boron and sulfate concentrations in deep groundwater are as large as 340 – 6,330 μg/L and about 23,000 – 85,000 μg/L, respectively. In the southern cross-section (Figure 13) boron and sulfate concentrations in deep groundwater are as large as 2,280 μg/L and about 35,000 – 70,000 μg/L, respectively. High sulfate concentrations were also detected at depth in the MRVA aquifer in ACC monitoring wells ACC-005-A (32,000 – 64,700 μg/L) and ACC-003-A (12,000 – 23,100 μg/L) (see RI Tables 6-13,a,b,c). These concentrations are significant relative to background levels. As reproduced in Table 1, the 2017 Annual Groundwater Monitoring Report (TVA, 2018a) for the ALF Plant indicates average (November 2016 to August 2017) boron and sulfate background concentrations of approximately 78 and 5,700 micrograms per liter (μg/L). The sulfate and boron concentrations at depth also represent a large percentage of the source concentrations. As illustrated in Figures 12 and 13, and ash porewater DPT data (RI report Fig. 3-1), source-area boron and sulfate concentrations in groundwater are generally in the ranges of 6,000 - 12,000 μg/L and 100,000 - 200,000 μg/L, respectively. Assuming one percent of the source-area concentrations as representative of the leading edge of the CCR plume (e.g., refer to analytical solutions of the one-dimensional advection-dispersion equation presented by Bear, 1979), equivalent “transport-based” threshold values would

correspond to boron and sulfate concentrations ranging from 60 - 120 µg/L and 1,000 - 2,000 µg/L, respectively. These “plume leading-edge” indicator concentrations are similar in magnitude to the respective measured background levels.

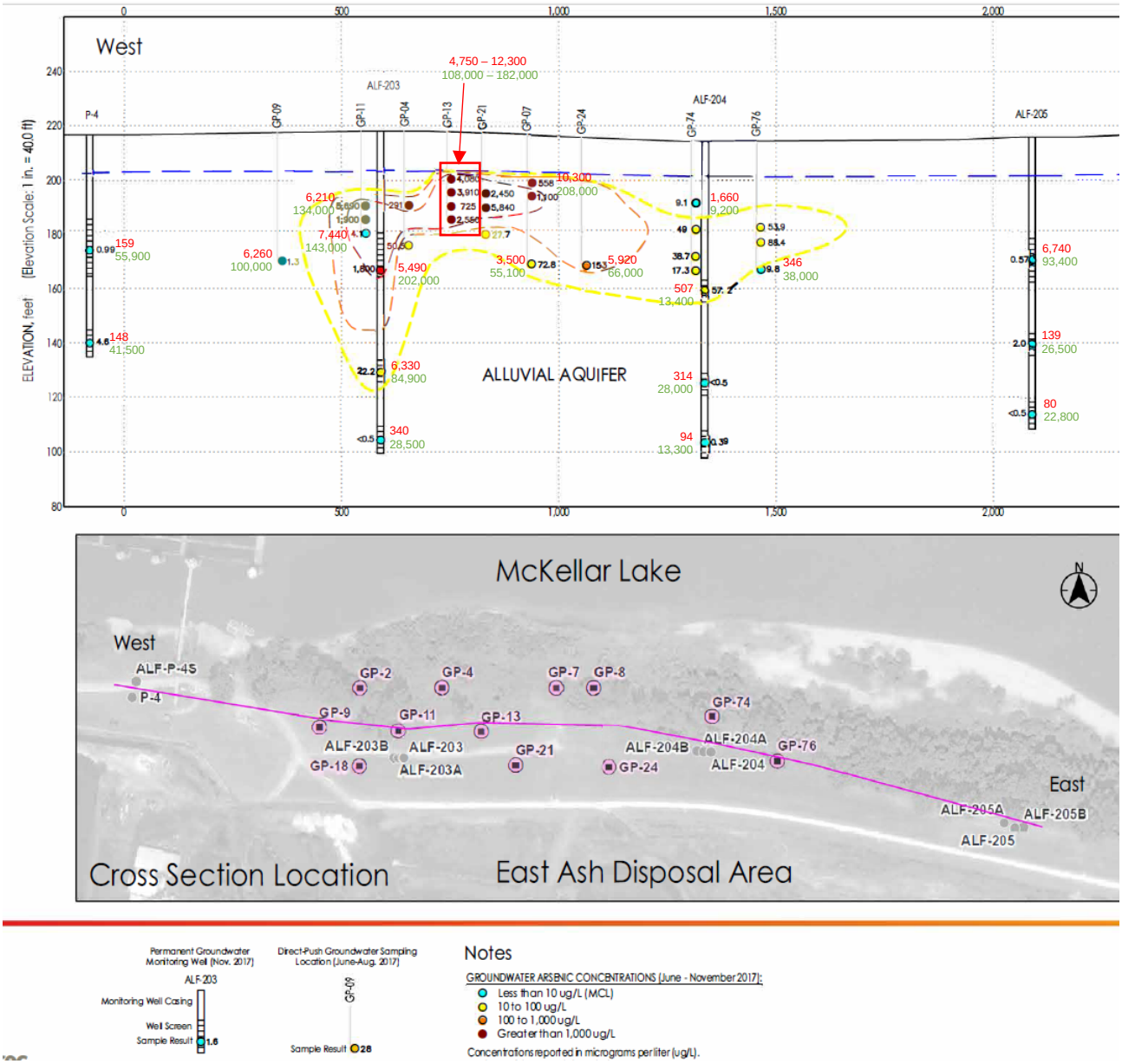

Figure 12
Arsenic (black), Boron (red), and Sulfate (green) Concentrations in Groundwater (Filtered)
East-West Cross-Section in Northern ALF and ACC Plants Area
(based on Fig. 6-20a in RI Report; Stantec, 2018a)

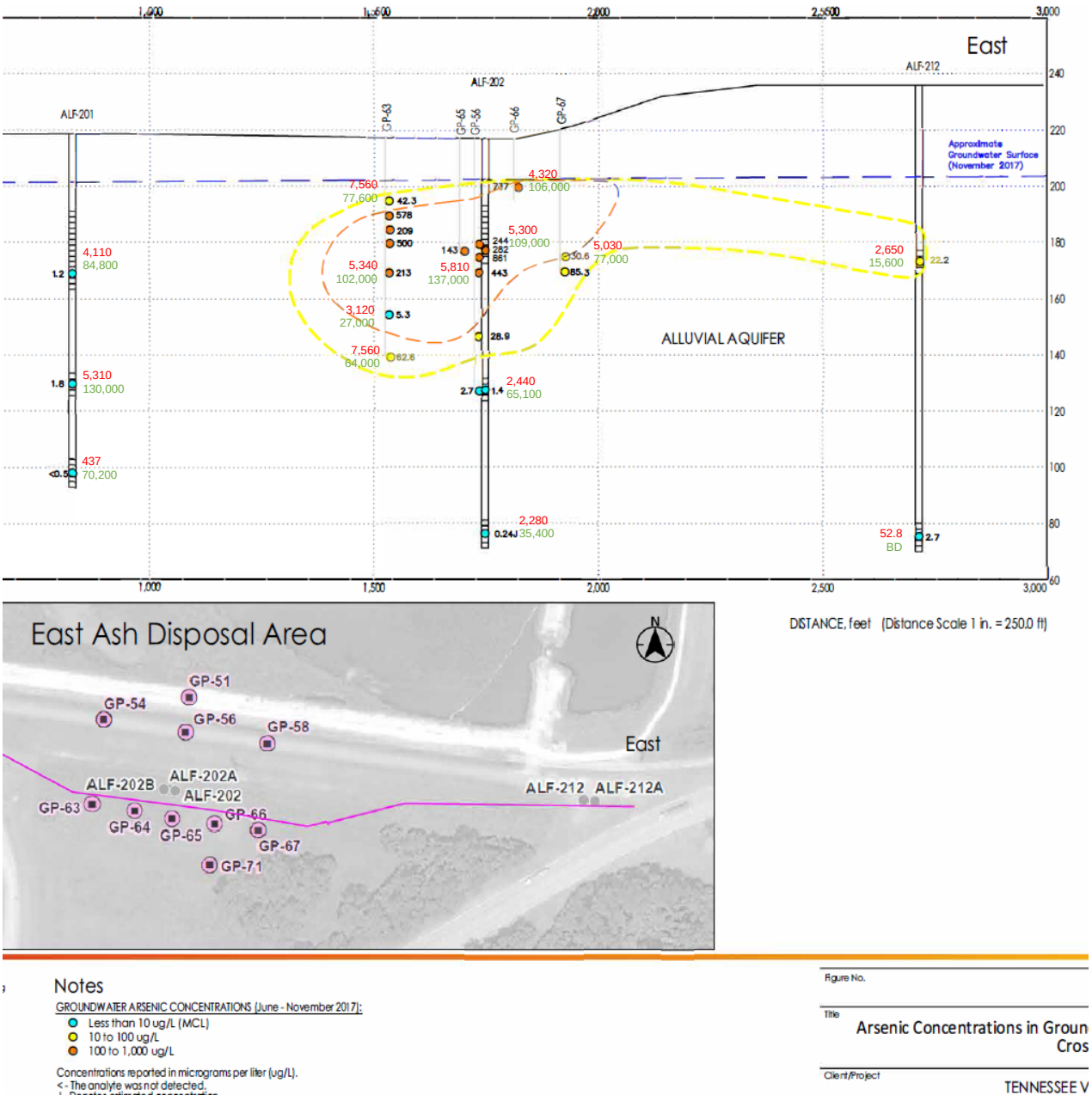

Figure 13
Arsenic (black), Boron (red), and Sulfate (green) Concentrations in Groundwater (Filtered)
East-West Cross-Section in Southern ALF and ACC Plants Area
(based on Fig. 6-20b in RI Report; Stantec, 2018a)

Therefore, using both background and source-area concentrations (i.e., transport-based threshold values) as a comparison, the site groundwater analytical data demonstrate that a long-term, downward component of groundwater transport has resulted in the migration of aqueous-phase boron and sulfate plumes to near the base of the MRVA alluvial aquifer. For example, boron levels in groundwater from the deepest alluvial-aquifer (MRVA) monitoring wells are typically a factor of 5 to 30 times greater than the background concentration. Similarly, sulfate levels in groundwater near the base of the MRVA aquifer are

typically a factor of 5 to 12 times greater than the background concentration. Relative to shallow-depth MRVA groundwater concentrations, this deep boron/sulfate contamination is generally about 10-35 percent and 25-50 percent of the boron/sulfate source-area concentrations, respectively, which is a very strong indicator that these deep boron/sulfate detections are related to CCR source areas. Moreover, if the predominant flow directions in the MRVA aquifer were horizontal or upward (e.g., near McKellar Lake) as concluded in the RI report, these high boron/sulfate concentrations would not be present at depth in the aquifer because vertical mixing due to transverse dispersion (assuming predominantly horizontal flow) is known to be very small (Gelhar et al., 1992; Zheng et al., 2010; Sudicky and Illman, 2011; Siegel, 2014) and would not cause such deep contamination. Specifically, the boron and sulfate tracer concentration distributions indicate that long-term downward groundwater flow (i.e., solute advection) has been occurring in the ALF-ACC Plants area.

Table 1
Background Groundwater Sampling Results
ALF Plant (from TVA, 2018a)

Monitoring Well		ALF-210																					
Sample Date		15-Nov-16		30-Jan-17		28-Feb-17		28-Mar-17		18-Apr-17		09-May-17		13-Jun-17		13-Jul-17		18-Jul-17		23-Aug-17	
Sample Type		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline		Baseline	
Location/Well ID		ALF-210		ALF-210		ALF-210		ALF-210		ALF-210		ALF-210		ALF-210		ALF-210		ALF-210		ALF-210	
Sample ID		ALF-GW-014-11152016		ALF-GW-014-01302017		ALF-GW-014-02282017		ALF-GW-014-03282017		ALF-GW-014-04182017		ALF-GW-014-05092017		ALF-GW-014-06132017		ALF-GW-014-07132017		ALF-GW-014-07182017		ALF-GW-014-08232017	
Well Designation		Background		Background		Background		Background		Background		Background		Background		Background		Background		Background	
Analyte	Units	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q	Result	Q
Total Metals																					
Antimony	mg/L	< 0.000330	U*	< 0.000998	U*	< 0.000565	U*	< 0.00142	U*	< 0.000478	U*	< 0.000443	U	< 0.000443	U	< 0.00103	U*	< 0.000669	U*	< 0.000918	U*
Arsenic	mg/L	0.00957	J	0.00346		0.0106		0.00924		0.00351		0.00293		0.00671		0.00637		0.00703		0.00474	
Barium	mg/L	0.298		0.323		0.328		0.313		0.339		0.424		0.361		0.335		0.324		0.311	
Beryllium	mg/L	< 0.000102	U	< 0.000131	U	< 0.000131	U	< 0.000131	U	< 0.000131	U	< 0.000131	U	< 0.000131	U	< 0.000131	U	< 0.000131	U	< 0.000131	U
Boron	mg/L	0.0803		0.0840		0.0794	J	0.0675	J	0.0694	J	0.0831		0.0691	J	< 0.0830	U*	0.0807		0.0805	
Cadmium	mg/L	< 0.000152	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U	< 0.0000781	U
Calcium	mg/L	133		137		137		123		132		158		131		136		135		132	
Chromium	mg/L	< 0.000339	U	< 0.000378	U	< 0.000378	U	< 0.000378	U	< 0.000378	U	< 0.000378	U	< 0.000378	UJ	< 0.000378	U	< 0.000378	U	< 0.000378	U
Cobalt	mg/L	0.00246		0.000212	J	0.00182		0.000726		0.000164	J	< 0.0000960	U*	0.000970		0.00105		0.00181		0.00124	
Lead	mg/L	< 0.0000675	U	< 0.000318	U	< 0.000318	U	< 0.000318	U	< 0.000318	U	< 0.000318	U	< 0.000318	U	< 0.000318	U	< 0.000318	U	< 0.000318	U
Lithium	mg/L	0.0231		0.0246		0.0233		0.0210		0.0204		0.0230		0.0206		0.0211		0.0207		0.0203	
Mercury	mg/L	< 0.0000521	U	< 0.0000521	U	< 0.0000653	U	< 0.0000653	U	< 0.0000653	U	< 0.0000653	U	< 0.0000653	U	< 0.0000653	U	< 0.0000653	U	< 0.0000653	U
Molybdenum	mg/L	0.00237	J	0.00154	J	0.00258	J	0.00141	J	0.00137	J	< 0.00108	U*	0.00122	J	0.00122	J	0.00161	J	< 0.00176	U*
Selenium	mg/L	0.000687	J	< 0.00127	U	< 0.00127	U	< 0.00127	U	< 0.00127	U	< 0.00127	U	< 0.00127	U	< 0.00127	U	< 0.00127	U	< 0.00127	U
Thallium	mg/L	< 0.0000360	U	0.000135	J	< 0.000110	U*	< 0.0000531	U	< 0.0000531	U	< 0.0000531	U	< 0.0000531	U	< 0.0000531	U	< 0.0000531	U	< 0.0000531	U
Radium 226 + radium 228	pCi/L	< 0.568	U	< 0.887	U	< 0.724	U	< 0.992	U*	0.844	J	< 0.830	U*	0.685	J	< 0.518	U	1.13	J	< 0.551	U
Anions																					
Chloride	mg/L	1.14		1.28		1.11	J	1.18		1.50		1.40		1.34		1.45		1.56		1.21	
Fluoride	mg/L	0.189		0.169		0.183		0.216		0.261		0.227		0.287		0.279		0.208		0.212	
Sulfate	mg/L	5.49		0.876	J	5.14		1.62		0.970	J	3.08		7.54		11.1		8.47		12.5	
General Chemistry																					
Total Dissolved Solids	mg/L	488		488		506		503		491		537		524		495		496		481	
Field pH																					
pH (field)	SU	6.67		6.78		6.73		6.73		6.76		6.83		6.73		6.72		6.72		6.78	

Notes:
NA - Not Available
Q - Data Qualifier
U* - Result should be considered "not-detected" because it was detected in a rinsate blank or laboratory blank at a similar level
J - Quantitation is approximate due to limitations identified during data validation
UJ - Analyte not detected, but the reporting limit may or may not be higher due to a bias identified during data validation
U - Analyte not detected
mg/L - milligrams per liter
pCi/L - picoCurie per liter
SU - Standard Unit

The shallow and deep hydraulic gradients in the MRVA aquifer also indicate downward groundwater flow. For example, in Figure 14 I have added the vertical hydraulic head differences (positive indicates downward flow) between shallow and deep MRVA monitoring wells measured before the start of the pumping test (9-20-2017) to the pumping-test drawdown contour map (Figure 5). These data show that the vertical flow direction is downward within the MRVA aquifer across most of the ALF-ACC Plants area except for one well cluster by McKellar Lake. Further, prior to the pumping test USGS/CAESER noted that hydraulic heads in the MRVA aquifer were about 3 to 5 feet greater than heads in the Memphis Sand

at Production Wells 5, 3, and 1 (“Data Analysis” section of RI Appendix E). A consistent downward flow component in the MRVA aquifer within this area is also demonstrated by the USGS regional modeling results (Figure 2) due to the very-high Memphis-Aquifer transmissivity and groundwater withdrawal, both of create a downward “driving force” for groundwater flow. In the ALF-ACC Plants area the identified window in the confining unit significantly increases downward flow and associated chemical transport rates due to the absence of the low-permeability layer.

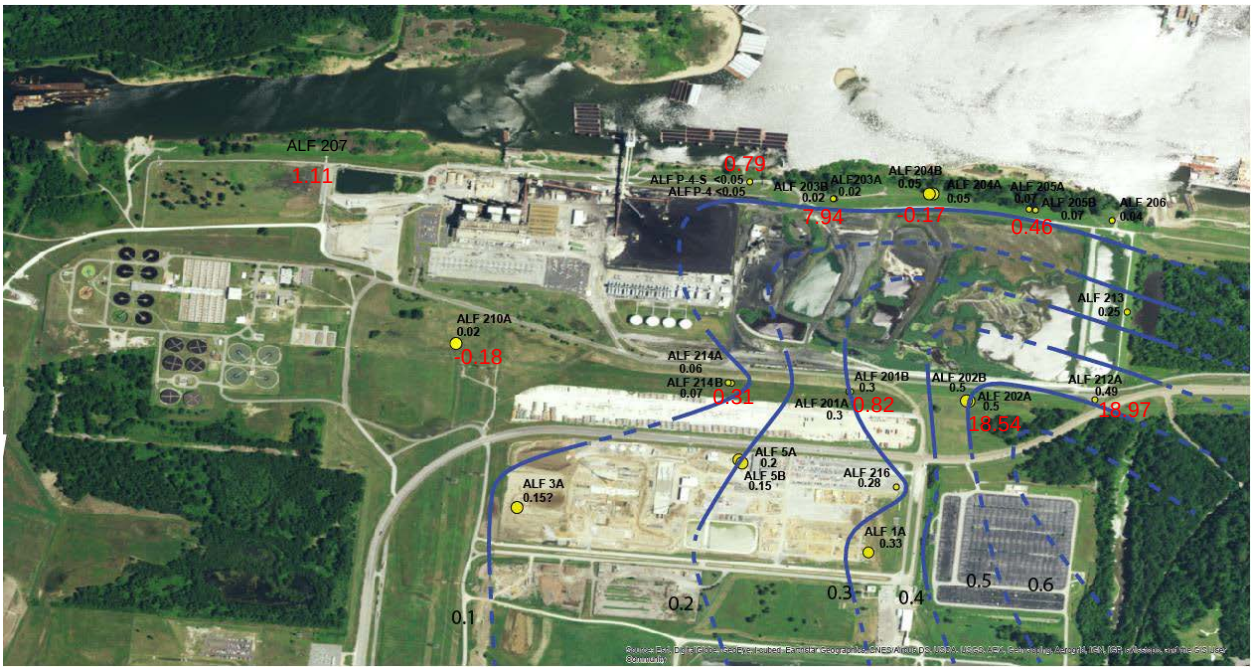

Figure 14
Estimated Drawdown in MRVA Aquifer Monitoring Wells During Memphis Aquifer Pumping Test (values in black, contours in blue). Red Numbers are 9-20-2017 (before Pumping Test) Hydraulic Head Differences between Shallow and Deep MRVA Monitoring Wells (pos. values indicate downward groundwater flow; neg. values indicate upward flow) (from USGS, 2018)

Groundwater Quality in the Memphis Sand Aquifer

The USGS/CAESER investigation also concluded that that mixing of MRVA groundwater with Memphis Sand water is occurring in in the vicinity of Production Wells (PW) 5 and PW 3 based on water quality differences. Water-quality parameters that indicate this contrast before and during the pumping test include specific conductance (Tables 3 and 5 in RI Appendix E), tritium (Tables 4 and 5 in RI Appendix E), sulfate (Table 3 in RI Appendix E and RI Tables 6-15a,b,c), total dissolved solids (RI Tables 6-15a,b,c), and other major inorganic constituents. The tritium analyses demonstrate that a component of young groundwater (post 1950) is present in the Memphis Sand aquifer beneath the ALF-ACC Plants area. Concentrations of these parameters are much higher in samples from PW 5 compared to the other

PWs, which is likely due to the shallower-depth well screen for PW 5 (i.e., less mixing of deeper, lower-concentration groundwater in the Memphis Sand aquifer).

Of particular interest are the high PW-5 sulfate concentrations (about 26,000 – 30,000 μg/L), which are almost a factor of ten greater than concentrations in samples of the other PWs and are similar in magnitude to MRVA sulfate levels in deep groundwater (discussed above). Sulfate concentrations in PW-5 water samples remained greater than 24,000 μg/L throughout the pumping test (Table 5 in RI Appendix E). These sulfate detections in PW 5 water samples are about an order of magnitude (~10x) greater than reported Memphis-Sand background sulfate levels of approximately 2,000-8,000 μg/L (Table A-1 of Stantec, 2017) and median of 3,100 μg/L (Table A-2 of Stantec, 2017). The fact that sulfate concentrations in PW-5 groundwater samples are similar in magnitude to deep-MRVA groundwater suggests possible ongoing transport of CCR constituents from the MRVA to Memphis Sand aquifers. The relatively elevated tritium and inorganic constituent concentrations in PW-5 water samples are consistent with this potential MRVA- to Memphis-aquifer chemical migration in the ALF-ACC Plants area.

Potential Hydraulic Impacts of Off-Site Groundwater Extraction at Davis Well Field

Due to environmental concerns the TVA is now planning on purchasing ACC-plant cooling water from the Memphis Light, Gas and Water (MLGW) Division's Davis Pumping Station located about three miles from the Allen plants (e.g., Charlier, 2018; Figure 1). To evaluate potential hydraulic head decreases in the Memphis Sand aquifer beneath the Allen plants due to pumping at the Davis Well Field I developed a three-dimensional, analytical (exact mathematical solution) groundwater flow model (Hantush, 1964) of the Memphis Sand aquifer. The steady-state (i.e., non-transient, average hydraulic conditions) Hantush model assumes a uniform hydraulic-conductivity distribution and groundwater leakage (proportional to drawdown) from the MRVA aquifer. I calibrated the Memphis Sand hydraulic conductivity and leakage rate to approximately match the steady-state Memphis-Sand hydraulic head decrease (drawdown) predicted by the USGS MERAS groundwater flow model for a uniform 2,500 gpm pumping rate (Figure 15).

