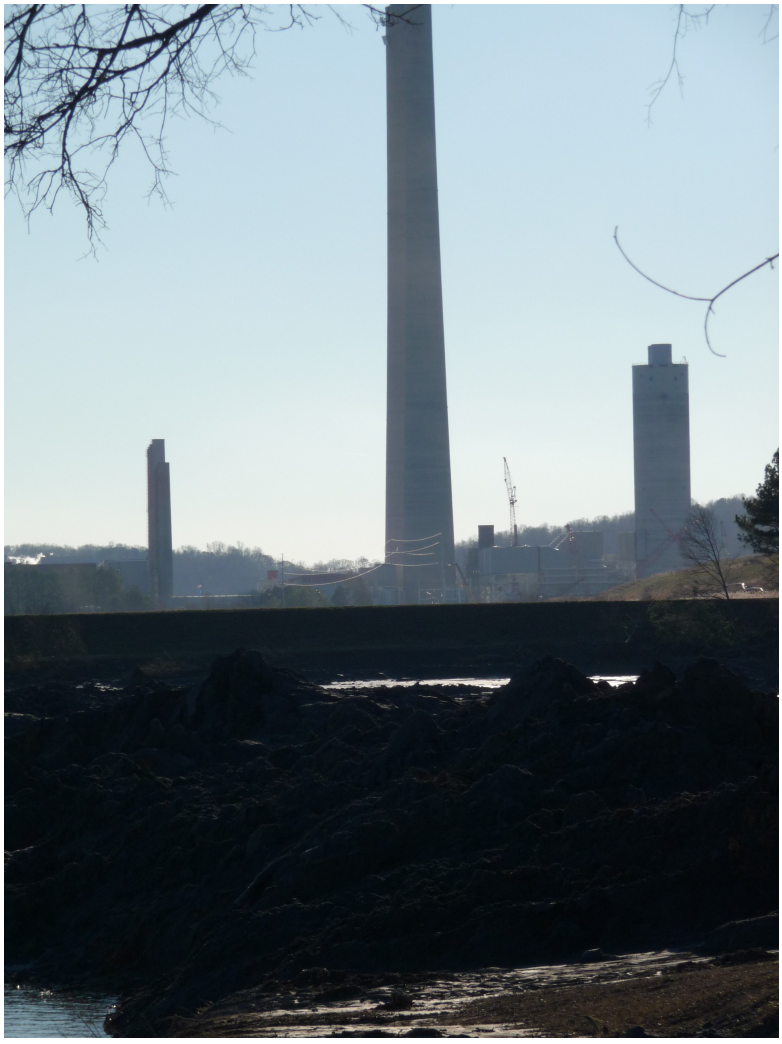
Slow Motion Spills:
Coal Combustion Waste and Water in Kentucky



A Report by the Sierra Club, Kentucky Waterways Alliance,
and Global Environmental, LLC

Researched and written by Mark Quarles, P.G., and Craig Segall

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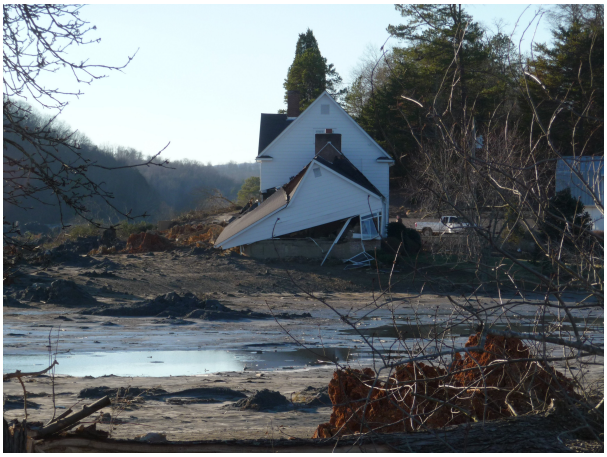
Quiet Leaks, Big Problems

In December 2008, a coal combustion waste pond in Kingston, Tennessee burst. Over 1 billion gallons of sludge poured out, burying houses and rivers in tons of toxic waste charged with heavy metals like mercury and arsenic. That disaster made headlines around the country – and still isn't cleaned up today. Kentucky isn't immune to big spills. In fact, EPA has identified six ponds in Kentucky that would pose a high hazard to human life should they fail.[2] But huge accidents aren't the only problem coal combustion waste or "CCW"[3] causes. Every day in Kentucky, ponds and landfills leak into our groundwater and rivers, seeping out a slow-motion flood of contamination. As this report shows, every site in Kentucky for which groundwater data was available appears to be leaking. Kentucky is failing to control coal combustion waste contamination.



After the Kingston spill.
Photo courtesy Lyndsay Moselely.

Coal combustion waste is a national problem. Every year, coal plants across the country produce over 130 million tons of waste, laden with hazardous chemicals, including arsenic, boron, cadmium, chromium, lead, mercury, selenium, and thallium. Some of this waste is stored in landfills, which often are unlined or poorly designed. Often, wet ponds – colloquially referred to as ash ponds or CCW ponds – are used. These ponds, generally unlined, pose particularly acute water risks.

Chemicals leaching from CCW in landfills or ponds can cause organ damage and cancer and many are connected with brain damage in children. Because the federal Environmental Protection Agency (EPA) does not yet regulate coal combustion waste, and

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[2] *See* EPA Fact Sheet: Coal Combustion Residue – Surface Impoundments with High Hazard Potential Ratings (listing facilities in Harrodsburg, Ghent, and Louisville, Kentucky).
[3] "Coal combustion waste" is a broad term. This report uses it to include bottom and fly ash from traditional coal plants along with sludge from coal plant scrubber systems and slag from coal gasification plants, among other waste products.

most states don't fill the gap, power companies are largely free to dispose of their waste how, and where, they like.

That casual and dangerous practice has damaged the water of more than a hundred communities.[4] EPA's own damage reports – which only describe a few examples of a national problem -- make for harrowing reading. In Virginia, for instance, CCW dumping turned water green in nearby residences – and filled that water with toxic selenium.[5] High levels of arsenic also fouled groundwater and a nearby stream. In South Carolina, a leaking old ash pond was replaced with a new pond – which still leaked so badly that arsenic levels in groundwater spiked above human health limits.[6] In North Carolina and Texas, selenium from CCW crept into the flesh of fish in lakes and reservoirs.[7] And in Indiana, where power plants dumped 1 million tons of ash in and around the town of Pines, well water turned foul and turned out to have elevated levels of arsenic, lead, and cancer-causing benzene.[8]

Kentucky has 44 ash ponds, the second most in the nation after Indiana…

Kentucky barely regulates these sites.

Is the past prologue for Kentucky? Kentucky has 44 ash ponds, the second most in the nation after Indiana,[9] and dozens of coal combustion waste landfills and dumpsites – and it barely regulates these sites. The Sierra Club and Kentucky Waterways Alliance, working with Global Environmental, LLC, launched an investigation into the commonwealth's own records to find out what coal combustion waste is doing to Kentucky's water. We found grim news. Although records are spotty, every one of the sites for which data were available has groundwater contamination consistent with coal combustion waste and, in many instances, this contamination is getting worse.

The Investigation

We set out to examine groundwater records for CCW sites throughout Kentucky. Using Kentucky Open Records Act requests, we reviewed monitoring records held by the Kentucky Division of Waste Management. We were interested in records for both dry landfill sites and CCW disposal ponds. We focused particularly strongly on pond disposal sites because, although both dry landfills and ponds can leach poisons into water, unlined CCW ponds pose an extreme threat to Kentucky's water, as they place huge volumes of wet sludge directly above groundwater, with no barrier in between. Eventually, we received monitoring data for 8 sites, covering a range of ponds and dry landfills.