Figure 16 shows the simulated Hantush-solution, steady-state Memphis-Sand drawdown for Davis Well Field groundwater pumping rates of 2,500 and 5,000 gpm. The rate of 2,500 gpm is the reported average cooling water requirements for the ACC plant, and 5,000 gpm corresponds to a short-term maximum required flow rate (Figure 4). The calibrated model hydraulic conductivity (*K*) is 230 ft/day and the aquifer

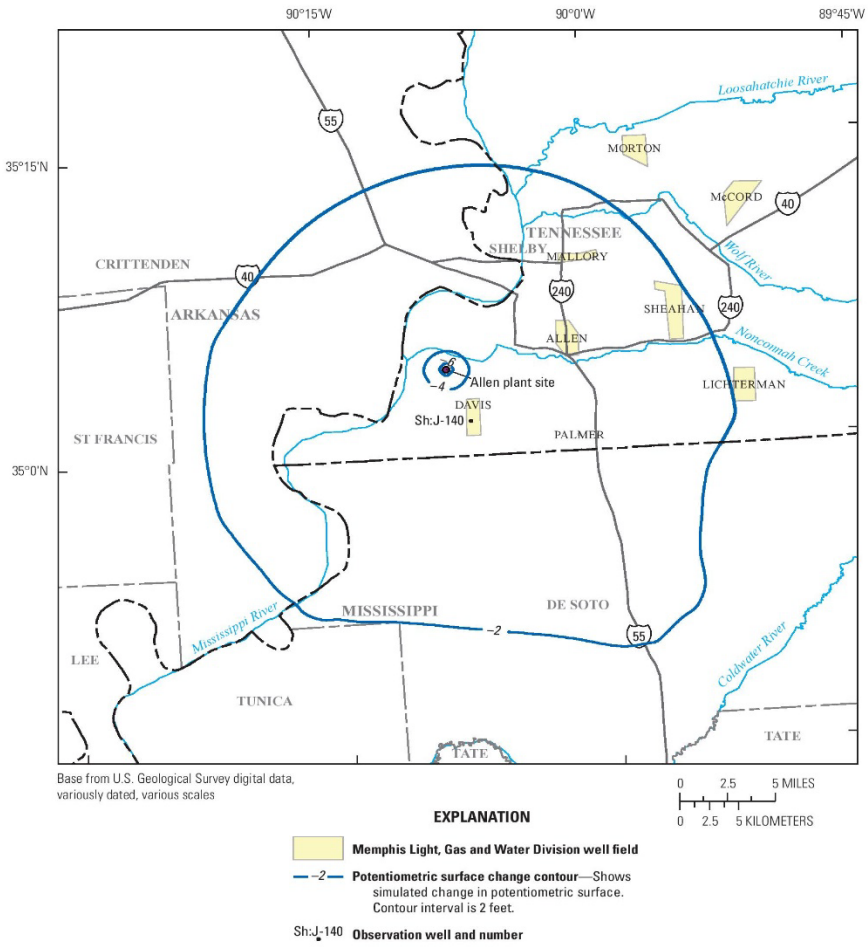

Figure 15
Simulated Hydraulic Head Change in Memphis Sand Aquifer
at End of 30-Year Average Withdrawal (2,500 gpm) Scenario for ACC Plant (from USGS, 2016)

thickness (*b*) is 350 feet. A 100-foot extraction well screen was assumed and drawdown was computed at the top of the aquifer. This calibrated transmissivity (*K* x *b*) is similar in magnitude to reported measured values in the Memphis area (Parks and Carmichael, 1990). The estimated long-term drawdown in the Memphis Sand aquifer beneath the Allen plants is about 3 to 7 feet for uniform pumping rates of 2,500 and 5,000 gpm, respectively. Note that these drawdown values could be smaller beneath the Allen plants due to local recharge from the Mississippi River and McKellar Lake. However, the near-circular nature of the drawdown distribution in Figure15 suggests that the difference would not be significant. For example, if the Mississippi River acted as a constant-head boundary (i.e., direct hydraulic connection between the river and the Memphis Sand) the drawdown near the Allen plants in Figure 15 would be near zero.

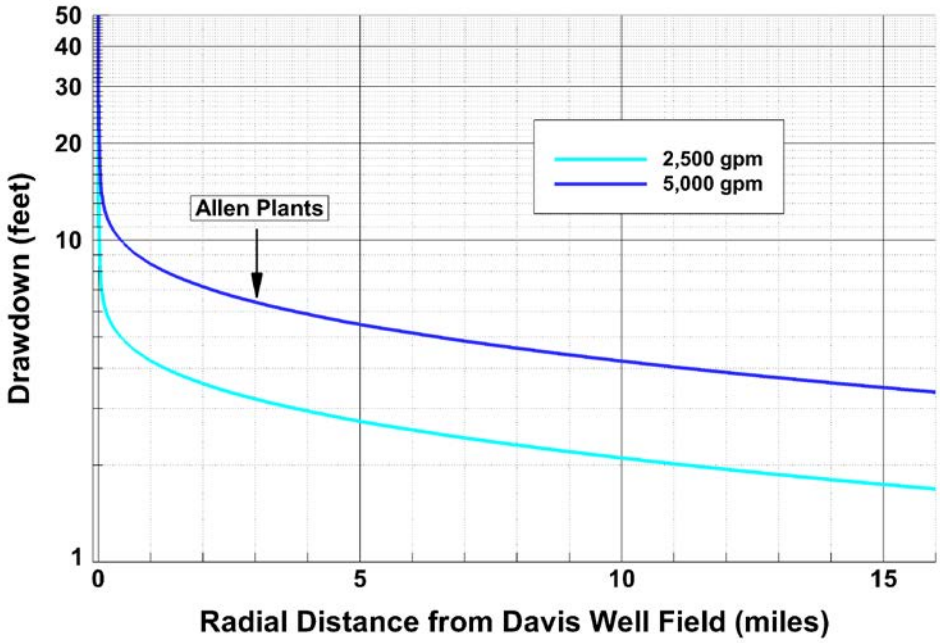

Figure 16
Simulated (Hantush Model) Steady-State Drawdown in Memphis Sand Aquifer
due to Groundwater Extraction at the Davis Well Field

As discussed in the previous section, prior to the recent Allen-site pumping test USGS/CAESER noted that hydraulic heads in the MRVA aquifer were about 3 to 5 feet greater than heads in the Memphis Sand at Production Wells 5, 3, and 1 ("Data Analysis" section of RI Appendix E). Therefore, extraction of an additional 2,500-5,000 gpm of groundwater from the Davis Well Field could double the downward flux of groundwater from the MRVA aquifer to the Memphis Sand in the vicinity of the Allen plants due to the possible doubling of the vertical hydraulic gradient between the two aquifers. Moreover, the flux of any dissolved coal-ash constituents that may be present in deep MRVA groundwater into the Memphis Sand could also be increased by up to a factor of two. Additional data collection and groundwater flow and solute transport modeling are needed to refine these estimates and better assess the potential groundwater quality impacts.

Chemical and Hydraulic Characterization of Groundwater beneath East Ash Basin

As shown below in Figure 17, no monitoring well clusters (shallow, intermediate, or deep) have been installed in the Alluvial Aquifer to enable the collection of groundwater hydraulic-head data or water-quality data directly beneath the central portion of the East Ash Basin CCR source area. This issue relates to the following sections of the EIP: 3.3.5, 4.3.3, 4.3.6, 4.3.7, and 4.5.2. These groundwater data are important for the following reasons:

- As illustrated in RI Figure 17 below, and other hydraulic-head maps presented in the RI report (Stantec, 2018a), the total horizontal hydraulic-head difference between the northern and southern limits of the East Ash Basin is generally on the order of a few feet, with the horizontal groundwater flow direction varying from northerly (toward McKellar Lake) to southerly on different dates. In addition, the RI interprets the vertical groundwater flow direction in the Alluvial Aquifer to vary from upward to downward on different dates, with a vertical groundwater velocity that is small (due to small vertical hydraulic head differences at monitoring well clusters that are typically less than a foot to a few tenths of a foot).

- Per EIP Section 3.2.4 (TDEC Memorandum of Agreement Request No. 4) the normal pool (water surface) elevation in the East Ash Disposal Area Stilling Pond is 225.39 feet. As shown above in Figure 12 this Stilling Pond water surface elevation is similar to the ground surface elevation in this area and is more than 30 feet higher than the interpolated East Ash Basin water table elevation (~ 185-190 feet in Figure 17). The water surface elevations of other ponded areas in the East Ash Disposal Area are likely to be similar in magnitude. In addition, if measured, the hydraulic head in the uppermost portion of the Alluvial Aquifer would be similar in magnitude to the Disposal Area ponded-water surface elevations because the East Basin acts as a constant-head boundary relative to groundwater flow (i.e., large source of groundwater inflow to the Alluvial Aquifer).

- Therefore, the true vertical groundwater velocity beneath most of the East Ash Basin CCR source area is definitively downward, and the corresponding downward groundwater velocity (proportional to shallow minus deep hydraulic heads) is more than a factor of 30 (30-foot vertical head difference compared to one foot, as reported in the RI) greater than the values reported in the RI. Similarly, the downward transport rates of all CCR constituents from the East Ash Basin source area are more than 30 times greater than values suggested in the RI. In other words, the potential for CCR contamination at depth in the Alluvial Aquifer is much greater than what was concluded in the RI. The RI ignored these key site-specific groundwater-flow and chemical-transport mechanisms and only installed monitoring-well clusters outside of the East Ash Basin footprint.

- Horizontal groundwater velocities and CCR transport rates are also much greater than values reported in the RI when the correct hydraulic head values beneath the East Ash Basin are used. In the immediate vicinity of the East Ash Basin the horizontal hydraulic gradients (and

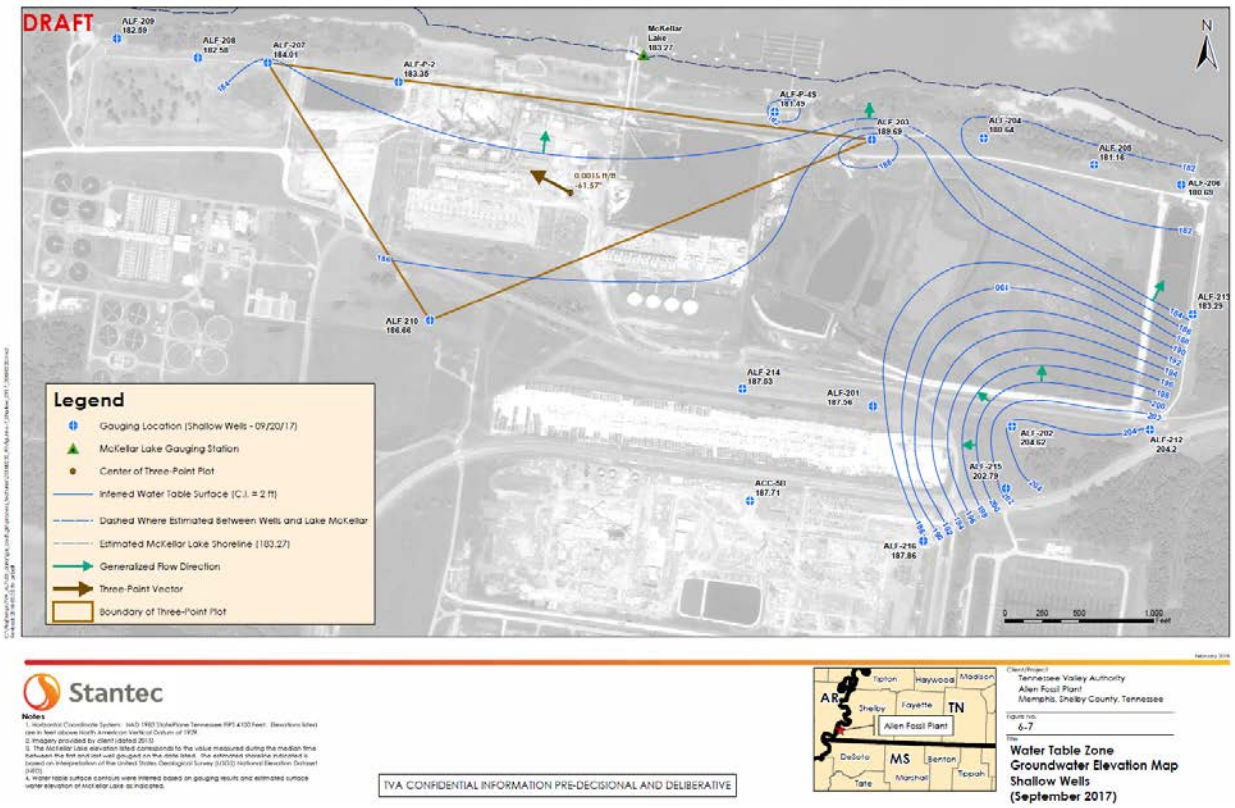

Figure 17
Locations of Shallow-Depth Monitoring Wells in Alluvial Aquifer (from Stantec, 2018a)

groundwater velocities) are expected to be as much as a factor of ten greater than reported in the RI (e.g., 30 feet actual horizontal head change compared to the few feet shown on RI hydraulic-head maps). Moreover, the correct groundwater flow direction beneath large portions of the East Ash Basin is expected to be northerly from the CCR source areas toward McKellar Lake and downward toward the Memphis Sand. The groundwater flow direction at depth in the Alluvial aquifer may also be influenced by flow into the Memphis Sand through the identified breach in the confining layer. This interpretation is significantly different that the RI conclusions of horizontal flow directions that vary from northerly to southerly.

- Moreover, the RI failed to measure the true average horizontal and vertical hydraulic heads in the alluvial aquifer which determine long-term horizontal/vertical chemical transport fluxes. Instead, the RI hydraulic-head maps are only random "snapshots" of the hydraulic heads and groundwater flow directions based on manual water-level measurements which, due to McKellar-Lake stage fluctuations, significantly change from one measurement date to another. Therefore, the RI significantly underestimates the horizontal mass transport rate of CCR constituents from groundwater into McKellar Lake and the downward flux of contaminants toward the Memphis Sand because the large influx of water from the East Ash Basin is not incorporated into the RI

groundwater flow characterization and correct mean hydraulic gradients were not used to evaluate chemical transport directions and rates. This situation is similar to a coastal aquifer and flow regime wherein tidally-induced water-level fluctuations must be filtered out of the data sets using analysis methods such as those presented by Serfes (1991). The U.S. Geological survey addressed this issue in their analysis of pumping-test data (water-level drawdown data in RI Appendix E) by using the software program SeriesSEE (Version 1.20), which is a Microsoft Excel Add-In (Halford et al., 2012), to remove the hydraulic influences of McKellar Lake and other environmental fluctuations such as barometric pressure changes and drawdown due to local water-supply wells. These types of water-level filtering techniques (i.e., averaging) need to be applied to water-level data collected by transducers over a sufficient averaging period in order to develop correct mean hydraulic head maps and groundwater-velocity distributions for the alluvial aquifer.

Characterization of CCR Constituent Sorption to Soil

Background

The fraction of chemical mass sorbed to soil can be represented by the soil-water partition coefficient, K_d (Lyman et al., 1982). K_d is an especially important parameter for most CCR constituents because the bulk of the chemical mass in the soil is associated with the solid phase (i.e., sorbed to soil grains rather than dissolved in pore water). In effect, the solid fraction of the soil matrix acts as a large "storage reservoir" for chemical mass when K_d is large [e.g., metals (e.g., CCR), many chlorinated solvents, and highly-chlorinated polycyclic aromatic hydrocarbon (PAH) compounds associated with coal tars and wood-treating fluids]. K_d is also a very important chemical transport parameter which is used to compute the chemical retardation factor, R_d, assuming linear equilibrium partitioning of mass between the soil (solid) and pore-water phases (Hemond and Fechner, 1994):

$$R_d = 1 + \rho_b K_d / n_e$$

where ρ_b is the soil matrix bulk dry density and n_e is the effective soil porosity. For example, the chemical migration rate (V) is directly proportional to hydraulic conductivity (K) and inversely proportional to R_d :

$$V = \frac{K i}{n_e R_d}$$

where i is the hydraulic gradient (change in hydraulic head divided by distance).

The total contaminant mass in an aquifer is also directly proportional to R_d, as well as aquifer cleanup times once the source is removed (e.g., Zheng et al., 1991). For most CCR constituents R_d is on the order of 10 to 1,000 (e.g., EPRI, 1984). For example, a chemical with R_d equal to 100 has 99 percent of its total mass sorbed to soil. Similarly, even constituents with R_d ~ 10 have about 90 percent of their mass sorbed onto the soil matrix with the remaining ten percent dissolved in groundwater.

Discussion

The RI has not measured or characterized the most critical chemical-specific fate and transport parameter, the soil-water partition coefficient (K_d), for any CCR constituent (refer to EIP Sections 3.3.3 and 4.1.2). As discussed above, K_d is a chemical parameter that quantifies the amount of chemical mass that is sorbed, or partitioned, onto the immobile soil grains in the aquifer compared to the dissolved-phase (porewater) mass. K_d also determines both chemical migration rate (along with hydraulic conductivity and hydraulic gradient) and the total mass of any CCR constituent in the Alluvial Aquifer. Clearly, site-specific characterization of the soil-water partition coefficient for the various CCR constituents should have been a key component of the Remedial Investigation.

Initial Remedial Design – Interim Response Action

The Initial Remedial Design (IRD) of the groundwater extraction well locations and pumping rates for the East Ash Basin (Stantec, 2018b) is incorrect because it is based on a groundwater model that was improperly calibrated and does not match existing hydraulic conditions in the alluvial aquifer. Hydrogeologic issues related to the IRD are the subject of most sections of the EIP. In addition, the vertical extent of CCR constituent contamination beneath the East Basin source area has not been determined, as discussed above. Therefore, the target depth for hydraulic containment of CCR plumes (i.e., capture zone), which largely determines extraction-well locations and pumping rates, has not been accurately characterized. The primary flaw in the model is that it inexplicably does not include a boundary condition to represent the major groundwater mounding effect of the East Ash Basin (refer to Figure 18 and above discussion), even though the model was constructed (i.e., calibrated) using hydraulic heads that were measured while the impoundment was active (full of effluent). One of the most impactful results of this erroneous approach to groundwater model development is that artificial, high-rate groundwater recharge zones (e.g., several hundred inches per year, whereas natural recharge rates are on the order of 10-20 inches per year) were defined in the model without any physical basis (refer to Figure 19). The false recharge zones are due to the fact that the water-level data sets used to calibrate the model were measured when the East Basin was full of effluent, but the model does not include the East Basin. Therefore, basically the model developers were forced to introduce an artificial source of groundwater recharge to account for the “real” influx of water from the East Ash Basin. A major problem with this, of course, is that these spurious recharge zones largely determined the extraction-well locations

and pumping rates presented in the IRD. Accordingly, the IRD extraction-well designs need to be corrected.

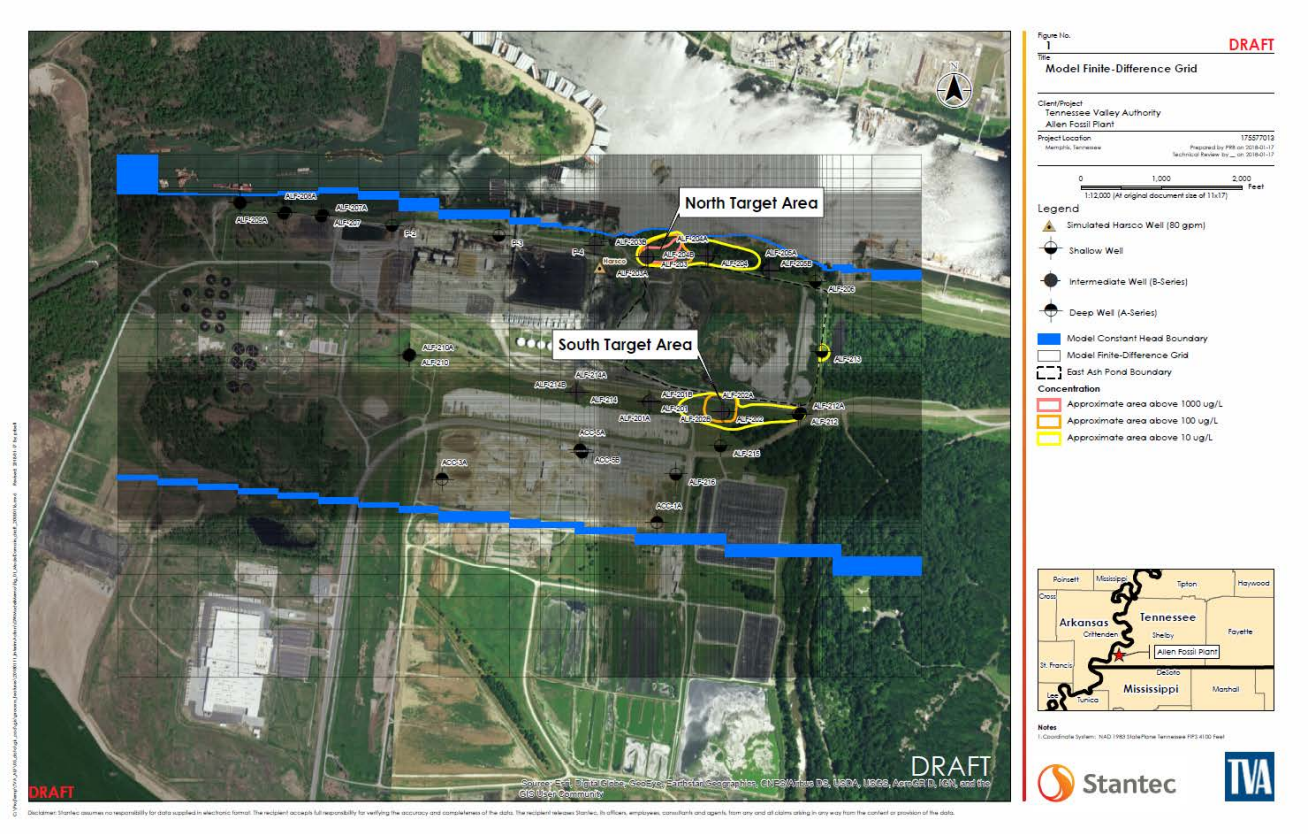

Figure 18
Groundwater Model Computational Grid for Initial Remedial Design (from Stantec, 2018b)

The IRD report (Section 2.6) also proposes monitoring of CCR concentration trends (i.e., concentration versus time) in monitoring and extraction wells as a key part of the Performance Monitoring plan:

Treatment performance will be measured through analysis of groundwater COC concentration trends, estimation of contaminant mass distribution prior to and during remedy operation, and by analyzing the COC concentration and general chemistry of the effluent.