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[4] *See* EPA, *Coal Combustion Waste Damage Case Assessments* (2007) (listing 71 potential or proven damage cases); Earthjustice & Environmental Integrity Project, *Out of Control: Mounting Damage from Coal Ash Waste Sites* (2010) (describing an additional 31 sites).
[5] EPA, *Coal Combustion Waste Damage Case Assessments* at 14-16 (2007)
[6] *Id.* at 24-25.
[7] *Id.* at 25, 33-34.
[8] *Id.* at 32-33.
[9] *See* Jim Bruggers, KentuckianaGreen.com, *Here are the Rankings* (Sept. 1, 2009) (Louisville Courier-Journal compilation of EPA data).

The Division of Waste Management's staff was very helpful, but it soon became clear that the Division's records are far from complete and well-organized. Of the 44 ponds in Kentucky, we were able to turn up information on only 8 sites. Even for those 8 sites, Kentucky did not have monitoring records for all CCW contaminants. In some cases, the Division had even allowed sites whose early records showed dangerous levels of toxic heavy metals to stop monitoring for those pollutants. Worse, the Division generally does not require specific monitoring sites near ponds, which are especially leak-prone. As a result, we were able to secure data associated with ponds only where a facility happened to have installed monitoring wells for a landfill, and those wells were placed in ways that allowed us to analyze pond contaminants. Finally, even more troubling, the Division often lacked even basic maps showing where monitoring wells were – meaning that, without following up, Division of Waste Management staff members are forced to rely upon company's characterizations of how wells are placed within a groundwater system, rather than being able to see for themselves.

Despite these limitations, the state's data still contained strong evidence of contamination, as we describe below. It is striking – and unfortunate – that the records documenting this important problem are so limited. Although it is possible that the Division's databases may hold information for other sites, which we did not obtain, the generally incomplete nature of records in this area suggests that Kentucky is not approaching the problem with sufficient seriousness.

The Results

Even with the limited data the Division of Waste Management could provide, signs of CCW contamination are unmistakable. At each site, the chemical signature of leaking coal combustion waste appears in the water, with pollutant levels that can be hundreds of times over levels EPA has determined to be safe. To be clear: while the data are imperfect, due to flawed state monitoring practices, the compounds fouling water beneath these sites very likely came from coal combustion waste. This is not a subtle problem. Coal combustion waste appears to be contaminating water across Kentucky.

We received groundwater monitoring data from eight power plants in Kentucky. All eight sites were contaminated.

We received groundwater monitoring data from eight power plants in Kentucky. All eight sites were contaminated. The plants are:

- Cane Run Station near Louisville, owned and operated by E.On and Louisville Gas & Electric
- East Bend Station near Rabbit Hash, owned and operated by Cincinnati Gas and Electric and Duke Power
- R.D. Green Station near Robards, owned and operated by Big Rivers Electric Corporation
- Paradise Station near Drakesboro, owned and operated by the Tennessee Valley Authority
- Trimble County Station near Louisville, owned and operated by E.On and Louisville Gas & Electric

- Shawnee Station near Paducah, owned and operated by the Tennessee Valley Authority
- Spurlock Station near Maysville, owned and operated by the Eastern Kentucky Power Cooperative
- D.B. Wilson Station near Centertown, owned and operated by Big Rivers Electric Corporation

We assessed environmental issues at these sites by relying on EPA's methods. EPA recognizes "proven damage cases" – instances where coal combustion waste has harmed water quality – where a plant causes violations of the Safe Drinking Water Act's primary standards, which are designed to protect human health and the environment, and polluted water is migrating away from the site. These primary standards, called "maximum contaminant levels" or "MCLs," are set for heavy metals found in coal combustion waste. EPA recognizes "potential" damage cases where either primary MCLs have been violated but there is not evidence that pollution has migrated, or where there are violations of secondary MCLs, which are set to protect public welfare.[10]

Each of these plants is, at a minimum, a potential damage case. Because Kentucky does not have monitoring data tracking how far pollutants have migrated, and sometimes did not have data for pollutants covered by primary MCLs, it's difficult to determine whether the plants are proven damage cases. Further, because these sites often have massive waste complexes, covering acres and containing both ponds and landfills, and companies often did not submit detailed groundwater diagrams or surface maps, it is sometimes hard to tell which component of the waste facility is causing pollution. Nonetheless, the available data do point to onsite CCW contamination and the degree of contamination strongly suggests that pollutants are making their way off site.

Indeed, EPA has already confirmed that one of these Kentucky facilities -- East Bend -- is, at the least, a potential damage case.[11] Notably, EPA's analysis focused on iron, dissolved solids, and sulfates leaking from the site, which were alone sufficient for it to make its case. Its report did not include some of the heavy metals we found in earlier groundwater monitoring data for that site, and which suggest even more substantial damage, as we discuss in a site-specific review later in this report. EPA's decision thus suggests the stronger evidence gathered in our file review warrants similar designations for the other facilities we reviewed, which have similar or more severe leaks.

Based upon our review of these sites, we drew three primary conclusions:

1. **Existing data point to groundwater contamination caused by coal combustion waste beneath every plant we studied. For many sites, contamination is intensifying as CCW continues to build up in ponds and landfills.**

2. **Kentucky's regulatory program is not properly addressing this threat; instead, it's getting weaker. Even as evidence of contamination mounted in state files, Kentucky reduced monitoring requirements, failed to commence enforcement action, and continued to permit new ponds and landfills without proper controls.**

[10] *See generally* EPA, *Coal Combustion Waste Damage Case Assessments* (2007).
[11] *See id.* at 43 (describing leaks to the Ohio River from the East Bend site).

3. **Kentucky is not comprehensively tracking where CCW contamination is going, putting off-site drinking water and communities at risk and allowing CCW discharges to enter our rivers and streams. Because heavy metals found in CCW waste are toxic in extremely low concentrations, and many of these metals accumulate over time, the combination of information gaps and leaky CCW sites is very dangerous.**

Our detailed results appear in the summary table below and in the plant-by-plant data attached to this report.

It is clear that something is badly wrong with the water under these waste facilities, and that the pollutants in that water are consistent with coal combustion waste contamination. Highlights of our findings include the following:

Clear Contamination

- Total dissolved solids (TDS), chlorides, iron, and/or sulfate parameter concentrations indicate groundwater contamination at every site. TDS, chlorides, iron, and sulfates are known to be good indicators of coal combustion wastes in groundwater and surface water.
- Every site that tested for heavy metals and reported the data to the Division of Waste Management had metal concentrations that exceeded state and EPA drinking water standards (e.g. Duke Energy East Bend; EKPC Spurlock; TVA Shawnee; Big Rivers D.B. Wilson; Big Rivers R.D. Green). In some cases, metals contamination is more than a hundred times over drinking water standards.
- CCW ponds are clearly leaking into the groundwater beneath them, as every pond for which data were available was associated with contamination (e.g. LG&E Trimble Station; Duke Energy East Bend).
- Groundwater contamination problems are becoming more acute with time at many sites, presumably due to long-term leakage (e.g., TVA Paradise, TVA Shawnee, Big Rivers D.B. Wilson).
- Compacted clay-liners have proven ineffective at preventing contaminant migration from the "dry" waste disposal in landfills (e.g. EKPC Spurlock Station).
- Coal combustion wastes are placed in unlined landfills on un-reclaimed mine spoil sites in close proximity to rivers, and there is no meaningful soil barrier on the spoil to provide any pollutant attenuation (e.g. Big Rivers D.B. Wilson Plant).