However, as discussed above, accurate evaluation of temporal concentration trends requires that site-specific characterization of the soil-water partition coefficients (K_d) for CCR constituents has been completed. Since K_d values have not been measured it is not possible to achieve the stated IRD objectives of "*analysis of groundwater COC concentration trends*" and "*estimation of contaminant mass distribution prior to and during remedy operation*" because concentration trends (a function of chemical migration rate, V, presented above) and contaminant mass (directly proportional to R_d values) are determined by both groundwater (aqueous-phase) concentrations and soil (sorbed fraction, which is proportional to K_d) concentrations. For example, if Performance-Monitoring decisions related to hydraulic containment of CCR plumes ignore chemical sorption and retardation then it is very possible that short-

term Performance Monitoring Well (PMW) concentration reductions (e.g., due to effluent concentration reductions caused by rainwater infiltration events) would be misconstrued as meaningful levels of aquifer remediation. The present CCR distribution in the Alluvial Aquifer has occurred over a period of decades, and a very-long time period will be required for aquifer cleanup. These types of time scales are consistent with characteristic CCR R_d values on the order of 100 to 1,000.

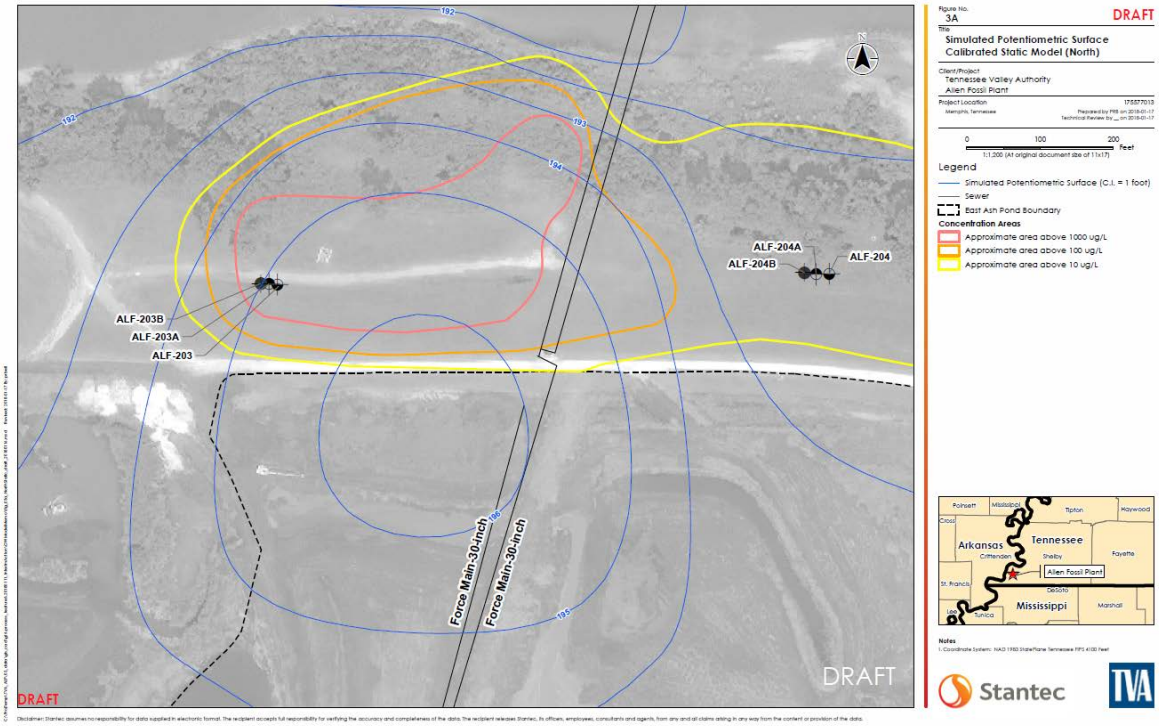

Figure 19
Simulated Shallow-Depth Hydraulic Heads Used for Initial Remedial Design (from Stantec, 2018b)

Characterization of Groundwater beneath West Ash Disposal Area

Figure 20 (TVA, 2018b; EIP Appendix M) shows the proposed monitoring well clusters (shallow, intermediate, deep) in the vicinity of the West Ash Disposal Area. This topic relates to EIP Sections 3.3.1, 3.4.1, and 4.3.6. Three of the proposed locations are downgradient well clusters (northern area), one is side-gradient (ALF-218), and two other clusters are upgradient (ALF-217 and ALF-210). Note that no monitoring wells are proposed in the middle of the coal-ash source area, which is also a major limitation with the East Ash Basin monitoring network. This data gap is very important because the West Ash Disposal Area used to be an active wastewater treatment facility during its operational phase, which means that the deepest vertical extent of CCR contamination is likely the interior portions of the disposal area due to the large downward hydraulic gradients that existed while the West Disposal Area was active (refer to similar discussions above regarding the East Ash Basin).

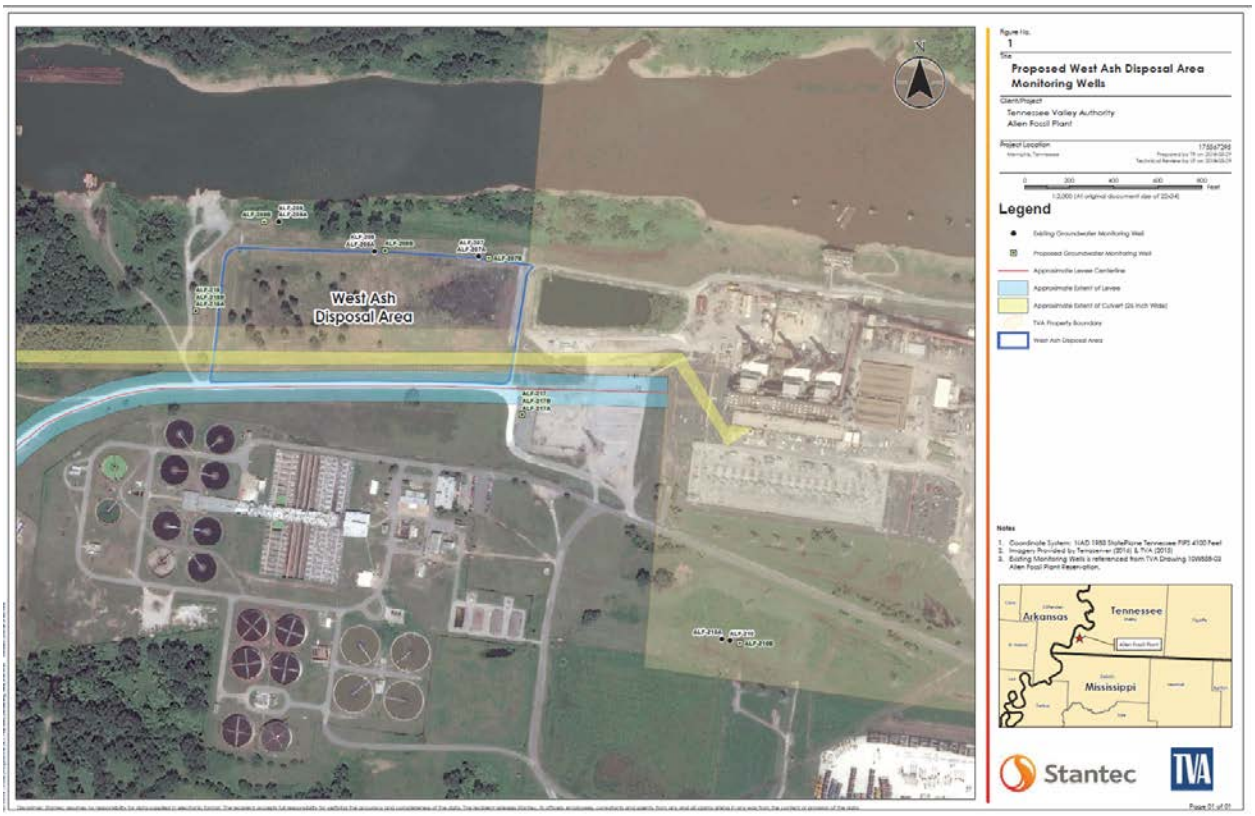

Figure 20
Proposed West Ash Disposal Area Monitoring Wells (from TVA, 2018b)

Summary and Conclusions

Hydrogeologic and groundwater-quality data from the recent 24-hours USGS/CAESER pumping test in the Memphis Sand Aquifer clearly identify a window, or breach, in the upper Claiborne confining unit that separates the MRVA and Memphis Sand aquifers in the ALF-ACC Plants area. In addition, pre-pumping-test vertical hydraulic gradient data (shallow-deep MRVA monitoring wells, and MRVA-Memphis aquifer gradients) indicated that the vertical groundwater flow direction in the MRVA aquifer was downward across most of the ALF-ACC Plants area. Regional groundwater-flow simulations using the USGS MERAS model also confirm strong downward hydraulic gradients from the MRVA to Memphis aquifer in the Memphis area and beyond on an average basis. Consistent with the measured downward flow component in the MRVA aquifer, very high boron and sulfate CCR-constituent concentrations (up to 30 times background levels) were detected near the bottom of the MRVA aquifer during the Remedial Investigation in both the northern and southern parts of the ALF-ACC Plants area. Further, water-quality data for the Memphis Sand aquifer (e.g., PW 5) are consistent with possible ongoing transport of CCR constituents from the MRVA to Memphis Sand aquifers in the ALF-ACC Plants area. Based on the high

concentrations of boron and sulfate in the deepest parts of the MRVA aquifer the potential exists for increased fluxes of CCR constituents through the confining unit window(s) in the future.

Therefore, it is very important to further characterize and quantify the risk of contamination by CCR constituents of the Memphis Sand Aquifer in the Allen Plants area. The conclusions of the USGS/CAESER investigation also strongly recommend these types of analyses. Specifically, the location(s) and extent(s) of leakage/window features in the confining unit need to be better defined and the fluxes of groundwater and CCR constituents from the MRVA to Memphis Sand aquifers need to be accurately quantified under current conditions and into the future under both static and pumping conditions. Depending on the results of these computations, three-dimensional groundwater flow and chemical transport (advection-dispersion) modeling of the Memphis Sand Aquifer should be conducted to evaluate potential impacts on downgradient environmental receptors.

In summary, my conclusions are:

- There is a hydraulic connection between the MRVA Aquifer and the Memphis Sand Aquifer;
- The areal extent of the breach in the confining layer that is causing the hydraulic connection may be much larger than the USGS-CAESER report initially indicated;
- The degree of hydraulic connection, based on pumping-induced water-level reductions in the MRVA Aquifer, may be much stronger than the USGS-CAESER report initially indicated;
- There are significantly elevated concentrations of boron and sulfate, CCR indicator constituents, deep in the MRVA Aquifer at the Allen Plant;
- These boron and sulfate tracer concentration distributions indicate that long-term downward groundwater flow has been occurring in the Alluvial aquifer in the Allen Plant area;
- Shallow and deep vertical hydraulic gradients within the MRVA Aquifer, as well as significantly higher hydraulic heads in the MRVA aquifer compared to the Memphis Sand, also indicate downward groundwater flow;
- Age dating of groundwater (e.g., tritium analyses by USGS, 2018) and elevated sulfate concentrations in Memphis-Sand Production Well 5 indicate that mixing of MRVA Aquifer groundwater with Memphis Sand Aquifer water is occurring in the vicinity of the Allen Plant and that potential ongoing transport of CCR constituents from the MRVA into the Memphis Sand Aquifer is occurring;
- TVA's extraction of Memphis Sand Aquifer groundwater from the Davis well field will result in long-term drawdown in the Memphis Sand under the Allen Plant and increase downward vertical hydraulic gradients from the MRVA to the Memphis Sand;

Based on these findings, I recommend the following significant changes in the RI and EIP:

- Require TVA to incorporate the conclusions of the USGS-CAESER report (USGS, 2018, page 44) into the RI and EIP;
- Require TVA to implement the recommendations of the USGS-CAESER report for future data collection and analysis (USGS, 2018, page 44), including more accurate characterization of the location(s) and extent(s) of leakage/breach features in the confining unit and more accurate quantification of the fluxes of groundwater and dissolved CCR constituents from the MRVA Aquifer to the Memphis Sand Aquifer;
- Install monitoring well clusters (shallow, intermediate, and deep) within the footprint of the East Ash Pond and within the footprint of the West Ash Pond to adequately assess the spatial

distribution of CCR contamination (including all Appendix III and IV constituents), the true groundwater velocity distribution (vertical and horizontal), and chemical transport rates;

- Properly average water-level measurements for monitoring wells, McKellar Lake, and the East Ash Basin water surface to allow construction of accurate mean hydraulic head maps that can reliably be used to analyze long-term chemical transport in the subsurface;
- Engage in site-specific characterization of the soil-water partition coefficient for the various CCR constituents (including boron, sulfate, and all other Appendix III and IV constituents) so that chemical transport rates can be estimated;
- Implement three-dimensional groundwater flow and chemical transport modeling that takes into account the above data (including all Appendix III and IV constituents); and
- Redesign the interim remedial action as further discussed in this report.

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ATTACHMENT 2

SOUTHERN ENVIRONMENTAL LAW CENTER

Telephone 615-921-9470 | 1033 DEMONBREUN STREET, SUITE 205 NASHVILLE, TN 37203 | Facsimile 615-921-8011

February 21, 2018

Ashley R. Farless, PE, AICP
NEPA Compliance
Tennessee Valley Authority
1101 Market Street
Chattanooga, TN 37402
Via Overnight Mail and Email to arfarless@tva.gov

Re: TVA Must Prepare an Environmental Impact Statement for the Allen Fossil Plant Emission Control Project (Project Nos. 2013-33 & 2015-28) to Consider New and Omitted Information Regarding Risk of Arsenic Contamination to Memphis Sand Aquifer

Dear Ms. Farless:

On behalf of Protect Our Aquifer and the Tennessee Chapter of the Sierra Club (collectively, "Conservation Groups"), we are writing to demand that the Tennessee Valley Authority ("TVA") fulfill its obligation pursuant to the National Environmental Policy Act, 42 U.S.C. § 4321 *et seq.* ("NEPA"), to supplement its previous environmental analysis and prepare an environmental impact statement ("EIS") regarding the utility's plan to pump millions of gallons of water per day from the Memphis Sand Aquifer ("Aquifer") less than half a mile from the leaking, unlined, contaminated coal ash pit at the Allen Coal Plant ("Pumping Plan" or "Plan"). TVA must prepare an EIS to address significant new and omitted circumstances and information regarding the risk of contamination of the Memphis Sand Aquifer—the primary drinking water source for the City of Memphis. This information includes evidence of historic and current groundwater contamination at the Allen Coal Plant, as well as TVA and U.S. Geological Survey reports identifying shallow groundwater in vicinity of the Allen Coal Plant as having a high potential for leaking into the Aquifer. TVA did not consider this information when it selected the Pumping Plan in the Supplemental Environmental Assessment ("SEA") TVA prepared in 2016.[1]

We also write to highlight the reasonable alternatives that exist to TVA's Pumping Plan, which must be analyzed in an environmental impact statement before TVA begins to implement the Plan. Engaging in a good-faith process and subjecting the Pumping Plan to public scrutiny is not only required by federal law, it is also essential to restoring the public trust. TVA has repeatedly refused and continues to refuse to provide the public, the Tennessee Department of Environment and Conservation, and the Shelby County Groundwater Board, with timely access to key environmental information evaluating the risk of contamination of the Aquifer associated with the Pumping Plan. TVA must immediately move to prepare an EIS and engage in public

[1]Attachment 1: TVA, Allen Fossil Plant Emission Control Project Supplemental Environmental Assessment (Apr. 2016) [hereinafter SEA].

discussion of the Pumping Plan and other alternatives for providing cooling water at the Allen Gas Plant.

Protect Our Aquifer is a Tennessee non-profit dedicated to supporting the protection and conservation of the Memphis Sand Aquifer for the benefit of present and future generations.[2] Protect Our Aquifer formed in the wake of TVA's unilateral decision to obtain cooling water for the Gas Plant water from the Aquifer, and the organization has been instrumental in providing information to the public about the Pumping Plan and other risks to the Aquifer. The Sierra Club is the largest and most influential grassroots environmental organization in Tennessee, with more than 105,000 members and supporters across the state. The Sierra Club works to safeguard the health of our communities, protect wildlife, and preserve our remaining wild places through grassroots activism, public education, lobbying, and litigation. Conservation Groups previously challenged the well permits for two of the wells TVA drilled at the Allen Gas Plant and has continued to advocate for TVA to revisit its decision to implement the Pumping Plan.[3]

Summary

Protect Our Aquifer and Sierra Club demand that TVA supplement its environmental analysis and prepare an EIS for the Pumping Plan as required by NEPA before selecting an option for cooling water at the Allen Gas Plant. As this letter explains, in its previous environmental analyses, TVA failed to address the Pumping Plan's significant impacts on the Memphis Sand Aquifer, the primary source of drinking water for the City of Memphis. In fact, in its Supplemental Environmental Analysis ("SEA"), the utility omitted data showing that the unlined, leaking pit where it stores coal ash at its nearby Allen Coal Plant had contaminated groundwater with arsenic. Nor did the SEA discuss a TVA-authored report showing that the utility knew of the high potential for contaminated groundwater to leak into the Aquifer. The public did not have an opportunity to bring this information to TVA's attention because TVA did not circulate its SEA for public comment.

TVA is also required to supplement its environmental analysis and prepare an EIS based on significant new circumstances and information that emerged after TVA completed the SEA. In July 2017, TVA disclosed to the public that it had detected high levels of arsenic, fluoride, and lead in the groundwater under the East Pond, a coal ash pit at the Allen Coal Plant. TVA's detection of arsenic and other contaminants triggered a remedial investigation by the Tennessee Department of Environment and Conservation ("TDEC"). Like Protect Our Aquifer and the Sierra Club, TDEC has been particularly concerned about the risk of contamination leaking into the Aquifer, or being pulled into the Aquifer when TVA turns on its wells under the Pumping Plan. The risk posed by the Pumping Plan is illustrated by this diagram:

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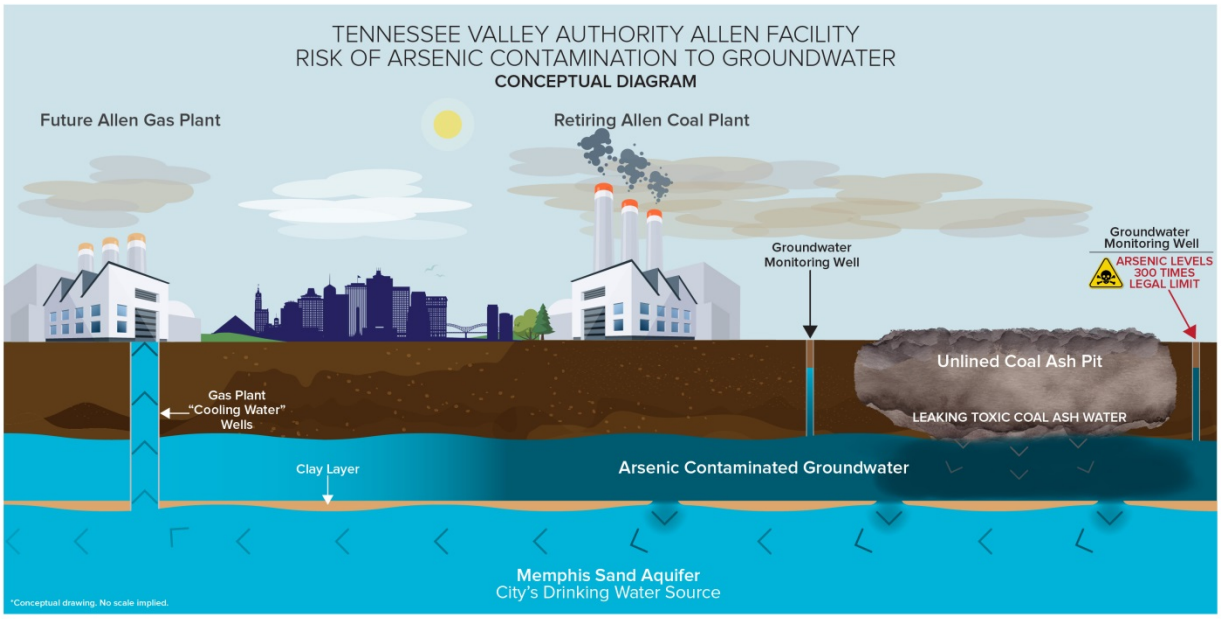
[2] Attachment 2: Protect Our Aquifer: Mission, http://protectouraquifer.org/.

[3] Attachment 3: Sierra Club, Tennessee Chapter: Background and Links Regarding TVA's Planned Use of the Memphis Sand Aquifer to Cool It's New Power Plant in Memphis (Aug. 13, 2016), https://www.sierraclub.org/tennessee/blog/2016/08/background-and-links-regarding-tvas-planned-use-memphis-sand-aquifer-cool-its.



As TDEC's remedial investigation itself indicates, the nature of the Pumping Plan's impact on groundwater is highly controversial, requiring TVA to prepare an EIS pursuant to its own regulations. TVA must also prepare an EIS because the Pumping Plan threatens to violate or exacerbate violations of Federal, State, and local laws that protect Memphis' clean water. In particular, TVA is operating the East Pond as an open dump in violation of the federal Coal Ash Rule, and the Pumping Plan threatens to violate TVA's obligation to remedy rather than exacerbate its groundwater pollution. TVA is also violating the Clean Water Act, its NPDES permit, and the Tennessee Water Quality Control Act by allowing coal ash pollution to enter groundwater. The Pumping Plan threatens to exacerbate this pollution. Finally, TVA is threatening to violate the Shelby County Groundwater Ordinance by putting wells into service less than half a mile from a RCRA corrective action site under the federal Coal Ash Rule and state Remedial Investigation.

TVA must consider the new and omitted information set forth in this letter, and supplement its previous analyses by preparing an EIS to evaluate the environmental impacts associated with a range of reasonable alternatives for providing cooling water at the Allen Gas Plant. New information indicates that planned upgrades at the nearby Maxson Waste Water Treatment Plant may make recycled graywater a reasonable alternative. In addition, new information suggests that MLGW has obtained easements or has the ability to obtain easements that would enable it to provide additional water supply to TVA.

For the reasons set forth below, TVA must rethink the Pumping Plan and provide the public with an opportunity to comment on the options available to TVA in light of the risk of contamination of the Memphis Sand Aquifer.

Table of Contents

I. Factual Background.

A. The Memphis Sand Aquifer, the primary source of drinking water for the City of Memphis, is vulnerable to contamination.

Memphis sits on the banks of the Mississippi River, but its drinking water comes from another source: the Memphis Sand Aquifer.[4] Until the late 19th Century, Memphians' drinking water was drawn from surface water and cisterns, but yellow fever epidemics left the city looking for a better, more sustainable source.[5] The Memphis Sand Aquifer was discovered in 1887; ever since, it has provided Memphians with the "sweetest water in the world,"[6] a true "buried treasure."[7]

The discovery of the Memphis Sand Aquifer was a public health win for the city. But because the Aquifer is vulnerable to contamination, there is no guarantee the water will remain pure. Since the mid-20th century, in fact, the U.S. Geological Survey has identified existing and potential risks to the Memphis Sand Aquifer.[8] The U.S. Environmental Protection Agency has identified dozens of sites in Memphis potentially eligible for listing on the Superfund National Priorities List,[9] many of which may pose a risk of groundwater contamination. EPA studies also

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[4] Attachment 4: Water Quality Report 2016, *Memphis Water: Pure and Abundant* (Memphis Light Gas & Water), http://www.mlgw.com/images/content/files/pdf/WaterQualityReport2016.pdf. MLGW also obtains water from the Fort Pillow formation. *Id.* "The Memphis Sand Aquifer is the most productive aquifer in the region, providing approximately 98 percent of the total pumpage to the City of Memphis in 1980 (Brahana and Broshears 2001), and it remains the primary supply in the area." Attachment 5: Stantec, TVA Allen Fossil Plant Remedial Investigation Work Plan, at § 3.5 (Sept. 15, 2017) [hereinafter "RI Work Plan"].

[5] Water Quality Report 2016, *Memphis Water: Pure and Abundant* (Memphis Light Gas & Water), http://www.mlgw.com/images/content/files/pdf/WaterQualityReport2016.pdf.

[6] *Id.* Attachment 6: "Dr. Jerry L. Anderson, Director of the Ground Water Institute at the University of Memphis [is] a nationally known expert in the field. Memphis has the 'sweetest, most wonderful tasting water in the world,' he said, in part because of the presence of so few minerals that the water can be used with little treatment when it is withdrawn from underground. "Memphis Water Termed 'Sweetest in the World," WaterWorld, http://www.waterworld.com/articles/print/volume-19/issue-11/washington-update/memphis-water-termed-sweetest-in-the-world.html.

[7] Attachment 7:Tom Charlier, "The Memphis Sand aquifer: A buried treasure," Memphis Commercial Appeal (Dec. 16, 2017), https://www.commercialappeal.com/story/news/environment/2016/12/16/memphis-sand-aquifer-buried-treasure/93814278/.

[8] *E.g.*, Attachment 8: Parks & Lounsbury, "Summary of Some Current and Possible Future Environmental Problems Related to Geology and Hydrology at Memphis, Tennessee" (USGS 1976); Attachment 9: Graham & Parks, "Potential for Leakage Among Principal Aquifers in the Memphis Area, Tennessee" (USGS 1986) [hereinafter USGS 1986]; Attachment 10: Branaha, Parks & Gaydos, "Quality of Water from Freshwater Aquifers and Principal Well Fields in the Memphis Area, Tennessee" (USGS 1987).

[9] *See, e.g.*, Attachment 11: Hazardous Waste: Information on Potential Superfund Sites (U.S. General Accounting Office, Nov. 1998).

show that the Upper Memphis Sand is close to the land surface near Memphis,[10] meaning that it is more susceptible impacts from surface pollution.

In August 2016, the Memphis City Council began taking measures to more actively protect the Aquifer, passing a resolution that stated, in part, that "it is in the best interest of the citizens of Memphis and Shelby County that the Tennessee Valley Authority should carefully consider using the Mississippi Alluvial Aquifer rather than our precious Memphis Sand Aquifer."[11] Further recognizing the special role that the drinking water aquifer plays in the life of the city, in January 2018, the Memphis City Council approved a 5-year, $5 million study to study the Memphis Sand Aquifer.[12] One council member described this study as an effort to protect the city's "21st Century gold."[13]

And, for the past year, the Shelby County Health Department has been re-writing its groundwater ordinances to better protect groundwater resources.[14]

B. TVA announced plans to construct and operate the Allen Gas Plant after agreeing to shutter the Coal Plant in settlement of a Clean Air Act enforcement case.

In 2011, TVA settled a lawsuit to address the air pollution caused by its fleet of coal-burning power plants.[15] As part of the settlement, TVA agreed to retire the Coal Plant by December 2018.[16] In July 2014, TVA released a draft Environmental Assessment to the public

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[10] Attachment 12: EPA, Office of Research and Development, "Mississippi Embayment Regional Ground Water Study," at pp. 31, 139-40 (2011).

[11] Attachment 13: Toby Sells, "Jones Opposes TVA Wells with Resolution Tuesday," MEMPHIS FLYER (Aug. 23, 2016), https://www.memphisflyer.com/NewsBlog/archives/2016/08/23/jones-opposes-tva-wells-with-resolution-tuesday.

[12] Attachment 14: Tom Charlier, "Council approves water hike, rejects gas and power increases," MEMPHIS COMMERCIAL APPEAL (Jan. 9, 2018), https://www.commercialappeal.com/story/news/2018/01/09/council-approves-water-hike-rejects-gas-and-power-increases/1016194001/.

[13] *Id.*

[14] Attachment 15: Tom Charlier, "Shelby board to rewrite rules to protect Memphis Sand aquifer," MEMPHIS COMMERCIAL APPEAL (Aug. 11, 2017), https://www.commercialappeal.com/story/news/2017/08/11/shelby-board-rewrite-rules-project-memphis-sand-aquifer/555411001/; Attachment 16: Tom Charlier, "Shelby County drafts stricter rules to protect groundwater," MEMPHIS COMMERCIAL APPEAL (Feb. 16, 2018), https://www.commercialappeal.com/story/news/2018/02/16/shelby-county-drafts-stricter-rules-protect-groundwater/343740002/ ("Zerwekh [administrator of the environmental health services bureau of the Health Department] said the controversy surrounding the TVA wells helped alert officials to the need for changes to the "old, antiquated" regulations so that proposed wells are sufficiently scrutinized to protect groundwater resources.")

[15] Attachment 17: *Sierra Club & Protect Our Aquifer v. Shelby County Groundwater Quality Control Board, Shelby County Health Department, & Tennessee Valley Authority* ("*Sierra Club*"), No. 17-cv-2114-SHL-dkv (W.D. Tenn.) [Doc. 19-13 at PageID 1178]; TVA, Allen Fossil Plant Emission Control Project Final Environmental Assessment, 1 (Aug. 2014) [hereinafter "Final EA"].

[16] Final EA, 1.

and provided for 37 days of comment[17] on TVA's decision to retire the Coal Plant and build the Gas Plant.

One of the issues addressed in the Environmental Assessment was the source of water needed to operate the Gas Plant. Because the Gas Plant captures the hot exhaust from burning gas and uses the captured condensed steam to run another turbine,[18] the Gas Plant needs millions of gallons of water, also known as "cooling water," to function.[19]

In the August 2014 Final Environmental Assessment, TVA selected as its preferred alternative using gray water ("recycled water") for cooling the Gas Plant.[20] TVA defined "gray water" as "non-potable treated wastewater . . . . [that] has 98 percent of waste removed."[21]

C. TVA has apparently taken no steps to clean up its legacy pollution at the retiring Allen Coal Plant.

Since the 1960s, TVA has operated the Allen Coal Plant along the shore of the Mississippi River to produce electricity in the Memphis area.[22] TVA dealt with the ash that was left over at the Coal Plant—ash that contains toxic chemicals like arsenic and lead—by mixing it with water and dumping it in unlined pits in the ground next to the River known as the East Ash Disposal Area ("East Pond")[23] and the West Ash Impoundment.[24] Periodically, to contain the waste, TVA simply raised the earthen dikes.[25]

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[17] Attachment 18: *Sierra Club*, Doc. 19-14 at PageID 1371.

[18] *See* Attachment 19: "How a Combined Cycle Power Plant Works" (TVA), https://www.tva.gov/Energy/Our-Power-System/Natural-Gas/How-a-Combined-Cycle-Power-Plant-Works.

[19] *See* Attachment 20: TVA, Finding of No Significant Impact, Allen Fossil Plant Emission Control Project–Groundwater Wells (Apr. 29, 2016) [hereinafter "2016 FONSI"].

[20] Final EA, at §§ 2.1.2.2.2, 2.5.

[21] Final EA at 11.

[22] In 1965, TVA leased the Allen Coal Plant from Memphis Light Gas & Water. Attachment 21: Lisa M. Beard, "Summary of Groundwater Data at Allen Fossil Plant, 1988," at 4 (TVA 1989) [hereinafter "1988 Groundwater Summary"]. In 1984, TVA purchased the Allen Coal Plant from the City of Memphis and Memphis Light, Gas & Water. Memorandum of Agreement, Deed and Bill of Sale (1984) (discussing ownership interests and easements).

[23] *See* Attachment 22: TVA, Environmental Investigation Plan, Allen Fossil Plant, Rev. 0, at p. 8 (noting that TVA began sluicing slag to the northeast corner of the East Ash Disposal Area beginning in 1967).

[24] Until 1978, the West Ash Impoundment received sluiced fly ash and boiler slag full-time; sluice lines temporarily re-rerouted to West Ash Impoundment in 1992-93 while work was done on East Impoundment; continued to intermittently receive ash until 2015. Attachment 23: TVA, Draft Environmental Impact Statement, Ash Impoundment Closure Programmatic EIS, Part II—Site-Specific NEPA Review: Allen Fossil Plant, at § 1.1 (Dec. 2015).

[25] Attachment 24: 1976-78: East Ash Disposal Area temporarily taken off-line and East Dike constructed to approx. elevation of 237 feet. Stantec, "Liner Demonstration East Ash Disposal Area, EPA Final Coal Combustion Residual (CCR) Rule, TVA Allen Fossil Plant," at 6 (Oct. 6, 2016) [hereinafter Allen CCR Rule Liner Demonstration].

For decades, too, TVA has known about elevated levels of arsenic in the shallow groundwater near the plant.[26] In 1988, TVA installed 5 wells known as the "P-Series" wells: P-1 through P-5.[27] P-1 was installed as the "background well."[28] None of these wells were "installed such that the screen/sand pack interval intercepts the clay in the confining unit."[29]

Well Description for Wells Installed 1/12-2/28/1988[30]
Well P-1: total depth 59.3' | Ground surface elevation 216.80 ft-msl [mean sea level]
Well P-2 total depth 70.3' | Ground surface elevation 230.45 ft-msl [mean sea level]
Well P-3 total depth 90.3' | Ground surface elevation 231.1 ft-msl [mean sea level]
Well P-4 total depth 80.3' | Ground surface elevation 219.37 ft-msl [mean sea level]
Well P-5 total depth 69.3' | Ground surface elevation 219.79 ft-msl [mean sea level]

In 1988, the Tennessee Valley Authority Engineering Laboratory authored a report entitled, "Summary of Groundwater Data at Allen Fossil Plant, 1988."[31] The report indicated that, "The Memphis Sand Aquifer, the primary drinking water source for the city of Memphis, is believed to be separated from the alluvial aquifer by the Jackson Formation."[32] Borehole data, according to the report, indicated that the Jackson Formation consists "*primarily* of bluish-grey silty clay."[33] However, in one boring it was found to have "an 8-foot lens of gravel and sand."[34]

[26] *See* Attachment 25: "Alternate Source Demonstration: Arsenic Concentrations in Groundwater: TVA Allen Fossil Plant" (TVA 2013) [hereinafter Alternate Source Demonstration].

[27] Alternate Source Demonstration. P-6 was later installed in 2010. *Id.*

[28] Attachment 26: TVA, *Groundwater Monitoring Report: May 2017* at 1 (TVA).

[29] "With the exception of monitoring well P-6, none of the downgradient wells were installed such that the screen/sand pack interval intercepts the clay in the confining unit." Alternate Source Demonstration, 4-5.

[30] Attachment 27: Allen Fossil Plant Well Logs.

[31] 1988 Groundwater Summary. Notably, TVA's Expert at the Shelby County Groundwater Board permit appeal hearing included a list of documents he reviewed before preparing his report, and it does not include the 1988 Groundwater Summary report. *See* Attachment 28: Opinion of Donald Brice (AECOM), at 2-3 (Nov. 28, 2016).

[32] 1988 Groundwater Summary. at 11 (Executive Summary).

[33] *Id.* (emphasis added).

[34] *Id. Accord* Attachment 29: TVA, Final Environmental Assessment: Development of Ash Management Strategy Allen Fossil Plant, at 12 (Aug. 2006) ("The alluvial aquifer is separated from the deeper Memphis sand aquifer by a clay aquitard associated with the Jackson and Upper Claiborne formations. Overall thickness of the Jackson clay varies from 0-360 feet regionally. Several deep borings completed at the ALF site encountered Jackson aquitard at depths between 114-144 feet, although none fully penetrated the unit. Aquitard penetrations ranged from 4-40 feet and generally indicated the formation consists of silty clay with occasional thin lenses of silt, sand, lignite, and gravel.").

In 1996, TVA noted that its coal yard drainage basin, which was constructed in 1992 to contain the storm water runoff from the coal yard area, was designed to discharge into the East Pond, but that there had never been a discharge from the pond since its construction.[35]

In 2011, TVA's Office of Inspector General concluded that the Coal Plant has a history of arsenic levels above the maximum contaminant level of 10 μg/L as well as elevated levels of boron and sulfate, which indicate "probable ash impoundment releases and migration" and were "historically higher than the background data."[36] The OIG report also informed that, "According to TVA personnel, these levels have not been reported to TDEC because the testing was not required."[37]

In 2013, TVA hired a consultant to explain the arsenic pollution at the Coal Plant. TVA's consultant concluded that the elevated arsenic surrounding TVA's coal ash ponds was not clearly TVA's fault.[38] It does not appear, though, that TVA ever told TDEC about the P-Series arsenic exceedances until late 2016,[39] except to reveal exceedances in well P-6 in 2012 in conjunction with its plan to investigate "natural levels of arsenic."[40]

In 2014, TVA discontinued the "voluntary (*e.g.*, non-regulatory) monitoring program) . . . for budgetary reasons."[41] When the P-6 exceedances were disclosed and the public expressed

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[35] Attachment 30: Dike Stability/Quarterly Red Water Seep Inspection (Oct. 28, 1996)

[36] Attachment 31: Office of the Inspector General (TVA), *Final Report – Inspection 2009-12991 – TVA's Groundwater Monitoring at Coal Combustion Products Disposable Areas*, at 7 (June 21, 2011)[hereinafter 2011 Inspector General Report] ("At the time of the last testing, Allen's arsenic levels did not exceed the Maximum Contaminant Level (MCL), which was 50 ug/L.10 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.").

[37] *Id.*

[38] Alternate Source Demonstration, § 5.0.

[39] 2011 Inspector General Report, 7.

[40] Attachment 32: June 29, 2012 Letter from TVA to TDEC, available at http://environment-online.state.tn.us:8080/pls/enf_reports/f?p=9034:34051:::NO:34051:P34051_PERMIT_NUMBER:TN0005355 (entered into NPDES permit dataviewer as "July 2, 2012 Letter"). *See also* Attachment 33: July 12, 2017 Email from TDEC to TVA ("To avoid any future confusion regarding the significance of arsenic findings at the site, the Division has no formal record of officially receiving the subject ASD for formal review and comment. Therefore, the validity of the report's findings that the arsenic detected above the MCL was from another source, or naturally occurring has not been accepted by the Division at this time.").

[41] Attachment 34: July 28, 2017 Letter from TVA to TDEC (attaching *Groundwater Monitoring Report: May 2017*, at 1 (TVA)).

concern, TDEC's Director of Solid Waste Management responded, in part, that, "[B]ecause of arsenic levels reported in excess of Maximum Concentration Levels (MCL), I am requesting that the Division of Water Resources require continuous/periodic groundwater monitoring at the Allen Fossil Plant for the facility until the causation has been determined and the hazards have been adequately mitigated by treatment and/or design."[42]

TVA's groundwater monitoring data that pre-existed the decision to build the Gas Plant suggest that TVA knew about a legacy of pollution at the retiring Allen Coal Plant, but did not analyze it in the SEA.

D. Without public notice or disclosing contamination risks, TVA switched course and unilaterally determined to use cooling water sourced from the City of Memphis' drinking water aquifer to run the Gas Plant.

In response to public comments on the 2014 Environmental Assessment, TVA confirmed that it planned to use recycled gray water from its neighbor, the Maxson Wastewater Treatment Plant ("Maxson Plant" or "Maxson"), for condenser cooling water.[43] In fact, TVA described its decision to use the recycled water as "an opportunity to reduce the use of natural resources in the Memphis area," because, according to TVA, "The proximity of the proposed facility to the Maxson WWTP makes the use of gray water feasible for all uses that are currently fulfilled by McKellar Lake water."[44] TVA therefore left no doubt in the public's mind that TVA's plan was viable. Indeed, the Gas Plant requires only a small fraction of the available recycled water generated each day at Maxson:

> *The proposed gas plant would use approximately 4-8% of the gray water available from the WWTP. TVA would treat the gray water as necessary for use in the gas plant and would return approximately 1-2% of the treated water back to the WWTP. Currently the WWTP produces over 100 million gallons per day (MGD). The maximum that TVA would use is approximately 7-10 MGD.*[45]

In 2016, TVA changed course.[46] While using gray water was still technologically feasible, a consultant hired by TVA concluded that using recycled wastewater would be more expensive than potable water. [47]

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[42] Attachment 35: December 6, 2012 Letter from TDEC to Conservation Groups re Section 113(h) Complaint.

[43] Final EA at 223.

[44] *Id.*

[45] Final EA at 223.

[46] *See* Attachment 36: *Sierra Club*, Doc. 19-12 at PageID 971 (Michael Stiefel (TVA) talks to Greg Parker (Shelby County Health Department) about TVA's desire to drill wells for process water for the Allen Combined Cycle Plant, explaining, "The initial plan for providing cooling water and boiler makeup water was to utilize treated effluent (graywater) from the T.E. Maxson Sewage treatment facility. Economic evaluations of this approach indicate that using graywater would cost approximately 3 to 5 times as much as using potable water or withdrawing and treating

Revisiting its available alternative sources for cooling water, TVA issued an SEA in 2016, without public notice or opportunity for comment.[48] The SEA evaluated three alternatives to supply the cooling water for the Gas Plant:

1. "No Action," under which TVA would obtain gray water from, and discharge waste water to, the Maxson Plant, as proposed and described in the 2014 Environmental Assessment;
2. Installation of five wells into the Memphis Sand Aquifer; and
3. Purchasing potable water from Memphis Light, Gas & Water.[49]

Without disclosing or analyzing groundwater contamination at the nearby Allen Coal Plant or the vulnerability of the Aquifer in the vicinity of the Plant, TVA determined that the use of groundwater extraction wells, which would withdraw water from the Memphis Sands Aquifer, would have no significant environmental impacts.[50]

E. TVA obtained water well permits from Shelby County for the Gas Plant without disclosing the arsenic contamination at the Coal Plant.

Its deficient SEA in hand, TVA obtained permits to drill wells into the Memphis Sand Aquifer from Shelby County.[51] Just as TVA appears not to have alerted TDEC to the elevated arsenic levels in the groundwater at Coal Plant, TVA also appears not to have revealed the arsenic problems to the Shelby County Health Department when it applied for its cooling water well permits in 2015 and 2016.[52]

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groundwater. This is because more extensive treatment to reduce the levels of ammonia and other constituents will be needed than was originally anticipated.").

[47]Attachment 37: Kiewit Study, "KP-TVA-0225 - TVA Allen Water Treatment Study."

[48] SEA, 11.

[49] 2016 FONSI, 1.

[50] *Id.*

[51] Attachment 38: WP-16-020, WP-16-034, WP-16-047. E.g., *Sierra Club*, Doc. 19-12 at PageID 940, 944-45; Doc. 19-13 at PageID 1107. Each of the permits state, "No authority is granted by this permit to construct, operate or maintain any well in violation of any law, statute, ordinance, rule or regulation of Memphis and Shelby County, Tennessee." Doc. 19-12 at PageID 960, 962. TVA obtained its first water well construction permits from Shelby County on January 7, 2016. TVA obtained its first water well construction permits from Shelby County on January 7, 2016. However, TVA had to abandon this well due to a "collapse," Doc. 19-12 at PageID 956, Subsequently, TVA's "drilling and subsurface investigator" drilled an 820-foot deep exploratory boring just south of the Coal Plant. Doc. 19-13 at PageID 1107.

[52] In November 2016, the Shelby County Health Department sent a memo to the Shelby County Groundwater Quality Control Board, which responded to the Sierra Club's arguments, and stated, in part, "**To the extent that groundwater contamination is discovered in the future**, those issues can be addressed through the Department's enforcement of the Rules' Inspection and Enforcement and Penalties provisions (Sections 8 and 16)." Attachment

In mid-2016, after TVA had already obtained three of the five permits it desired, the community found out about TVA's changed plans.[53] The public and their elected officials were deeply concerned to learn that "TVA has diverged from its previously-announced plans to utilize gray water . . . and has instead decided to pursue the use of fresh water from the Memphis Sands Aquifer . . . . a precious interstate resource that provides millions of Americans with fresh, famously palatable drinking water."[54] Around this time, U.S. Representative Steve Cohen memorialized a meeting he had with TVA's CEO, Bill Johnson, on the subject:

> In our meeting, you expressed your reluctance to commission an additional study to review specifically the potential for water-quality changes as a result of TVA's proposed use of groundwater at the Allen Combined-Cycle Plant, indicating that as a former trial lawyer you were uncomfortable with commissioning such a study amid local scrutiny. . . . You agreed that the USGS could likely conduct a study to review the potential for contamination of groundwater in the Memphis Sand Aquifer, but indicated that TVA would be interested in requesting such a study only on the contingency that public scrutiny lessens.[55]

Other efforts were undertaken by TVA to educate critics of the Pumping Plan.[56] However, after taking a tour of MLGW's infrastructure and visiting the site of TVA's wells,

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39: Shelby County Health Department's Response to Sierra Club's Appeal to TVA Well Permits, *Sierra Club*, Doc. 19-17 at PageID 1869 (emphasis added),

[53] "On July 20, 2016, Sierra Club staff learned that a Supplemental Environmental Assessment (SEA) was conducted in April but that the public, including the approximately 1,500 people and organizations that had commented on the original EA, was not notified in any way that it was being done. It was not even posted on its own NEPA compliance page for the Allen Fossil Plant Emission Control Project. Upon learning that an SEA was available, Sierra Club Staff inquired with TVA as to where it could be found. The next day TVA directed Sierra Club Staff to the aforementioned webpage where it was NOT to be found the day before. Sierra Staff checked the Wayback Machine (historical snapshots of websites) and confirmed that it was not there in April." Attachment 40: https://www.sierraclub.org/tennessee/blog/2016/08/background-and-links-regarding-tvas-planned-use-memphis-sand-aquifer-cool-its.

[54] Attachment 41: August 29, 2016 Rep. Cohen Letter to TVA CEO Johnson, https://cohen.house.gov/sites/cohen.house.gov/files/documents/8.29.2016%20Letter%20to%20President%20Johnson.pdf [hereinafter October 18, 2016 Cohen Letter] *See also* Attachment 42: October 18, 2016 Rep. Cohen Letter to TVA CEO Johnson, https://cohen.house.gov/sites/cohen.house.gov/files/documents/10.18.2016%20Letter%20to%20President%20Johnson.pdf [hereinafter October 18, 2016 Cohen Letter].