Failed Oversight

- Ash ponds are not monitored statewide even though data clearly indicate leakage resulting in contamination of groundwater (e.g. LG&E Trimble Station; Duke Energy East Bend). Ash ponds are extensive in acreage (up to ¾-mile long) and are located adjacent to major rivers and small tributary streams (e.g. EKPC Spurlock Station; LG&E Trimble Station).

- Groundwater monitoring programs dating to the 1980s and mid-1990s were more stringent because metals testing was required. The Division of Waste Management discontinued metals testing in 1997 / 1998, even though contamination above regulatory standards existed dating to the 1980s (e.g. Duke Energy East Bend, Big Rivers D.B. Wilson and R.D. Green Plants).
- No surface water, fish and aquatic life, or sediment monitoring is required even where contaminated groundwater is expected to discharge to a receiving stream (e.g. LG&E Trimble Station; LG&E Cane Run).
- Statistical analyses of groundwater data are not always required and even when required, are not always performed by the owner (e.g. LG&E Trimble Plant; EKPC Spurlock).
- The Division of Waste Management does not require that potentiometric surface diagrams for each groundwater monitoring event be prepared, even though the owner already has the information necessary to prepare such a map. As a result, neither the Division nor the plant owner knows with certainty the rate or direction of groundwater flow that are critical to determine migration pathways and risks. Instead, plant owners report wells as "upgradient", "downgradient" or "sidegradient," and Division staff must take companies' word for it if they do not conduct further research.
- In fact, even basic maps showing the location of monitoring wells were missing from some files.

Continuing Pollution

- Unlined disposal sites that the Division of Waste Management continues to approve are typically located adjacent to receiving streams where shallow groundwater is expected.
- Many ash ponds are not lined and expansions of unlined ponds continue – even though groundwater data at expansion sites indicate contamination of groundwater (e.g. LG&E Trimble).
- Recent unlined, horizontal expansions of permit-by-rule landfills continue even though there is clear evidence of leakage resulting in groundwater contamination, and/or the "horizontal expansions" are not contiguous on power plant properties (e.g., TVA Shawnee; Big Rivers D.B. Wilson Plant; LG&E Cane Run Station).

Kentucky's failure to control metal discharges is particularly troubling. Monitoring groundwater and surface water for metals, and controlling these discharges, should be of utmost importance to Kentucky because these substances can be extremely harmful at very low concentrations. A summary of the metals detected above regulatory standards at one or more of the power plant sites and their known harm is below. Importantly, these metals may not produce these results in every case: not everyone responds in the same way to pollution. But it is clear that even very small concentrations of these pollutants can make people sick. Indeed, EPA studies have found that cancer risk for well users living near leaking CCW sites can increase dramatically.[12]

[12] *See* EPA, *Draft Human and Ecological Risk Assessment of Coal Combustion Wastes* (Aug. 6, 2007); *See also* Earthjustice & Environmental Integrity Project, *Coming Clean: What the EPA Knows About the Dangers of Coal Ash* (May 2009).

Metals and Their Effects

Parameter	Effect
Arsenic	Human carcinogen (0.01 mg/L MCL)
Boron	Nausea, vomiting, and throat ulcer (2.0 mg/L EPA long-term child health advisory average)
Cadmium	Kidney, lung, and bone damage (0.005 mg/L MCL)
Lead	Kidney damage, high blood pressure, and development delays for children (0.015 mg/L MCL)
Mercury	Kidney damage (0.002 mg/L MCL)
Selenium	Hair and fingernail loss (0.05 mg/L MCL) Fish and aquatic life toxicity (0.020 mg/L acute toxicity, 0.005 mg/L chronic toxicity, 401 KAR, 10:031)

Toxins leaching from CCW can also cause substantial environmental harm. Heavy metals that slowly accumulate in the food chain are particularly dangerous, and may be toxic at extremely small concentrations. EPA, for instance, recommends that states set water quality limits to ensure that ecosystems are not exposed to chronic levels of more than just 0.77 micrograms of mercury per liter – that is, 0.00000077 grams – or more than 5 micrograms per liter of selenium.[13] Long term leaks from CCW sites can push ecosystems above such limits, leading to lasting harm to rivers and streams.[14]

The conclusion is simple: Kentucky has failed to control coal combustion waste pollution and that pollution is dangerous.