[55] Attachment 43: February 3, 2017 Rep. Cohen Letter to TVA CEO Johnson, https://cohen.house.gov/sites/cohen.house.gov/files/documents/2.3.2017%20Letter%20to%20President%20Johnson.pdf.

[56] Attachment 44: Bill Dries, "State Sens. Harris, Kelsey Critical of TVA Water Wells", MEMPHIS DAILY NEWS (Jan. 26, 2017), https://www.memphisdailynews.com/news/2017/jan/26/harris-and-kelsey-critical-of-tva-water-wells//print.

State Senator Brian Kelsey told the Memphis Daily News, "I feel more convinced now that drilling these wells was not the best way to provide water to the TVA plant."[57]

In late 2016, the Sierra Club appealed TVA's final two well construction permits issued by the Shelby County Health Department.[58] The appeal related only to the final two well permits because, without having had notice of the first three permits, the deadline to appeal had already passed to challenge them.[59] In November 2016, the Shelby County Groundwater Control Board and an appointed hearing officer heard the Sierra Club's appeal, which was subsequently denied.[60]

Conservation Groups then filed a Petition for Writ of Certiorari in the Shelby County Chancery Court to challenge the Board's decision to uphold the county's issuance of TVA's well permits, claiming that the Board's decision to issue permits to TVA was contrary to the Board's Rules and Regulations.[61] TVA removed the case to federal court and moved to dismiss the appeal, claiming procedural defects (*i.e.*, that the petition filed in Chancery Court was not sworn to within 60 days).[62] The district court concluded that the appeal became final on February 5, 2017 such that the petition filed on February 1 and verified on February 9, 2017 was untimely.[63] The court did not reach the merits of the appeal.

Despite the public outcry and the availability of other sources of cooling water, TVA has continued to fight to use what it considers "free" drinking water as industrial cooling water. But as described below, new circumstances and information regarding the risk of contamination of the Aquifer require TVA to prepare an environmental impact statement ("EIS"), including a full analysis of available alternatives, before selecting a source of cooling water to operate the Allen Gas Plant.

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[57] *Id.*

[58] *See* Attachment 45: *Sierra Club*, Doc. 29 at PageID 2108.

[59] Attachment 46: Appeal filed by Sierra Club, https://www.sierraclub.org/sites/www.sierraclub.org/files/sce/tennessee-chapter/20161004_SierraClub_TVA_Well_Permits_Appeal.pdf.

[60] Attachment 47: *Sierra Club*, at Doc. 7-2 (Shelby County Health Department cover letter enclosing Final Order of Shelby County Groundwater Control Board).

[61] Attachment 48: Tom Charlier, "Environmentalists sue to block TVA wells in Memphis aquifer," MEMPHIS COMMERCIAL APPEAL (Feb. 1, 2017), https://www.commercialappeal.com/story/news/environment/2017/02/01/environmentalists-sue-block-tva-wells-memphis-aquifer/97295656/.

[62] Attachment 49: *Sierra Club*, Doc. 30 at PageID 2125-27 (noting that on December 5, 2016, a "Final Order" was entered and signed by the Hearing Officer; on December 7, 2016, a copy of the Final Order was sent by certified mail to Sierra Club's representative, who received it on December 19, 2016; the petition was verified on February 9, 2017).

[63] Attachment 50: *Sierra Club*, Doc. 30 at PageID 2131.

II. TVA must prepare an EIS to analyze groundwater quality impacts associated with the Pumping Plan and a reasonable range of alternatives to the Plan.

A. To ensure no-regrets, informed federal action under NEPA, agencies like TVA are required to prepare supplemental environmental analyses when significant new circumstances or information emerges.

NEPA is "our basic national charter for protection of the environment."[64] Other environmental statutes focus on particular media (like air, water, or land), specific natural resources (such as wilderness areas or endangered plants and animals), or discrete activities (such as mining, introducing new chemicals, or generating, handling, or disposing of hazardous substances). In contrast, NEPA applies broadly "to promote efforts which will prevent or eliminate damage to the environment."[65]

NEPA has "twin aims. 'First, it places upon [a federal] agency the obligation to consider every significant aspect of the environmental impact of a proposed action. Second, it ensures that the agency will inform the public that it has indeed considered environmental concerns in its decisionmaking process.'"[66]

To accomplish its goal of informed decision-making, NEPA requires agencies to disclose and analyze potential environmental impacts associated with any "major federal action,"[67] which means any action which has the potential to significantly affect the environment.[68] Courts have found the commencement of operation of an already-constructed project to constitute remaining "major federal action" subject to the requirements of NEPA.[69]

NEPA "emphasizes the importance of coherent and comprehensive up-front environmental analysis to ensure informed decisionmaking to the end that 'the agency will not act on incomplete information, only to regret its decision after it is too late to correct.'"[70]

NEPA requires an agency to prepare a supplemental EIS if: "(i) The agency makes substantial changes in the proposed action that are relevant to environmental concerns; or

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[64] 40 C.F.R. § 1500.1(a).

[65] National Environmental Policy Act § 2, 42 U.S.C. § 4321.

[66] *Kern v. Bureau of Land Mgmt.*, 284 F.3d 1062, 1066 (9th Cir. 2002) (quoting *Balt. Gas & Elec. Co. v. Natural Res. Def. Council, Inc.*, 462 U.S. 87, 97 (1983)) (internal quotations and citations omitted, alteration in original).

[67] 42 U.S.C. § 4332(C); 40 C.F.R. § 1508.18.

[68] 40 C.F.R. §§ 1508.18; 1508.27.

[69] *See Chem. Weapons Working Grp. Inc. v. U.S. Dep't of Army*, 935 F. Supp. 1206, 1217 (D. Utah 1996), *aff'd sub nom. Chem. Weapons Working Grp., Inc. (CWWG) v. U.S. Dep't of Army*, 111 F.3d 1485 (10th Cir. 1997) (quoting Marsh, 490 U.S. at 374).

[70] *Blue Mountains Biodiversity Project v. Blackwood*, 161 F.3d 1208, 1216 (9th Cir. 1998).

(ii) There are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts."[71] An agency is required to "prepare, circulate, and file a supplement to a statement in the same fashion (exclusive of scoping) as a draft and final statement. . . ."[72] If changed circumstances or new information will affect the environment "in a significant manner or to a significant extent not already considered, a supplemental EIS must be prepared."[73] TVA's NEPA implementing procedures require it to supplement an environmental assessment (EA) in the same circumstances.[74]

A supplemental EIS is also appropriate to correct significant omissions in the original draft.[75] "Informed public participation in reviewing environmental impacts is essential to the proper functioning of NEPA."[76] An environmental analysis that omits significant information prevents both the public and the decisionmaker from making an informed decision.

As the Supreme Court has explained, it would be incompatible with NEPA's key purpose of informed federal decisionmaking for the "blinders to adverse environmental effects" to be restored prior to the completion of agency action simply because the relevant proposal has received initial approval."[77] In ordering supplemental analysis based on significant new circumstances, the Court of Appeals for the Ninth Circuit has observed, "Without supplemental analysis of impacts…the public would be at risk of proceeding on mistaken assumptions."[78]

An agency must also consider its own guidelines implementing NEPA in determining whether to prepare an environmental impact statement rather than an environmental assessment.[79] TVA's NEPA guidelines require the agency to prepare an EIS when the environmental impact of a major action "is expected to be highly controversial."[80] In the context of NEPA, the long-standing definition of "controversial" is derived from judicial opinions.

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[71] 40 C.F.R § 1502.9(c)(1).

[72] 40 C.F.R § 1502.9(c)(1).

[73] *Marsh v. Oregon Nat. Res. Council.* 490 U.S. 360, 374 (1989).

[74] Attachment 51: TVA, Procedures for Compliance with the National Environmental Policy Act, § 5.3.6 [hereinafter TVA NEPA Implementing Procedures] ("If new information concerning action modifications, alternatives, or probable environmental effects becomes available, the initiating office, in consultation with the Environmental Quality Staff and the Office of General Counsel, will consider preparing a revision or supplement to the EA based on the significance of the new information.")

[75] *Idaho Sporting Cong. Inc. v. Alexander*, 222 F.3d 562, 567 (9th Cir. 2000).

[76] *League of Wilderness Defenders/Blue Mountains Biodiversity Project v. Connaughton*, 752 F.3d 755, 761 (9th Cir. 2014).

[77] *Marsh*, 490 U.S. at 371.

[78] *League of Wilderness Defenders*, 752 F.3d at 761.

[79] 40 C.F.R. §§ 1501.4(a); 1508.9.

[80] TVA NEPA Implementing Procedures § 5.4.1.

These opinions hold that "controversial" means "a substantial dispute as to the size, nature, or effect of the action."[81] A substantial dispute about the size, nature, or effect of the action may exist without reference to the agency's methodology or data, and may be based on simple facts on the ground, including but not limited to community concern and existing and new data and reports that were not adequately considered by the agency.[82]

TVA's NEPA guidelines also require the agency to prepare an EIS when a major action "will have a significant effect on the quality of the human environment."[83] Under NEPA, an agency must evaluate the significance of environmental impacts, including the significance of new information relevant to those impacts, using several factors,[84] including, but not limited to:

- Potential impacts on public health and safety;
- Unique characteristics of the geographic area;
- The controversial nature of the effects on the environment;
- The degree of uncertainty about the effects, or the degree to which the effects involve unique or unknown risks;
- Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment; and
- Whether the action threatens a violation of Federal, State, or local law or requirements imposed for the protection of the environment.[85]

If a major action does not fall into the category of actions for which an agency must prepare an EIS, it may evaluate the significance of potential impacts in an environmental assessment or supplemental environmental assessment. If, after preparing a supplemental environmental assessment, an agency finds that significant environmental impacts are likely, the agency must prepare an environmental impact statement.[86]

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[81] *Rucker v. Willis*, 484 F.2d 158, 162 (4th Cir. 1973); *Hillsdale Env'l Loss Prevention, Inc. v. U.S. Army Corps of Eng'rs*, 702 F.3d 1156, 1181 (10th Cir. 2012); *Wetlands Action Network v. United States Army Corps of Eng'rs*, 222 F.3d 1105, 1122 (9th Cir. 2000), abrogated on other grounds by *Wilderness Soc. v. U.S. Forest Service*, 630 F.3d 1173 (9th Cir. 2011).

[82] In its proposed revisions to its NEPA procedures, TVA impermissibly attempts to narrow the definition of "controversial" to refer only to "scientifically supported commentary that casts substantial doubt on the agency's methodology or data, but does not mean commentary expressing mere opposition." This is not the definition that applies to TVA currently, and, as Conservation Groups argued in response to the proposal, it is contrary to law and arbitrary. Attachment 52: Letter from Conservation Groups re TVA Proposed Rule, Procedures for Implementing NEPA, 10-12 (September 6, 2017) [hereinafter Conservation Group Comments on TVA Proposed NEPA Rule].

[83] *Id*.

[84] *Id.*

[85] *See* 40 C.F.R § 1508.27 (defining "significantly").

[86] 40 C.F.R. § 1501.4(c).

B. Neither the 2014 EA nor the 2016 SEA analyzed groundwater quality impacts associated with operating on-site cooling water wells.

As described in Section I.D above, TVA's previous NEPA analyses for the Allen Gas Plant did not evaluate the potential for on-site cooling water wells to pull contaminated shallow groundwater into the Aquifer. The 2014 EA defined the project to include the use of gray water from the Maxson Treatment Plant and a *de minimis* amount of treated water from MLGW.[87] Although the EA briefly discussed groundwater, it did not contemplate the use of on-site groundwater wells for cooling, and therefore it did not analyze any potential impacts to groundwater quality that would be associated with drawing water directly from the Memphis Sand Aquifer.[88]

TVA prepared the 2016 SEA specifically to analyze impacts associated with its Pumping Plan to draw water directly from the Memphis Sand Aquifer on site, rather than use gray water from the nearby Maxson Plant.[89] However, the analysis in the SEA focused exclusively on the potential impacts of the Pumping Plan on groundwater *quantity*.[90] As described in Section II.D below (omitted information), at the time, TVA knew that (1) the Allen Fossil Plant was located in an area known to have a thin or non-existent clay confining layer between the shallow aquifer and the Memphis Sand Aquifer; and (2) the shallow groundwater under the East Pond was contaminated with arsenic and other pollutants. But TVA did not disclose or analyze either of these facts about the existing environment in its SEA. Instead, the agency concluded, without analysis, that it did not need to study the potential impacts to groundwater quality because it would comply with applicable laws:

> …TVA will adhere to and support all appropriate standards and requirements (including licensing and permitting) associated with well installation and groundwater usage, as to prevent contamination of groundwater during well installation or operation. Accordingly, no significant impacts to groundwater quality are expected to occur for any of the proposed alternatives.[91]

A report prepared by the United States Geological Survey ("USGS") to support TVA's SEA expressly disclaimed having performed any analysis of risks to groundwater quality posed by the proposal:

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[87] 2014 Final EA, 4, 68-69.

[88] *Id.*

[89] 2016 SEA, 1-3.

[90] *Id.* ("[T]he analysis below is appropriately limited to groundwater supply or quantity.")

[91] *Id.*

> This report does not address the potential effects of water leakage from the shallow aquifer on groundwater quality in the Memphis aquifer.[92]

The USGS nevertheless observed, in its discussion, that contamination risks to the Aquifer were a distinct possibility:

> The potential effect of the withdrawals at the Allen plant site on water levels in the shallow aquifer as well as the potential for water-quality changes due to the leakage of water from the shallow aquifer near the Allen plant site cannot be fully evaluated with the available data. Simulated declines in the overlying shallow aquifer at the Allen site were less than 1 ft; however, water-quality changes in the Memphis aquifer due to the leakage of water from the shallow aquifer have been noted in nearby Memphis Light, Gas and Water Division well fields at Davis and Allen."[93]

In fact, as discussed below in Section II.D, existing TVA reports had also previously identified the contamination risk. But in the SEA, TVA did not disclose or analyze its own reports or the risk of contamination of the Aquifer posed by its Pumping Plan.

TVA did not circulate the draft SEA and FONSI for public comment. The public therefore had no opportunity to provide TVA with additional information regarding existing contamination and local hydrogeology at and near the Allen facilities.

C. After TVA issued its Finding of No Significant Impact for the SEA, new circumstances and information emerged related to the risk of contaminating the Memphis Sand Aquifer.

In July 2017, TDEC notified the public that TVA had reported contaminants in its groundwater wells along the perimeter of the East Pond above the relevant groundwater protection standards—in some cases, *300 times* the groundwater protection standard. Shockingly, TVA waited *six months* before disclosing this information to TDEC.[94] The new information reported by TDEC included the following chart:[95]

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[92] Attachment 53: Haugh, Connor J., Evaluation of Effects of Groundwater Withdrawals at the Proposed Allen Combined-Cycle Combustion Turbine Plant, Shelby County, Tennessee, U.S. Geological Survey, Scientific Investigations Report 2016-5072, 1 (2016) [hereinafter USGS 2016].

[93] USGS 2016, 7.

[94] At the same time, TVA was defending its groundwater well permits before the Shelby County Groundwater Board and in court. *Cf.* Attachment 54: *Sierra Club*, Doc. 30: Order Granting Respondents' Motions to Dismiss (noting that on February 27, 2017, TVA moved to dismiss the Conservation Groups' petition for judicial review of the Groundwater Board's final order to issue well permits to TVA).

[95] TDEC, TVA Allen Fossil Plant –Site Information: Discovery of Arsenic in Ground Water Monitoring Wells, 3 (July 11, 2017) [hereinafter Allen Fossil Plant-Site Information].

Table 1. Arsenic Levels in the TVA ALF Ground Water Monitoring Wells near the TVA ALF East Ash Surface Impoundment

	MW 202	MW 203	MW 204	MW 210	MW 212	MW 213
November 2016	177	3900	46	< 10	11.6	31.6
January 2017	176	3230	42.8	< 10	12.2	16.4
February 2017	199	3220	36.8	10.6	15.4	15.1
March 2017	245	3620	49.9	< 10	14.5	11.4
April 2017	197	2890	49.1	< 10	< 10	< 10
May 2017	235	3560	56.9	< 10	< 10	< 10

Results are in parts per billion
The Drinking Water Limit for Arsenic is 10 ppb

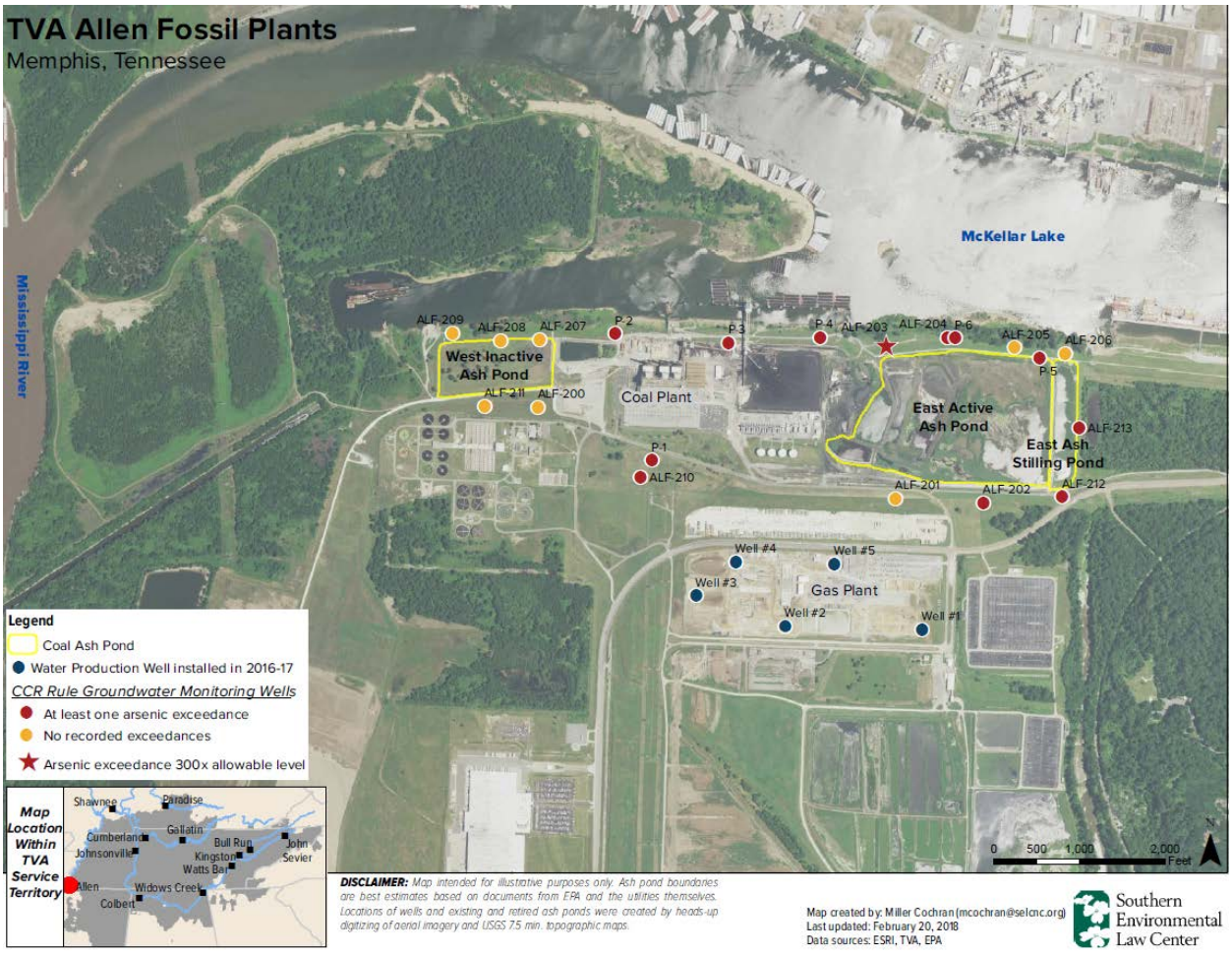
In addition to extremely high levels of arsenic, TVA also reported significant exceedances of groundwater protection standards for lead and fluoride.[96] Arsenic, lead, and fluoride are all coal ash indicator pollutants identified in Appendix IV to the federal Coal Ash Rule as triggering the need for corrective action to remedy the contamination.[97]

The contaminated wells along the perimeter of the leaking, unlined East Pond are located very close to the cooling water wells TVA has installed at the nearby Allen Gas Plant and intends to operate pursuant to the Pumping Plan. This proximity is illustrated in the following map:[98]

[96] *Id.*

[97] *See* Appendix IV to 40 C.F.R. Part 257.

[98] *See* Attachment 55: TVA, Environmental Investigation Plan, Allen Fossil Plant Revision, 1 (TVA Dec. 8, 2017) (Appendix P: Groundwater Monitoring Data) (identifying arsenic exceedances).



Based on the new information TDEC received regarding groundwater contamination at the Allen Coal Plant, TDEC invoked its authority under the Commissioner's Order and state law to require TVA to perform a remedial investigation.[99] TDEC required an expedited investigation because of TVA's plans to operate the cooling water wells at the Allen Gas Plant so close to the contaminated groundwater under the East Pond.[100] TDEC specifically required TVA to investigate the potential for the contamination to migrate from the shallow aquifer into the Memphis Sand Aquifer.[101]

To address TDEC's concerns, TVA's consultants provided a survey of existing information and proposed to perform a 24-hour pump test to begin assessing whether there are

[99] Attachment 56: Letter from Steve Goins, TDEC to TVA (July 18, 2017) (outlining requirements for remedial investigation) [hereinafter TDEC Letter re: RI Requirements].

[100] *Id.*

[101] *Id.*

windows in the clay confining layer under the contaminated East Pond.[102] At the same time, the consultants acknowledged that mapping the subsurface would require additional study that could not be completed before TVA's planned start date for operating the gas plant.[103]

TVA nevertheless continued to insist that it could move forward with operating the Gas Plant before the remedial investigation was complete.[104] After SELC sent a letter raising concerns about TVA's plans,[105] TVA agreed that it would not operate the cooling water wells until the remedial investigation is complete.[106] But the utility continues to insist that it may ultimately operate the wells, without having analyzed the new information under NEPA. TDEC's remedial investigation, which includes studies being conducted at both the Coal plant and the Gas plant, constitutes new circumstances relevant to impacts to groundwater quality associated with TVA's proposal to operate the on-site cooling water wells.

Further, although the remedial investigation ordered by TDEC is still pending, TVA's own documents developed during the investigation indicate significant uncertainty regarding whether there is a continuous clay liner that will protect the Memphis Sand Aquifer from the Coal Plant contamination now and in the future. In particular, TVA has reported that it did not encounter a clay layer when drilling one of the deep monitoring wells it proposed to install as part of the investigation.[107] "During drilling, a lower confining unit was encountered during advancement of every deep monitoring well except for ALF-212."[108] And despite having performed the 24-hour pump test in October, TVA has repeatedly delayed releasing the results to TDEC or the public.[109]

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[102] RI Work Plan, at Appendix E.

[103] *Id.*

[104] Attachment 57: August 23, 2017 Letter from TVA to TDEC re "Allen Fossil Plant CCR Constituents in the Upper Most Aquifer and Use of Cooling Water Wells Installed into the Memphis Sands Aquifer" ("TVA does not plan to utilize ACC cooling water wells for plant operations until we have additional data to support safe use.").

[105] Attachment 58: October 24, 2017 Letter from SELC to TDEC re: Inadequacy of TVA Allen Fossil Plant Remedial Investigation Work Plant Proposal re: Allen Combined Cycle Production Wells" [hereinafter SELC Letter re: Inadequacy of RI Work Plan].

[106] Attachment 59: November 27, 2017 Letter from TVA to TDEC re "Allen Combined Cycle Plant (ACC) – Use of Production Wells" ("TVA will not sue the production wells at the Allen Combined Cycle Plant before the completion of the Remedial Investigation, and TVA will rely on the results of the Remedial Investigation to guide TVA's actions thereafter.").

[107] Attachment 60: September 15, 2017 Spreadsheet ("TVA ALF RIWP TDEC Comments").

[108] Attachment 61: September 15, 2017 Spreadsheet ("TVA ALF RIWP TDEC Comments"). *See also* Sept. 14, 2017 Email from Robert Wilkinson (referencing the fact that no confining layer was encountered at ALF-212: "TVA are proposing an additional stratigraphic boring at an adjacent location (STN 212). How deep are they planning on advancing the new boring? What was the depth of the clay that was encountered at the other deep wells? Do they have any confidence that they will encounter the clay at this location?").

[109] Attachment 62: Figure 7, ALF Remedial Investigation Schedule (initial pump test results submitted to TDEC October 27, 2017 or November 1, 2017); Attachment 63: Figure 7, ALF Remedial Investigation Schedule (initial pump test results submitted to TDEC on January 31, 201[8]); Attachment 64: Figure 7, ALF Remedial Investigation

Nor did TVA disclose or analyze the impact of the Pumping Plan in light of:

- Neighboring sites' contamination, such as the documented elevated arsenic levels at the Maxson wastewater treatment plant;[110] or
- The proximity to the Allen Plants of other facilities requiring pollution permits and RCRA/Superfund sites.[111]

These developments constitute additional new information relevant to environmental impacts associated with TVA's proposal to operate the cooling water wells.

D. New circumstances and information about the risk of contamination to the Aquifer also includes information TVA *omitted* from the EA and SEA.

TVA has known for several years that the groundwater under the East Pond has been polluted with arsenic and other contaminants. From 2011-2014 and beginning again in 2016,[112] TVA engaged in voluntary groundwater monitoring at the Allen coal plant. Arsenic levels regularly exceeded the groundwater protection standard, but at the time TVA apparently did not believe it needed to inform TDEC of the contamination.[113] After TDEC ordered an investigation of coal ash contamination at all of TVA's coal plants in Tennessee, TVA reported the arsenic contamination to TDEC in a slide presentation in late September 2016.[114] The levels of contamination TVA had been recording did not approach the levels TVA subsequently reported in July 2017. Nevertheless, at the time it prepared the SEA, the utility nevertheless had long been aware of contamination exceeding groundwater protection standards at the site and apparently had done nothing to disclose them or remedy them, as illustrated by the following slide from TVA's September 2016 presentation:

Schedule (initial pump test results submitted to TDEC on March 6, 2018); Attachment 65: Toby Sells, "Aquifer Test Results Still Not Available to Public," MEMPHIS FLYER (Jan. 30, 2018).

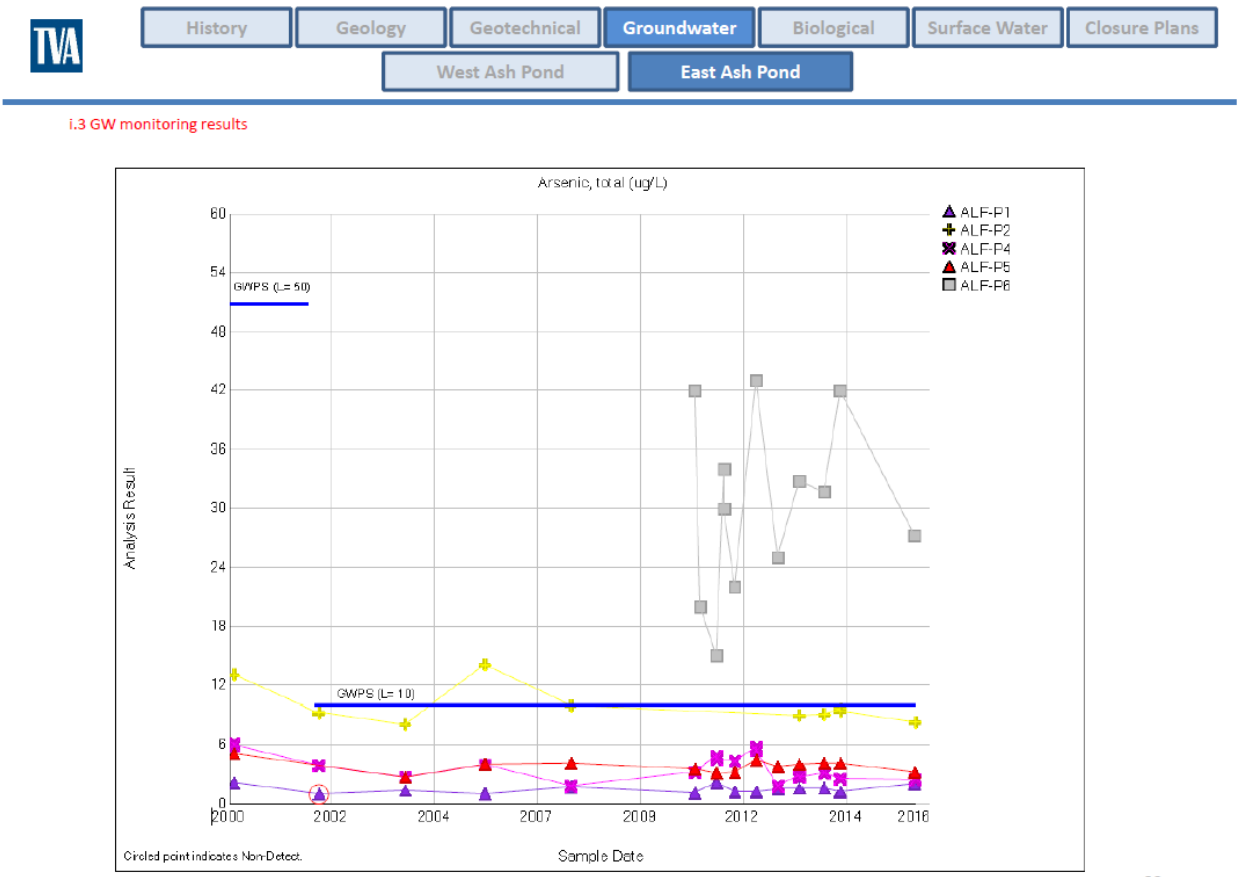
[110] Since 1995, "groundwater monitoring data for the T.E. Maxson South Wastewater Treatment Plant have documented consistent concentrations of arsenic higher than 200 µg/L in shallow alluvial groundwater . . . ." Attachment 66: RI Work Plan, at § 4.1.

[111] Attachment 67: Rules and Regulations of Wells in Shelby County, https://www.shelbycountytn.gov/DocumentCenter/View/768 ("A well cannot be sited or placed in service within a half-mile of the designated boundaries of a listed federal or State Superfund site or Resource Conservation and Recovery Act corrective action site, unless the well owner can make a demonstration that the well will not enhance the movement of contaminated groundwater or materials into the shallow or deep aquifer.")

[112] Attachment 68: TVA, Allen Fossil Plant Multisite Order Presentation, Slide 58 (September 28-29, 2016), .

[113] 2011Inspector General Report, 7.

[114] TVA Allen Fossil Plant Multisite Order Presentation, Slide 58 (September 28-29, 2016).



TVA has also been aware for decades that the area near the Allen Fossil Plant is highly likely to have windows in the clay confining layer that would allow contaminated shallow groundwater to flow into the Aquifer. A report from 1989 titled "Summary of Groundwater Data at Allen Fossil Plant" includes this statement:

> Although there is a sparsity of data in the plant area, the [USGS] report indicated that [the Allen Fossil Plant] is located in a region where the Jackson Bed is thin or absent and contains very little clay. Therefore, the potential for leakage from the overlying beds is apparently very high.[115]

The report analyzed groundwater samples taken from wells drilled in several places around the Allen Coal Plant and concluded:

[115] 1988 Groundwater Summary, 3.

> [G]roundwater pollution of the alluvium aquifer may be occurring and contamination of underlying formations is still a possibility. The groundwater flow in the alluvium is in the general direction of the Allen well field.[116]

This report indicates that TVA has been aware of the risk of its coal ash pollution entering into the Aquifer since at least 1988. Yet TVA did not disclose or analyze this risk in the SEA.

In addition, USGS reports that had been published decades before TVA prepared its SEA, and are publicly available through simple internet searches, also identified the area as high risk for leakage from the shallow aquifer into the Aquifer. For example, a 1986 USGS report[117] identified the Mississippi Alluvial Plain area along the Mississippi River where the Allen Plant is located as one of four large areas (illustrated as hatched areas on the figure below) considered to have a "high potential" for leakage from the shallow water table aquifer directly into the Memphis Sand Aquifer.

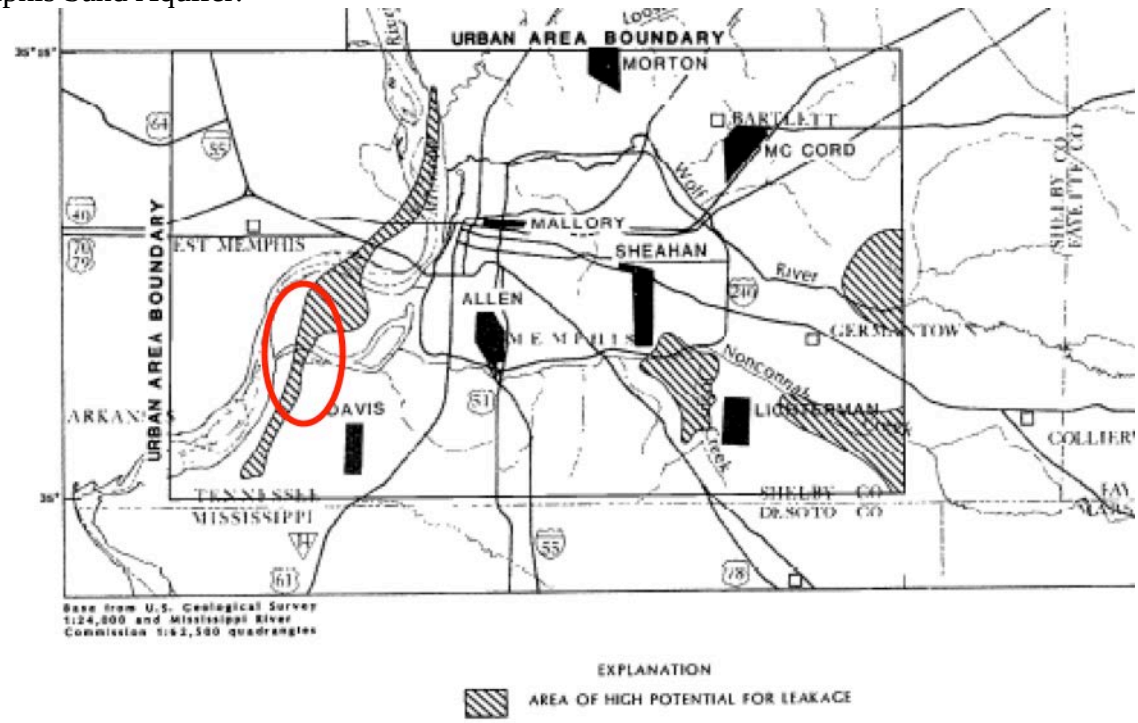


Figure 21.--Areas of high potential for downward vertical leakage from the water-table aquifers to the Memphis Sand in the Memphis urban area.

The Allen Plant area of the Mississippi Alluvial Plain is very near - if not within – an elongated "belt" of high leakage potential identified by the USGS parallel to the Mississippi River, as illustrated above. The USGS concluded that these areas have a high potential for leakage because the confining layer is locally "thin or absent," and that a "high potential exists

[116] *Id.* 13.

[117] USGS 1986, 37-38.

for the movement of water from the water table aquifers *directly* into the Memphis Sand."[118] The 1986 USGS report also reported that the area across McKellar Lake just north of the Allen Plant Site had a "zero" thickness of a confining layer above the Memphis Sand Aquifer. That area of zero thickness is less than 1 mile north of the Allen Plant. The "zero" thickness area is illustrated below:

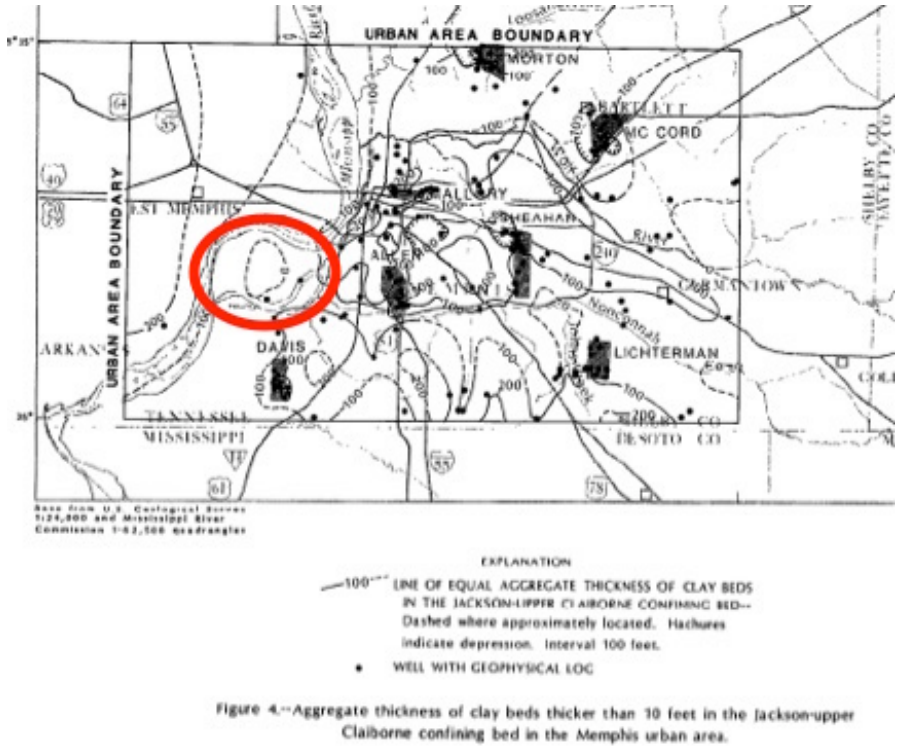


Figure 4.--Aggregate thickness of clay beds thicker than 10 feet in the Jackson-upper Claiborne confining bed in the Memphis urban area.

The USGS also concluded that even where the confining layer is present, the geologic formation includes multiple beds of clay, silt, sand, and minor lens of lignite and that "locally, individual beds may not be aerially extensive."[119] Further, the USGS concluded that because the confining layer contains so much fine sand and sandy silt, that a "better indicator of aerial differences in its ability to retard the movement of water between the water-table aquifers and the Memphis Sand is the *aggregate* thickness of clay beds within the unit."[120]

The USGS concluded that leakage is already occurring as a direct result of pumping from the Memphis Sand Aquifer in the active public water supply well fields and that "vertical downward leakage occurs from the water table aquifer through the confining beds to the Memphis Sand in MLGW (Memphis Light Gas and Water) well fields."[121]

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[118] *Id.* 37.

[119] *Id.* 9.

[120] *Id.*

[121] *Id.* at 37.

A 1995 USGS report identified additional areas that lack a clay confining layer just south of the Allen Coal Plant.[122] The report concluded, based on actual boring data, that there is no confining layer south of the Allen Plant along an area of the Mississippi Alluvial Plain, in which the Allen Plant is located. The USGS concluded that the confining layer "locally is absent."[123] The USGS concluded that "the absence of the confining unit beneath the Mississippi Alluvial Plain just west of the well field (Davis Field) provides a direct pathway for water in the alluvial aquifer to enter the Memphis aquifer."[124]

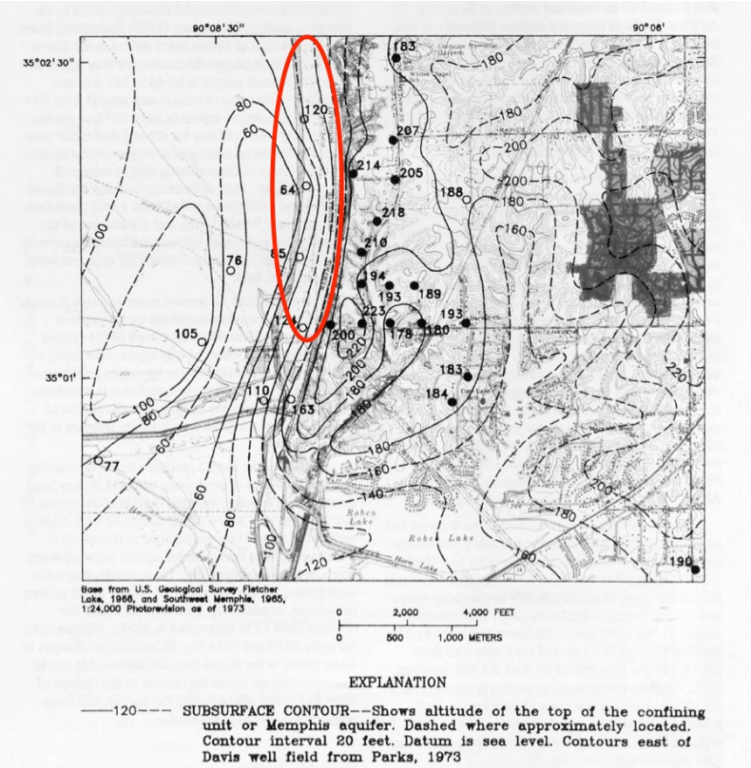
Another significant finding of the 1995 report is that the Memphis Sand Aquifer beneath the Mississippi Alluvial Plain is closer to the ground surface (*i.e.*, very shallow) when compared to other Memphis urban areas because of the undulations of the underlying geologic structure. The USGS concluded that the estimated top of the Memphis Sand Aquifer or the thin layer of the Cook Mountain Formation is approximately 100 to 120 feet above mean sea level (MSL) south of the Allen Plant, as illustrated below.[125]

[122] Attachment 69: Parks, William S., June E. Mirecki, and James A. Kingsbury, Hydrogeology, Ground-Water Quality, and Source of Ground Water Causing Water-Quality Changes in the Davis Well Field at Memphis, Tennessee, U.S. Geological Survey, Water Resources Investigations Report 94-4212, 1 (1995) [hereinafter USGS 1995].

[123] *Id.* at 1.

[124] *Id.*

[125] *See id.*, Figure 8, at 16.



Despite the significant findings in the 1986 and 1995 USGS reports relevant to the potential for contamination to travel from shallow groundwater into the Aquifer, the 2016 analysis conducted by USGS for TVA does not provide further analysis of contamination potential. Although USGS cites the 1995 report as a reference in in its 2016 evaluation, it expressly states that its analysis does not address the risk of contamination through leakage from the shallow aquifer into the Aquifer.[126]

TVA omitted all of the significant information described above regarding groundwater quality and the risk of contamination of the Aquifer from the SEA, including its history of arsenic contamination at the Allen Coal Plant as documented in several years of the utility's own groundwater monitoring reports and its awareness of the high potential for leakage of that contamination into the Aquifer as documented in the utility's own 1988 report. TVA also omitted information regarding the high potential for leakage of shallow groundwater into the Aquifer contained in publicly-available USGS reports, one of which was expressly referenced but not analyzed by the 2016 USGS report commissioned by TVA. As explained in Section II.E below, this information is significant and indicates that the Pumping Plan will have significant groundwater quality impacts. Accordingly, TVA must prepare an EIS to analyze this significant, omitted information.

[126] 2016 USGS, at 7.

E. The new circumstances and information relevant to groundwater contamination are significant and highly controversial, requiring TVA to prepare an EIS.

Even a cursory review of the significance factors TVA is required to consider under NEPA shows that the new circumstances and information described in Section II.C-D of this letter trigger an obligation to supplement TVA's environmental analyses and prepare an EIS, in order to evaluate the Pumping Plan and reasonable alternatives for providing cooling water at the Allen Gas Plant. In particular, the nature of the impacts is also highly controversial and uncertain, warranting the need for the detailed scrutiny and heightened public participation opportunities provided by an EIS. TVA's Pumping Plan also threatens violations of Federal, State, and local laws imposed for the protection of the environment.[127] Given the local hydrogeology, the proposal may also have significant cumulative impacts, by drawing contaminated shallow groundwater from other sites within the cone of depression created by operating the cooling water wells. Finally, the new circumstances and information also show that the proposal would threaten a unique local resource—the Aquifer—which also serves as Memphis's only drinking water source. For any and all of these reasons, described in more detail below, TVA must prepare an EIS for its proposal.

1. The nature of the Pumping Plan's impact on groundwater is highly controversial, requiring TVA to prepare an EIS pursuant to its own regulations.

As explained above in Section II.A, TVA's own regulations implementing NEPA require it to prepare an EIS when the environmental impact of a major action "is expected to be highly controversial."[128] In the NEPA context, courts have interpreted "controversial" to mean "a substantial dispute as to the size, nature, or effect of the action."[129]

The new and omitted circumstances and information detailed in Section II.C-D demonstrate that the nature of the Pumping Plan's impact on groundwater quality in the Aquifer is highly controversial. Indeed, after TVA belatedly disclosed the high levels of contamination in the East Pond, TDEC became so concerned about the Pumping Plan's impact on the Aquifer that it has required TVA to investigate the impact and complete a three-dimensional contaminant transport and groundwater flow model before TVA implements the Pumping Plan.[130] Emails among TDEC staff at the time of public disclosure of the exceedingly high arsenic contamination at the Allen Coal Plant including the following statements:

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[127] *See* 40 C.F.R § 1508.27 (defining "significantly").

[128] TVA NEPA Implementing Procedures § 5.4.1.

[129] *Rucker v. Willis*, 484 F.2d 158, 162 (4th Cir. 1973); *Hillsdale Env'l Loss Prevention, Inc. v. U.S. Army Corps of Eng'rs*, 702 F.3d 1156, 1181 (10th Cir. 2012); *Wetlands Action Network v. United States Army Corps of Eng'rs*, 222 F.3d 1105, 1122 (9th Cir. 2000), abrogated on other grounds by *Wilderness Soc. v. U.S. Forest Service*, 630 F.3d 1173 (9th Cir. 2011).

[130] TDEC Letter re: RI Requirements.