[13] *See* EPA, National Recommended Water Quality Criteria, available at http://www.epa.gov/waterscience/criteria/wqctable/.

[14] *See, e.g.*, A. Dennis Lemly, *Aquatic Exposure to Selenium is a Global Environmental Safety Issue*, 59 Ecotoxicology and Environmental Safety 44 (2004) (observing that coal ash may have as much as 1250 times the selenium that unburned coal does and listing "locations where selenium pollution has contaminated fish and wildlife populations").

Table 1 - Summary of Findings - Coal Combustion Waste Monitoring – All Sites

Site / Owner	Location	Disposal Units	Permitted (Y/N)	Lined (Y/N)	MCL Exceedance (Max. MCL exceedance)	SMCL Exceedance (Max. SMCL exceedance)	Proximity To Stream	Other (all units)
CG&E Duke Energy East Bend Station	Rabbit Hash				9 wells (of 10) exceeded at least 1 std. from 1981 to 1997	9 wells (of 10) exceeded at least 1 std. from 1981 to 1997		No metals analyses required since 1997
		CCW Landfill	Yes	Unknown	Arsenic – 4 times std. Mercury – 300 times std.	Iron – 1.5 times std.	1,300 ft. Ohio River	12 sludge pond, ash pond, and landfill wells decommissioned in 1997
		Sludge Pond	Unknown	Unknown	Lead – 1.6 times std. Mercury – 450 times std.	Iron – 43 times std. Silver – 66 times std.	300 ft. Ohio River	Groundwater assessment plan required
		Ash Pond	Unknown	Unknown	Mercury – 450 times std.	Iron – 28 times std.	400 ft. Ohio River	Process wells provide drinking water for station
		Sanitary Landfill	No	Unknown		Iron – 2.4 times std.	Unknown	
EKPC Spurlock Station	Maysville				1 well (of 4) exceeded at least 1 std. from 2005 to the present	2 wells (of 4) exceeded at least 1 std. from 2005 to the present		Lined landfill is leaking Groundwater data worsened from 2005 to 2009
		CCW Landfill	Yes	Yes	Arsenic – 16 times std. Arsenic - 121 times mean background	Sulfate – 3.5 times std. TDS – 4.3 times std. Iron – 11 times std.	Unknown	Statistical analyses required but not performed
		CCW Pond (0.7-mile)	Unknown	Unknown			200 ft. Ohio River	No upgradient well

LG&E, E. On Cane Run Station	Louisville	CCW landfill (1-mile) 5 CCW Ponds	Yes Unknown	No Unknown	No metals analyses required	6 wells (of 7) exceeded at least 1 std. from2005 to the present Chlorides – 3.5 times std. Sulfate – 7 times std. TDS - 9 times std. pH	220 feet from Ohio River	"Horizontal expansion" planned for non-contiguous disposal sites
LG&E, E. On, Trimble Station	Bedford	CCW Pond (0.6-mile)	Yes	No	No Data Metals collected from 1996 to 2003 but not reported	9 wells (of 12), exceeded at least 1 standard, 2003 to the present Chlorides – 2 times std. Sulfate – 9 times std. TDS – 10 times std.	1,300 from Ohio River	Vertical expansion of CCW pond (2009) No metals analyses required since 2003 Statistical analyses not performed
TVA Paradise Plant	Drakesboro	Asbestos Landfill	Yes	No		5 wells (of 5), exceeded at least 1 std. from2003 to the present TDS – 11 times std. pH Chlorides – SSI[15] Nitrate – SSI Sodium – SSI	Green River	Increasing chloride concentrations Surface water runoff contains high sulfate and TDS Sulfate monitoring not required for groundwater

[15] SSI=statistically significant increase.