> [T]here is evidence for connectivity between the shallow alluvial aquifer at the Allen Plant and the Memphis Sands Aquifer due to the potential erosion/absence of the confining layer, and, there is a potential pathway for migration of contaminants that needs to be investigated and assessed.[131]

> Given that TVA may begin use of the 3 Colling [sic] Water wells that are installed into the Memphis Sands, TDEC needs to move quickly to understand the ground water contamination, potential for use of the Cooling Water wells to drawdown the Uppermost Aquifer, the extent of contamination (horizontally and vertically) in the Uppermost Aquifer, etc.[132]

Under pressure from the public and local officials,[133] TDEC also obtained agreement from TVA not to implement the Pumping Plan until its investigation is complete.[134] TVA waited six months even to disclose the high levels of contamination,[135] and, once it did so, continued to insist that it could implement its Pumping Plan without further investigation of the impact on the Aquifer. In fact, TVA's communications staff represented to reporters and the public that there was no concern about the migration of contaminants into the Aquifer:

> TVA spokesman Scott Brooks said the agency is cooperating with TDEC. The discovery of the pollution, however, won't affect the agency's plans to pump water from the Memphis Sand to cool the natural gas-fired, $975 million Allen Combined Cycle Plant, which is set to replace the nearby coal-burning plant in June 2018, he said. The shallow aquifer in which the contaminants showed up is not connected to the shallow [aquifer] and above the dense clay over Memphis Sand. "The wells that were tested don't go below the clay barrier," Brooks said.[136]

TDEC has identified the risk to the Aquifer and required TVA to conduct an investigation, over TVA's insistence that there was no problem. In other words, a substantial

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[131] Attachment 70: July 11, 2017 Email from Wilkinson (TDEC).

[132] Attachment 71: July 13, 2017 Email from Head (TDEC): "Ground Water Investigation at the TVA Allen Fossil Plant."

[133] Attachment 72: Bill Dries, "Harris Calls for Suspension of TVA Well Permits," MEMPHIS DAILY NEWS (July 24, 2017), https://www.memphisdailynews.com/news/2017/jul/24/harris-calls-for-suspension-of-tva-well-permits/ (describing letter Sen. Harris sent to the Shelby County Groundwater Board); SELC Letter re: Inadequacy of RI Work Plan.

[134] Attachment 73: August 23, 2017 Letter from TVA to TDEC re "Allen Fossil Plant CCR Constituents in the Upper Most Aquifer and Use of Cooling Water Wells Installed into the Memphis Sands Aquifer"; Attachment 74: November 27, 2017 Letter from TVA to TDEC re "Allen Combined Cycle Plant (ACC) – Use of Production Wells".

[135] TVA Allen Fossil Plant Site Information.

[136] Attachment 75: Tom Charlier, "High levels of arsenic, lead found beneath Tennessee Valley Authority plant," MEMPHIS COMMERCIAL APPEAL (July 12, 2017), https://www.commercialappeal.com/story/news/2017/07/12/high-levels-arsenic-lead-found-beneath-tennessee-valley-authority-plant/470096001/.

dispute exists between TDEC and TVA as to the size, nature, or effect of the Pumping Plan on the Aquifer.[137]

This in itself demonstrates that the Pumping Plan's impacts are highly controversial.

Other indications that a substantial dispute as to the size, nature or effect of the Pumping Plan in light of the new and omitted circumstances and information detailed in Section II.C-D include, but are not limited to, the following:

- The well permit appeal and subsequent litigation regarding two of the wells, in which Conservation Groups attempted to bring forward some of the omitted history of contamination at the Allen Coal Plant and evidence of the lack of a confining layer in the area;[138]
- Letter from State Senator Lee Harris demanding that the Shelby County Groundwater Board revoke TVA's well permits in light of the high levels of contamination reported at the Allen Coal Plant;[139]
- Letters and statements from U.S. Representative Steve Cohen demanding answers from TVA regarding the Pumping Plan;[140]
- Additional statements by public officials as described in Section II.E, above, including Congressman Cohen reporting that TVA CEO Bill Johnson refused to analyze impacts of the Pumping Plan on groundwater quality until "public scrutiny" subsided;
- The Shelby County Groundwater Board convening a public meeting to address citizen concerns regarding the risk of TVA's contaminated groundwater being pulled into the Aquifer[141] and deciding to rewrite the local groundwater ordinance in the aftermath of TVA's permit approval;[142] and

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[137] In a recently-obtained February 2018 letter reporting November 2017 groundwater monitoring results for selected wells, including high levels of arsenic in Well P6, TVA again asserts that exceedances of arsenic groundwater protection standards are due to "naturally occurring" arsenic. *See* Attachment 75a: Letter from TDEC to TVA re: Tennessee Valley Authority (TVA)-Allen Fossil Plant (ALF)-Groundwater Monitoring Report for August and November 2017 Sampling Events for Wells in the Vicinity of NPDES Permitted Ash Ponds, 1 (February 14, 2018); Attachment 75b, TVA, Groundwater Monitoring Report August and November 2017 Sampling Events, prepared by Ronda L. Hooper (February 14, 2018). This claim is additional evidence of a substantial dispute as to the size, nature, or effect of impacts on groundwater quality.

[138] Attachment 76: *Sierra Club*, at Doc. 24-1 (Index to Administrative Record) and Doc. 19-11 (Transcript of Hearing).

[139] Attachment 77: Bill Dries, "Harris Calls for Suspension of TVA Well Permits," MEMPHIS DAILY NEWS (July 24, 2017).

[140] August 29, 2016 Cohen Letter *See also* October 18, 2016 Cohen Letter.

[141] Attachment 78: Local 24 News, Conservationists Meet With Shelby County Groundwater Control Board On Water Safety (August 24, 2017). http://www.localmemphis.com/news/local-news/conservationists-meet-with-shelby-county-groundwater-control-board-on-water-safety/797510652.

[142] Tom Charlier, "Shelby County drafts stricter rules to protect groundwater," MEMPHIS COMMERCIAL APPEAL (Feb. 16, 2018), https://www.commercialappeal.com/story/news/2018/02/16/shelby-county-drafts-stricter-rules-

- Media interest in the impact of the Pumping Plan on the Aquifer, cited throughout this letter.

For all of these reasons, the effects of the Pumping Plan on the water quality of the Aquifer are highly controversial and warrant the need for the detailed scrutiny and heightened public participation opportunities provided by an EIS.

2. The Pumping Plan threatens violations of Federal, State, and local law or requirements imposed for the protection of the environment.

By allowing the leaking, unlined East Pond to pollute shallow groundwater, TVA is already violating several laws imposed to protect the environment, including the federal Coal Ash Rule, the Clean Water Act, the Tennessee Water Quality Control Act, and the Shelby Country Groundwater Ordinance. Implementing the Pumping Plan threatens to exacerbate or cause additional violations of law as described in this section.

i. TVA is operating the East Pond as an open dump in violation of the federal Coal Ash Rule, and the Pumping Plan threatens to violate TVA's obligation to remedy rather than exacerbate groundwater pollution.

The federal Coal Ash Rule "establishes minimum national criteria for purpose of determining which solid waste disposal facilities and solid waste management practices do not pose a reasonable probability of adverse effects on health or the environment…"[143] The Coal Ash Rule applies specifically to existing coal ash surface impoundments.[144] A coal ash surface impoundment that does not meet the minimum national criteria set forth in the Coal Ash Rule is an open dump prohibited by the federal Resource Conservation and Recovery Act.[145]

protect-groundwater/343740002/ ("Zerwekh [administrator of the environmental health services bureau of the Health Department] said the controversy surrounding the TVA wells helped alert officials to the need for changes to the "old, antiquated" regulations so that proposed wells are sufficiently scrutinized to protect groundwater resources.")

[143] 40 C.F.R. § 257.50.

[144] *Id.*

[145] *See* 42 U.S.C.A. § 6907(a)(3); *Id.* § 6944(a)-(b).

ii. TVA is operating the East Pond as an open dump in violation of the federal Coal Ash Rule.

The Coal Ash Rule imposes special obligations and restrictions on unlined surface impoundments.[146] In particular, the Coal Ash Rule requires an existing, unlined surface impoundment to cease accepting coal ash waste and close within six months of detecting certain coal ash contaminants above groundwater protection standards. The language of the Rule provides:

> … if at any time after October 19, 2015 an owner or operator of an existing unlined CCR surface impoundment determines in any sampling event that the concentrations of one or more constituents listed in appendix IV to this part are detected at statistically significant levels above the groundwater protection standard established under § 257.95(h) for such CCR unit, within six months of making such determination, the owner or operator of the existing unlined CCR surface impoundment must cease placing CCR and non–CCR wastestreams into such CCR surface impoundment and either retrofit or close the CCR unit in accordance with the requirements of § 257.102.[147]

TVA has determined that the East Pond at the Allen Coal Plant is an unlined surface impoundment within the meaning of the Rule.[148] Accordingly, the special restrictions for unlined surface impoundments apply to the East Pond.

As described in Section II.C above, beginning in November 2016, TVA detected high levels of arsenic, fluoride, and lead, in the groundwater in its CCR Rule monitoring system at the East Pond. Arsenic, fluoride, and lead are Appendix IV constituents under the Coal Ash Rule.[149] TVA continued to detect similar groundwater exceedances through at least May 2017. The groundwater protection standard for arsenic is 10 ppb.[150] TVA's groundwater monitoring detected exceedances for arsenic ranging from 11.4 ppb to 3,900 ppb.

Pursuant to the Coal Ash Rule, TVA was required to cease placing coal ash and non-coal ash wastestreams into the East Pond no later than May 2017, six months after TVA detected arsenic above the applicable groundwater protection standard.[151] TVA was also required to begin

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[146] 40 C.F.R. § 257.101.

[147] 40 C.F.R. § 257.101(a).

[148] Allen CCR Rule Liner Demonstration.

[149] *See* Appendix IV to 40 C.F.R. Part 257.

[150] The groundwater protection standard for arsenic is established with reference to the maximum contaminant limit established for arsenic. *See* 40 C.F.R. § 257.95(h)(1) ("For constituents for which a maximum contaminant level (MCL) has been established under §§ 141.62 and 141.66 of this title, the MCL for that constituent"); *see also* **§** 40 C.F.R. § 141.62(a) (establishing MCL for arsenic at .01 mg/l).

[151] 40 C.F.R. § 257.101(a). There are a couple of exceptions to the six month timeframe for ceasing to dispose of CCR in an unlined impoundment after detection of Appendix IV constituents above groundwater protections

closure of the East Pond no later than May 2017.[152] To the best of our knowledge, TVA has not ceased placing coal ash into the East Pond and has not begun closing the leaking, contaminated, unlined pit. TVA was also required to post notification of the exceedances of Appendix IV constituents on its CCR compliance website within 60 days after detection.[153] It has not posted any such information.[154]

In addition, TVA was required to begin an assessment of corrective measures for the contamination at the East Pond within 90 days of detection of Appendix IV constituents, complete that assessment and select a remedy within 90 days, and begin implementing the corrective action program within 90 days of selecting the remedy.[155] TVA is required to post to its public Coal Ash Rule compliance website notification of the initiation of corrective action assessment, selection of remedy, and any notification that the remedy has been completed.[156] To the best of our knowledge, TVA has not initiated corrective action at the East Pond, despite its obligation to do so pursuant to the Coal Ash Rule.

TVA is also subject to a Commissioner's Order that provides state oversight by TDEC with regard to TVA's compliance with the Coal Ash Rule.[157] The Commissioner's Order imposes penalties for failure to comply with the requirements of the Coal Ash Rule as follows: "FIVE THOUSAND DOLLARS ($5,000) for each noncompliance and ONE THOUSAND DOLLARS ($1,000) for each day until the noncompliance is remedied."[158] TVA should therefore be accruing penalties for violating the requirements described above, beginning in May 2017 and continuing to the present with respect to the requirements that (1) TVA cease placing coal ash in the East Pond and (2) begin closure of the East Pond, and beginning in January 2017 for TVA's failure to post notice of its November 2016 exceedances and begin corrective action (for each exceedance required to be reported), and continuing for each month in which new exceedances were detected but not reported, addressed through corrective action, or posted to TVA's Coal Ash Rule compliance website.

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standards. These exceptions apply where a utility meets the criteria for alternative closure under 40 C.F.R. §257.103. However, these exceptions require notification of intent to comply using alternative closure—placed in records within six months of the triggering event and posted publicly 30 days later. 40 C.F.R. §§ 257.103(c)(1) and 257.107(d), (i)(10). TVA has not placed any such notifications on its website.

[152] *Id.*

[153] 40 C.F.R. § 257.107 (d), (h)(6).

[154] Attachment 79: Screenshot, TVA Allen Coal Combustion Residuals (February 20, 2018), available at https://www.tva.gov/Environment/Environmental-Stewardship/Coal-Combustion-Residuals/Allen#.

[155] *See* 40 C.F.R. §§ 257.96-98.

[156] *See* 40 C.F.R. 257.96-98; 257.107(h)(7)-(10).

[157] Attachment 80: TDEC, Commissioner's Order No. OGC15-0177 (September 9, 2015), Section VII.D, VIII.

[158] *Id.* § VIII(b).

iii. The Pumping Plan would threaten additional violations of the federal Coal Ash Rule.

Having established that TVA is operating an open dump, should have begun closing the dump more than half a year ago, and is subject to penalties under state requirements, we now turn to the question of how the Pumping Plan threatens additional violations of the federal Coal Ash Rule. Because of TVA's arsenic and other groundwater exceedances, the Coal Ash Rule requires TVA to initiate and implement corrective action and close the East Pond. TVA has proposed to cap the East Pond in place.[159] The Coal Ash Rule includes performance standards for closure in place that include, among other things, closing the impoundment in a manner that will "control, minimize or eliminate, to the extent feasible, post-closure… releases of CCR, leachate, or contaminated run-off to the ground or surface waters…." The Pumping Plan threatens to violate this requirement by pulling contaminated groundwater into the Aquifer. Rather than remedying the pollution, the Pumping Plan would potentially facilitate the migration of contaminated groundwater into the City's drinking water source. For this reason, if TVA wants to implement the Pumping Plan, it must close the East Pond by removing the coal ash consistent with the requirements for closure by removal.[160] Even if TVA abandons the Pumping Proposal, as it should, closure by removal may be necessary at the East Pond to meet the performance standards in the Rule.

In certain circumstances, a utility can extend the six month timeframe for ceasing to dispose of CCR in an unlined impoundment after detection of Appendix IV constituents above groundwater protections standards. These exceptions apply where a utility meets the criteria for alternative closure under 40 C.F.R. §257.103. However, these exceptions require notification of intent to comply using alternative closure—placed in records within six months of the triggering event and posted publicly 30 days later.[161] TVA has not placed any such notifications on its website.[162]

Even if the alternative closure provision applied at the East Pond, TVA would still be required to begin the corrective action process required by the CCR Rule.[163] The corrective action remedy must, among other things, "be protective of human health and the environment," and "control the source(s) of releases so as to reduce or eliminate, to the maximum extent feasible, further releases of constituents in appendix IV to this part into the environment." Just as the Pumping Plan would threaten to violate the closure-in-place performance standards, it would

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[159] Attachment 81: Stantec, Closure and Post-Closure Plan, East Ash Disposal Area, EPA Coal Combustion Residuals Rule, TVA Allen Fossil Plant, Memphis Tennessee § 2,2 (October 12, 2016).

[160] 40 C.F.R. § 257.102(c).

[161] 40 C.F.R. §§ 257.103(c)(1) and 257.107(d), (i)(10).

[162] Screenshot, TVA Allen Coal Combustion Residuals (February 20, 2018), available at https://www.tva.gov/Environment/Environmental-Stewardship/Coal-Combustion-Residuals/Allen#.

[163] 40 C.F.R. §§ 257.103(a)(1)(iii); (b)(1)(ii).

also threaten to violate these requirements for corrective action under the federal Coal Ash Rule by pulling contaminated groundwater into the city's drinking water source.

For all of these reasons and based on the new circumstances and information described in Section II.C-D, the Pumping Plan threatens to violate the federal Coal Ash Rule and therefore warrants additional analysis in an EIS.

iv. TVA is violating the Clean Water Act, its NPDES permit, and the Tennessee Water Quality Control Act by allowing coal ash pollution to enter groundwater, and the Pumping Plan threatens to exacerbate this pollution.

As described in Section I.C above, for decades TVA has "managed" its coal ash pollution by allowing some of the coal ash to settle to the bottom of massive leaking, unlined pits filled with water. The settled coal ash, mixed with water, creates coal ash sludge. Pursuant to the federal Clean Water Act and the Tennessee Water Quality Control Act, TVA maintains a NPDES permit for the East Pond. The 2007 NPDES permit contains the following provision at p. 5:

> …Sludge or any other material removed by any treatment works must be disposed of in a manner which ***prevents it entrance into or pollution of any surface or subsurface waters***. Additionally, the disposal of such sludge or other material must be in compliance with the Tennessee Solid Waste Disposal Act, TCA 68-31-101 et seq. and the Tennessee Hazardous Waste Management Act, TVA 68-46-101 et seq.[164]

This condition, known as the "Removed Substances" provision of the permit, prohibits TVA from disposing of its coal ash in a way that will allow coal ash to enter into groundwater or the nearby river. The Removed Substances provision protects groundwater and surface water from pollution caused by coal ash sludge "disposed of" in the leaking, unlined pits themselves, in addition to any other locations where TVA might dispose of its coal ash.[165]

The East Pond—the leaking, unlined pit TVA uses for wastewater treatment at Allen—contains coal ash sludge that was "removed" during treatment. For many years, TVA has detected coal ash contaminants, including arsenic above the groundwater protection standard, in the groundwater beneath the East Pond. Yet as described in Section II.D, TVA omitted this information from the SEA. The groundwater monitoring results TVA provided to TDEC in May 2017 also detected arsenic and other coal ash contaminants above groundwater protection

[164] Attachment 82: NPDES Permit No. TN0005355, TVA Allen Fossil Plant (issued November 30, 2007), 7.

[165] *Tennessee Clean Water Network v. Tennessee Valley Authority*, 2017 WL 3476069, *56 (August 4, 2017) (holding that discharge of coal ash directly from an ash pond into groundwater and surface water violates Removed Substances provision of TVA's permit for the Gallatin Fossil Plant).

standards.[166] But TVA has not disclosed or analyzed this information in any supplemental environmental analysis under NEPA. TDEC has previously informed TVA that:

> The migration of untreated/partially treated wastewater from a surface impoundment into groundwater is not an NPDES authorized discharge. The NPDES Program was never intended to permit the discharge of wastewater or partially treated wastewater from the bottom of a wastewater treatment unit into groundwater.[167]

As described above, settled coal ash and water create coal ash sludge—a form of untreated wastewater. Thus, according to the plain language of the Allen NPDES Permit and TDEC's own previous statements, TVA's current NPDES permit does not authorize the entry or discharge of coal ash sludge into groundwater.

The entry or discharge of coal ash sludge into groundwater is not authorized by the Allen NPDES Permit, and in fact constitutes violation of the Tennessee Water Quality Control Act[168] in addition to violations of the Permit and the Clean Water Act. The NPDES requirements, as well as the TWQCA, apply to this pollution. As discussed above, TVA's current NPDES permit does not authorize TVA to place or discharge coal ash pollution into groundwater. Indeed, the NPDES Permit requires settled coal ash sludge to be "disposed of in a manner which *prevents* its entrance into or pollution of any surface or subsurface waters."[169] The Department itself has taken the position that the NPDES permit does not authorize the entrance or discharge of pollutants into groundwater through the bottom of TVA's leaking, unlined pits.

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[166] T Allen Fossil Plant –Site Information, 3.

[167] Attachment 83: Letter from Chuck Head, TDEC, to Terry Cheek, TVA (May 15, 2017); *see id.* ("As TDEC considers the pending TVA Gallatin NPDES Permit Renewal Application, and for any previous NPDES permits TDEC has issued, the NPDES permit does not authorize discharge of wastewater or partially treated wastewater into groundwater.")

[168] The TWQCA defines "waters" to include water "on or beneath the surface of the ground." Tenn. Code Ann. § 69-3-103(44). The Tennessee Water Quality Control Act, which is to be "liberally construed," prohibits all persons—including federal agencies—from discharging a pollutant into groundwater without a permit. Tenn. Code Ann. §§ 69-3-120. 69-3-103(26); 69-3-103(27) (defining "pollutant" as "sewage, industrial wastes, or other wastes"); § 69-3-103(10) (defining "discharge of a pollutant" as the "addition of pollutants to waters from a source"). More specifically, without a valid permit, is unlawful to alter the state's waters, Tenn. Code Ann. § 69-3-108(b)(1); operate certain equipment in a way that "will likely cause an increase in the discharge of wastes into the state's waters," Tenn. Code Ann. § 69-3-108(b)(4). Tenn. Op. Atty. Gen. No. 01-105 (Tenn. A.G.), 2001 WL 770922; discharge industrial or other wastes into the state's waters or to a place "from which it is likely that the discharged substance will move into waters," Tenn. Code Ann. § 69-3-108(b)(6); or discharge industrial[168] or other waste[168] "into a well or a location where it is likely that the discharged substance will move into a well . . . or the underground placement of substances that may affect the waters of the state," Tenn. Code Ann. § 69-3-103(15), (23), -208(b)(8).

[169] *Id.*, 1, 3 (Emphasis added.)

The Pumping Plan would not remedy these violations of laws that protect Memphis' clean water. Instead, the Pumping Plan threatens to exacerbate these violations by facilitating the migration of TVA's existing unlawful pollution into the city's drinking water source. The Pumping Plan may also threaten violation of the Tennessee Safe Drinking Water Act and Underground Injection Control.[170] These threats warrant additional scrutiny of the Pumping Plan in an EIS.

v. TVA is threatening to violate the Shelby County Groundwater Ordinance by putting wells into service less than half a mile from a RCRA corrective action site.

TDEC is usually responsible for the issuance of water well drillers' licenses and permits,[171] but "any county operating under a county charter form of government, may enact, by . . . resolution . . . enforceable requirements not less stringent than the standards adopted by the state pursuant to this chapter." Tenn. Code Ann. § 19-10-112(a). As recognized by the district court in Conservation Group's appeal of the well construction permits, Shelby County has employed this authority to create the Shelby County Groundwater Quality Control Board.[172] The Board's purpose is twofold: to "secure, protect, and preserve" groundwater in Shelby County and to "abate existing pollution of the groundwater and to plan for the future use of the groundwater . . . [in] the best interests of all of its citizens."[173]

Pursuant to its delegated authority, the Board promulgated rules and regulations, which include permitting requirements for well drillers.[174] The rules also set forth minimum siting criteria.[175] Conservation Groups challenged the siting of the wells in the permit appeal, but no court heard the merits of their arguments.

Even if one assumes that the wells were properly permitted in 2016, which we do not, new information shows that the five wells installed by TVA are now in violation of the Shelby County Groundwater rules. Most significantly, the rule providing: A water well cannot be **sited or placed in service** within a half-mile of the designated boundaries of a listed federal or State

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[170] *E.g.*, Tenn. Code Ann. § 68-221-711(8) (prohibiting "The heavy pumping or other heavy withdrawal of water from a public water system or its water supply source in a manner that would either interfere with existing customers' normal and reasonable needs or threaten existing customers' health and safety"). *Cf.* Rules of Tennessee Department of Environment and Conservation Water Supply Division, Chapter 0400-45-45-06, http://publications.tnsosfiles.com/rules/0400/0400-45/0400-45-06.20140505.pdf.

[171] *See* Tenn. Code Ann. § 69-10-102; Tenn. Code Ann. § 19-10-112(b).

[172] Attachment 84: *Sierra Club*, Doc. 30 at PageID 2126.

[173] Attachment 85: Shelby County Ordinance § 42-71.

[174] *See* Attachment 86: Shelby County Ordinance § 42-74(1); Shelby County Well Regulations, https://www.shelbycountytn.gov/DocumentCenter/View/768.

[175] Shelby County Well Regulations, § 5.02.

Superfund site or Resource Conservation and Recovery Act corrective action site, unless the well owner can make a demonstration that the well will not enhance the movement of contaminated groundwater or materials into the shallow or deep aquifer.[176]

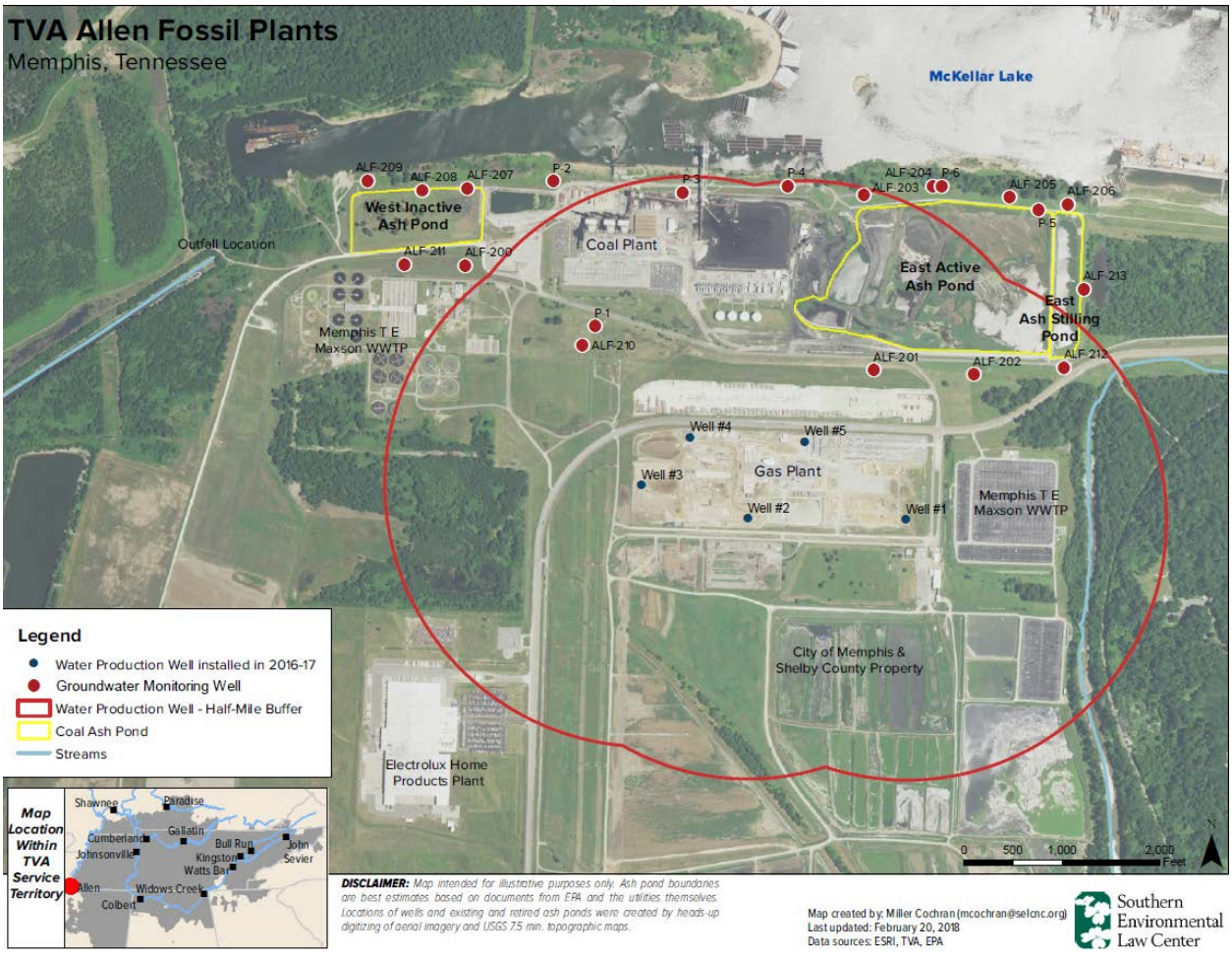
As shown in the map below, the water production wells are with ½ mile of the Coal Plant, East Ash Pond, CCR Rule monitoring network, and Remedial Investigation site. As described in Section II.E.2 above, TVA's East Ash Pond is a federal RCRA corrective action site. TVA reported exceedances of Appendix IV coal ash constituents, which triggered its obligation to initiate corrective action under the federal Coal Ash Rule, which is a rule promulgated pursuant to the solid waste provisions of RCRA.[177] Even if the alternative closure provision applied at the East Pond, TVA would be required to begin a corrective action process under the CCR Rule.[178] TVA is also subject to a Commissioner's Order, which was issued pursuant to the State of Tennessee's remedial authority and provides for state oversight by TDEC with regard to TVA's compliance with the Coal Ash Rule.[179] Under either theory, the wells cannot be "placed in service."

[176] Shelby County Well Regulations, §§ 4.01, 5.02(E) (emphasis added).

[177] *See* 42 U.S.C. § 6907(a)(3); *Id.* § 6944(a)-(b).

[178]

[179] Commissioner's Order, Section VII.D, VIII.



The rules also provide that all wells shall be maintained in a condition whereby they are not a hazard to health or environment nor a source of potential contamination to the groundwater aquifers.[180] The Pumping Plan cannot satisfy this requirement, either.

Because the Pumping Plan threatens to violate Federal, State, and local laws enacted to protect the environment, TVA must prepare an EIS for the Plan to analyze the new and omitted information related to groundwater quality and the risk to the Aquifer.

3. Additional significance factors also require TVA to prepare an EIS for the Pumping Plan.

The new and omitted circumstances and information described in Section II.C-D also require TVA to prepare an EIS based on consideration of additional significance factors. First,

[180] Shelby County Well Regulations, § 5.02(C). *Cf.* Shelby County Ordinance § 42-108(b) ("No water well shall be located close enough to any existing or proposed well in the county that would materially affect the static head of water from the underground strata of any such well or proposed well."

the new and omitted information shows that the Pumping Plan threatens a unique local resource—the Aquifer[181]—in a manner not previously disclosed analyzed in TVA's NEPA documents for the Plan. This fact speaks both to the context and the degree to which the Pumping Plan would impact unique local geography.[182]

The Aquifer also serves as Memphis's only drinking water source, which means the Pumping Plan threatens to affect public health.[183] This is particularly concerning because, given the local hydrogeology, the Pumping Plan may have significant cumulative impacts, by drawing contaminated shallow groundwater from other sites within the cone of depression created by operating the cooling water wells.[184] The Allen facilities are in a heavily industrial area, and TVA must analyze whether there are other sites with contaminated groundwater in areas likely to have windows in the clay layer that protects the Aquifer. The Pumping Plan could pull contamination from these sites into the Aquifer, just as it may pull contaminated groundwater from the Allen Coal Plant. The potential for an action to have a significant cumulative impact is a factor to be considered in determining whether an action is significant and requires additional environmental analysis.[185]

In addition, for many of the same reasons that the impact of the Pumping Plan is highly controversial, see Section II.E.1, its impacts are also "highly uncertain or involve unique or unknown risks."[186] Finally, TVA's decision to move forward with the Pumping Plan despite the risk to the City's drinking water source "may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration."[187] Indeed, TVA has proposed to exempt all future decisions to drill and withdraw groundwater from analysis under NEPA.[188] That TVA appears not to have considered the risk of contamination to the City's drinking water source from its own leaking, unlined ash pit, despite decades of evidence that suggested that risk, does not give the public confidence in TVA's ability to identify and analyze significant risks associated with groundwater withdrawals the utility might plan to make in the future.[189]

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[181] See Section XX , explaining Aquifer's unique status as the "sweetest water in the world."

[182] 40 C.F.R. § § 1508.27(a) and (b)(3).

[183] *Id*. § 1508.27 (b)(2).

[184] 2016 USGS, 3-6.

[185] *Id.* § 1508.27 (b)(7).

[186] *Id.* § 1508.27 (b)(5).

[187] *Id.* § 1508.27 (b)(6).

[188] Attachment 87: TVA, Proposed Categorical Exclusion Supporting Documentation, 3-186 to 3-191 (June 8, 2017).

[189] SELC, et al., Comments re: TVA, PROPOSED RULE, PROCEDURES FOR IMPLEMENTING THE NATIONAL ENVIRONMENTAL POLICY ACT, 82 FED. REG. 26,620 (JUNE 8, 2017), 107-112 (September 6, 2017). *See also* Attachment 88: Garcia, Amanda and S. Banbury, "Memphis Aquifer Belongs to the Public, Not TVA,"Memphis Commercial Appeal, September 26, 2017,

F. Significant new circumstances and information regarding alternatives to TVA's Pumping Plan—including using MLGW water or gray water from Maxson Plant—also require analysis in an EIS.

Over objections from conservation groups including the Sierra Club, TVA decided to spend more than a billion dollars on a new Gas Plant. [190] The utility claims, however, that it cannot bear the purported cost it would take to source cooling water from a source other than the city's drinking water aquifer.[191]

Other reasonable alternatives exist for providing the Gas Plant's cooling water. Specifically, new information with respect to the quality of gray water from the Maxson Plant and MLGW's capacity to provide sufficient cooling water is available. Further, even if we assume cost is the controlling factor for TVA's decision-making, this new information suggests TVA's cost estimates for its alternatives are based on incorrect information. Circumstances regarding alternatives to using the wells—including using MLGW water or gray water from Maxson WWT plant—have changed.

1. The City of Memphis is improving the Maxson Plant, making the gray water alternative (the most environmentally sensitive alternative) even more cost-competitive.

In the 2014 Environmental Assessment, TVA explained its decision to use gray water as "an opportunity to . . . reduce[e] the use of valuable natural resources in the area."[192] TVA subsequently "found out about a couple of constituents, ammonia and phosphate, that created treatment issues for us."[193] At the 2016 permit appeal hearing, TVA's witnesses insisted that the

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http://www.commercialappeal.com/story/opinion/contributors/2017/09/26/memphis-aquifer-belongs-public-not-tva/704405001/.

See, e.g., Attachment 89: Southern Alliance for Clean Energy et al., Comments on Allen Fossil Plant Emission Control Project Draft Environmental Assessment (Aug. 7, 2014) (discussing alternatives, including a smaller gas plant and noting that, "Renewable energy and energy efficiency reduce air pollution, carbon emissions, water consumption and waste generation, not to mention reduction of upstream environmental impacts associated with production of natural gas (effects of which are not discussed in the Draft EA)."). Alternatives to aquifer water include (1) potable water supplied by MLGW, (2) surface water, (3) gray water from the Maxson Plant, and (4) groundwater in the shallow aquifer.[191] *E.g.*, Attachment 90: *Sierra Club*, Doc. 19-11 at PageID 703-04. Of course, TVA's analysis does not include costs associated with risks of impacts to the City's drinking water aquifer.

[191] *E.g.*, Attachment 90: *Sierra Club*, Doc. 19-11 at PageID 703-04. Of course, TVA's analysis does not include costs associated with risks of impacts to the City's drinking water aquifer.

[192] 2014 Final EA at 28. *Accord id.*at 206 ("The TVA Act directs TVA to deliver low-cost, reliable power to the Valley while also promoting economic prosperity and the wise use and conservation of the natural resources of the region."). *See also* Attachment 91: 2014 EA at 74 (noting that gray water would account for 80% of the Gas Plant's needs).

[193] *Sierra Club*, Doc. 19-11 at PageID 705. *Accord id.* at Doc. 19-11 at PageID 686 ("So once the project was approved by our board in August of 2014, we began taking water samples and started doing some detailed analysis. At that time, we saw high levels of ammonia and phosphates primarily, generically called nutrients in the

need to treat the Maxson Plant's gray water for ammonia and phosphate made it too costly an option.[194] Notably, though, TVA's consultant's cost analysis was predicated on the need to chemically treat the Maxson Plant's effluent.[195] The capital expenses were relatively similar; without the annual expense of chemical feed to treat the gray water, the operating expenses were also within a similar range.[196]

The gray water alternative was therefore economically unattractive from TVA's perspective, not technologically infeasible. Indeed, TVA's consultant concluded that, "To utilize the water for cooling tower makeup, treatment options include ammonia reduction, biological treatment/disinfection, solids removal, alkalinity reduction, and potentially softening."[197]

Since then, in November 2017, the City of Memphis broke ground on upgrades to the Maxson Plant.[198] Upgrades will include disinfection structures and a return activated sludge re-aeration basin.[199] It therefore appears that at least some of the treatment options identified by TVA's consultant as ideal for Gas Plant cooling water are akin to (or potentially fall within the scope of) improvements now underway at the Maxson Plant.

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industry."); *id.* at PageID 741 ("The ammonia and the phosphate probably give us the greatest issues in a cooling tower application.").

[194] Attachment 92: *Sierra Club*, Doc. 19-7 at PageID 403 [Doc. 19-7 at PageID 403] (After TVA decided to pursue aquifer water rather than gray water, TVA explained that, "Under the TVA Act, TVA is required to provide least cost power for all consumers in the Tennessee Valley. . . . After detailed engineering, it was determined that grey water was not a least cost option.").

[195] Attachment 93:*Sierra Club*, Doc. 19-12 at PageID 1059; Doc. 19-11 at PageID 686-87 (p. 128:4-10). Kiewit Study on water treatment options for Allen- Addendum. Doc. 19-12 at PageID 1061 et seq.

[196] *Sierra Club*, Doc. 19-12 at PageID 1059.

[197] *Sierra Club*, Doc. 19-12 at PageID 1030. *Cf. id.* at PageID 1033 ("The primary concern in the water supply is ammonia.").

[198] *See* Attachment 94: http://www.commercialappeal.com/story/news/2017/11/02/rehab-project-disinfect-wastewater-memphis-treatment-plant/823194001/.

[199] *See* Attachment 95: T.E. Maxson Upgrades Site Plan, http://maxsonupgrades.com/project-overview/; City of Memphis Letter to TDEC (Nov. 3, 2017) re "Disinfection Compliance Schedule Progress Report No. 8 ("CDM Constructors, Inc. submitted a proposal to the City on 3-7-2017 to construct the Maxson Disinfection Facility and related improvements as outlined in Package 1. A contract to perform this work was executed on 7-27-2017. Bidding for subcontracted services were advertised on 10-24-2017 and are expected to be opened 11-20-17 in early December. Ground breaking ceremonies for the project took place on 11-2-2017. Construction of the Maxson Disinfection Facility and other related improvements is expected to commence in late 2017 with completion by late 2019."), http://environment-online.tn.gov:8080/pls/enf_reports/f?p=9034:34051:::NO:34051:P34051_PERMIT_NUMBER:TN0020729. "In 2012, the City began negotiating a new NPDES permit for the Maxson WWTF. As part of this process, the State of Tennessee required the City to implement disinfection. The City retained CDM Smith to evaluate available disinfection technologies at the facility. . . . . In November 2015, CDM Smith was retained by the City of Memphis to design and construct theprocess and disinfection improvements as outlined in the 2013 reports." Attachment 96: CDM Smith, T.E. Maxson WWTF Process Upgrades: Conceptual Design Report, at 1-1, 1-2 (June 2016).

The City of Memphis is exploring ways to further improve the nutrient concentrations of its gray water. Just last month, the consulting firm in charge of the Maxson Plant's upgrades produced to the City an "Ammonia Optimization Plan," which evaluated several approaches to achieve nitrification (reduce ammonia and nutrients in the gray water), including "dual carbonaceous and nitrifying trickling filters, expanding the aerations tanks to change the process from solids contact to nitrifying activated sludge, and post nitrification of clarified secondary effluent."[200]

Even if the upgrades at Maxson will not be completed when TVA plans to begin operating the Allen Gas Plant, the utility should consider an alternative that would phase out reliance on purchases of water from MLGW and transition to the use of gray water over time. Given improvements that are being and will continue to be made to the Maxson gray water, the EIS should consider the use of gray water for cooling water in light of these new circumstances and information.

In addition, to the extent that TVA believes additional treatment of the gray water is necessary, TVA should explore an alternative that would include partnering with the City of

[200] Attachment 97: CDM Smith, T.E. Maxson WWTF Process Upgrades Package 2B: Preliminary Engineering Report, at B-2 (Jan. 2018).

Memphis to further improve the Maxson Plant, as TVA has done with the City's biogas project.[201] The co-benefit of improving effluent into the Mississippi River and reducing the Gas Plant's environmental impacts on the aquifer make this an opportunity for TVA to recommit to its mission of environmental stewardship by protecting Memphis' clean water.

2. New information suggests MLGW is or will soon be able to provide all of the water TVA needs.

TVA's asserts that, on average, it will need 3.5 MGD of water to run the Gas Plant with "up to [7.2 MGD] for peak operation during short periods on the hottest days of the year."[202] The 2016 Supplemental EA therefore ruled out MLGW as a "viable" alternative to supply the Gas Plant with cooling water because MLGW could not supply the "peak system needs."[203]

However, by November 2016, TVA acknowledged that MLGW had increased its ability to supply TVA with water to "[5 MGD] at max continuous use"[204] and "[6.5 MGD] for short intermittent periods."[205] In other words, MLGW can now provide virtually all of the water demanded by TVA. MLGW's increased capacity constitutes new information that must be analyzed in an EIS.

Additional new information suggests that MLGW may be closing the gap entirely. For example, in August 2017, MLGW was granted easements for water pipeline(s) across railroad tracks in the vicinity of the Gas Plant.[206] And in January 2018, TVA CEO Bill Johnson told the Memphis City Council that, "We are currently using MLGW water to test the plant and, if the time comes that that's what we need to run it, then we will[]."[207]

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[201] "TVA is investing up to $20 million in infrastructure at both the Allen CC site and in upgrades to the city of Memphis equipment in order to reliably deliver the methane gas to the Allen CC site." Attachment 98: TVA, Turning Memphis Wastewater into Energy, https://www.tva.com/Newsroom/Turning-Memphis-Wastewater-into-Energy.

[202] 2016 SEA at 1, 2. According to the 2014 Environmental Assessment, operation of the Gas Plant would have required 7-10 MGD of water. 2014 Environmental Assessment at 14.

[203] 2016 FONSI at pp. 1-2. In October 2015, according to TVA, MLGW reported that it could only supply up to 2,800 gpm [4 MGD].*Sierra Club*, Doc. 19-11 at PageID 673. However, by November 2016, TVA represented that the Gas Plant's average need is "about 2400 GPM. Our peak need is 5,000 GPM." Doc. 19-11 at PageID 673.

[204] *Sierra Club*, Doc. 19-11 at PageID 689.

[205] Attachment 99: *Sierra Club*, Doc. 19-15 at PageID 1443. *See also id.* at Doc. 19-11 at PageID 707 (MLGW tells TVA it can supply up to 4,500 gallons per minute). Notably, despite TVA's insistence that the peak capacity water rate is a determining factor for its decisions, as part of the Remedial Investigation, USGS and the University of Memphis only assumed that the "projected annual average daily pumping rate of 2,500 gpm [3.6 MGD]." Since they are not using the higher rate, the study's ability to address the impacts of the Gas Plant's activities on the aquifer is diminished. (September 12, 2017: Attachment to Email; 722529b8cb65e38c22592486].

[206] *See, e.g.*, Tom Leatherwood, Shelby County Register of Deeds, Instrument Nos. 18001156, 18001157.

[207] Attachment 100: Michelle Corbet, "TVA CEO regrets Memphis aquifer decision," MEMPHIS BUSINESS JOURNAL (Jan. 24, 2018) ("When Tennessee Valley Authority CEO Bill Johnson visited the Memphis City Council Tuesday,

Despite MLGW's ability to provide TVA with all of the water TVA claims it needs, this alternative to should still be fully analyzed because it does not moot all of the impacts of concern to the aquifer (*i.e.*, both conservation and contamination impacts). TVA's impact on the Aquifer likely remains if TVA buys water from MLGW. Whether TVA pumps directly from the Aquifer or buys water from MLGW, the city's drinking water source is impacted. For example, USGS concluded that the 30-year average withdrawal from the Gas Plant will impact the Davis Well Field, MLGW's closest drinking water intake field.[208] This could mean that if MLGW withdraws water for the Gas Plant at the rates TVA demands, the long-term impacts could reach the Allen Fossil Plants' property. Therefore, before selecting MLGW water as the preferred alternative, TVA should analyze whether, if it obtains drinking water from MLGW for the lifetime of the Gas Plant, it will induce contamination from the Coal Plant or other sources of contamination.[209]

III. Conclusion

For all of the foregoing reasons, TVA must supplement its previous environmental analyses and prepare an EIS for the Pumping Plan as required by NEPA. In the event that TVA selects a different alternative for cooling water, it must still consider the new and omitted information set forth in this letter and prepare an EIS to evaluate the environmental impacts associated with a range of reasonable alternatives for providing cooling water at the Allen Gas Plant.

Conservation Groups respectfully request a response to this letter by no later than March 16, 2018.

Sincerely,

Amanda Garcia
Anne Passino
Attorneys

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he admittedly wished for a do-over regarding the TVA's decision to bypass Memphis Light, Gas and Water with its new natural gas plant."), https://www.bizjournals.com/memphis/news/2018/01/24/tva-ceo-regrets-memphis-aquifer-decision.html.

[208] 2016 USGS.

[209] *Cf.* 2016 FONSI ("Under most conditions, simulated water level changes in the Memphis Sands aquifer from the proposed groundwater withdrawal create an anticipated cone of depression result in a reduction in the potentiometric surface of 7 ft at the plant site and 4 ft within approximately 1 mi (2,590 ac area) from the proposed groundwater wells. Under more extreme and less likely conditions, the reduction in the potentiometric surface at the plant was expected to be 11 ft.").

Attachments provided via ShareFile and CD

CC:

Jenny Howard (TDEC), Jenny.Howard@tn.gov

Joseph Sanders (TDEC), Joseph.Sanders@tn.gov

Chuck Head (TDEC), Chuck.Head@tn.gov

Britton Dotson (TDEC), Britton.Dotson@tn.gov

Robert S. Wilkinson (TDEC), Robert.S.Wilkinson@tn.gov

Rob Burnette (TDEC), Rob.Burnette@tn.gov

Jamie Woods (TDEC), Jamie.Woods@tn.gov

Kendra Abkowitz (TDEC), Kendra.Abkowitz@tn.gov

Carter Gray (Shelby County), Carter.gray@shelbycountytn.gov

Larry Smith (Shelby County), Larry.Smith@shelbycountytn.gov

Bob Rogers (Shelby County), Bob.Rogers@shelbycountytn.gov