		4 CCW Ponds Suspect Landfills	Unknown No	Unknown Unknown		TOC – SSI		
TVA Shawnee Plant	Paducah	 2 CCW landfills 2 CCW Ponds	 Yes Unknown	 No Unknown	2 wells (of 14) exceeded at least 1 standard in 2008 Arsenic – 1.2 times std. Selenium – 1.7 times std.	14 wells (of 14) exceeded at least 1 standard Boron – 7.5 times std. Sulfate – 5.6 times std. TDS - 4 times std. TOC – SSI COD - SSI	 Border Little Bayou Creek 700 ft. Ohio River	Most recent landfill expansion approved in 2007 No metals analyses required
Big Rivers D.B. Wilson Plant	Centertown	 2 CCW Landfills Suspect CCW Ponds	 Yes Unknown	 No Unknown	3 wells (of 4) exceeded 1 std., 1993 to 1994 Cadmium – 2 times std. Lead – 3.5 times std. Mercury – 17 times std.	3 wells (of 4) exceeded 1 std., 1993 to 1994 Sulfate – 5 times std. TDS – 2.4 times std. 9 wells (of 10), exceeded 1 std., 2009 TDS – 8 times std. Chlorides – SSI TOC - SSI	 500 ft. Green River	Wastes placed on un-reclaimed mine spoil “Horizontal expansion” planned for non-contiguous disposal sites No metals analyses required since 1997 Owner argues “no trends” in data and chlorides do not trigger assessment

Big Rivers R.D. Green Plant	Robards	CCW Landfill CCW Pond	Yes Unknown	Unknown Unknown	5 wells (of 11) exceeded 1 std., 1988 Cadmium – 5 times std. Lead – 1.1 times std.	10 wells (of 11) exceeded 1 std., 1988 to current Chlorides – 6 times std. Iron – 4 times std. Sulfate – 22 times std. TDS – 16 times std. Nitrate – 1.4 times std.	200 ft. Green River 250 ft. Groves Creek	No metals analyses required since 1998 TDS and chloride concentrations have increased Owner argues “no trends” in data and chlorides do not trigger assessment

What Went Wrong?

How did contamination become so severe and so widespread? After all, most coal combustion waste issues can be solved by using modern landfills with composite liners (which are multilayered lining systems) and effective leachate collection and treatment systems. Yet, Kentucky continues to permit antiquated projects without basic monitoring and safeguards.

In part, this state of affairs came about because the coal industry has spent decades insisting, despite mountains of evidence to the contrary, that its waste is not dangerous. In part, it is because the EPA has failed to provide federal leadership by classifying and regulating coal combustion waste as the hazardous waste that it is. And, in part, it is because Kentucky, in the absence of federal leadership, did not act strongly enough to protect its citizens.

The state oversight structure fails at the start due to a state law classifying most coal combustion waste as "special waste," which is defined as "high volume and low hazard."[16] This decision, which ignores the heavy metals that leach from these wastes, permits the Division of Waste Management to regulate these "special wastes" as a distinct category, to be treated as if it is not dangerous.

Compounding this problem is the Kentucky legislature's decision not to lead on environmental issues. A section of the Kentucky code provides that Kentucky rules "shall be no more stringent than the federal law or regulations."[17] As a result, Kentucky has largely decided to follow the federal government's lead, rather than to actively work to find solutions to environmental challenges. Although Kentucky could still do better, even with this prohibition, its decision to preemptively limit its efforts to protect citizens and the environment is a lasting mistake.

The regulatory structure that has resulted from these choices has many flaws, including:

- <u>Free passes for dangerous CCW ponds</u>
  CCW ponds are among the most dangerous of all coal combustion waste sites but the Kentucky rules pay them almost no attention. "[S]pecial waste surface impoundments" –ponds – which comply with state water discharge permits are "permit-by-rule."[18] That means that the Division of Waste Management just "deem[s]" that they have a permit provided they meet extremely basic generic design requirements, which do not even include a requirement to line and monitor the pond. As a result, CCW ponds are not subject to detailed engineering reviews, public oversight, or most protective rules. CCW ponds should be phased out entirely – not completely overlooked.

- <u>A "beneficial reuse" loophole</u>
  "Beneficial reuse" projects, which are very broadly defined, are also in the "permit-by-rule" category.[19] As a result, if a company recharacterizes a CCW disposal site as, for

[16] K.R.S. § 224.50-760.
[17] K.R.S. § 13A-120(1).
[18] *See* 401 K.A.R. 45:060 § 1(4).
[19] 401 K.A.R. 45:060 § 1.

instance, “structural fill,” “highway base” material, or “mine stabilization and reclamation material,” it may be able to evade permit review – even though the site remains dangerous. The company must “characterize[ ] the nonhazardous nature of the coal combustion byproducts” to use this loophole, but it’s far from clear that this requirement is applied rigorously – especially because CCW is inherently hazardous. Moreover, even if that hurdle is cleared, most design review requirements are waived, save for basic siting standards, which means that these projects may lack liners, appropriate monitoring systems, or other safeguards a full permit review would include. .If “beneficial reuse” of this sort can ever be safe, oversight must be far tighter, ensuring, for instance, that any ash is safely insulated from water supplies.

- Lax design requirements
  Even those projects that escape the “permit-by-rule” loopholes do not face much stronger oversight. Design requirements for special waste landfills are weak. Liners, cover materials, and leachate collection systems – the basic, unglamorous tools that would prevent most coal combustion waste contamination -- must be used only if the Division of Waste Management determines that a company should be “required” to do so – not as a matter of course. Rather than establishing a firm, sensible baseline, the rules leave basic safety measures as options, to be implemented on a case-by-case basis.

- A major water loophole
  The Division of Waste Management may require a landfill to collect its leachate, but it does not set treatment standards for the leachate discharges themselves. That responsibility falls to the Division of Water, and the Division of Water is not doing its job. The Division of Water regularly fails to impose *any* limits on heavy metals in coal combustion waste discharges because antiquated EPA guidelines, which are nearly thirty years old, do not contain such requirements. EPA itself has warned that the guidelines “do not adequately address the pollutants being discharged” and cautioned that states nonetheless have a duty to impose appropriate limits.[20] Because the Division of Water ignores this duty, untreated toxin-filled landfill leachate can be discharged into rivers, streams, or even the old unlined ash ponds landfills are meant to replace. Indeed, the Division of Water sometimes declines to process a discharge permit at all, on the grounds that ash ponds are “zero discharge,” a stance that ignores the state’s own data demonstrating extensive leaks. Even worse, many of these new landfills, including, for instance, LG&E’s $94 million Trimble landfill project, are ratepayer-funded,[21] in part because they have been presented as environmental improvements. It risks public health and wastes ratepayer money to build new ash landfills when the Division of Water allows their leachate discharges to wind up right back in old ponds or in rivers.

[20] *See* 74 Fed. Reg. 55,837 (Oct. 29, 2009); 74 Fed. Reg. 65,599 (Dec. 28, 2009).
[21] *See, e.g.*, PSC Order in Case 2009-00197 (Dec. 23, 2009).

- Subpar enforcement

  Even though file data show that pollution is widespread and increasing, Kentucky enforcement agencies are not acting to force CCW dumpers to clean up their acts. Under Kentucky's rules, all waste impoundments must, at a minimum, avoid violating primary MCLs, which are core federal groundwater protections against toxic metals like arsenic and mercury.[22] Such violations should trigger enforcement action and should also trigger groundwater contamination corrective action.[23] Despite the systemic violations and contamination documented in the Division of Waste Management's own monitoring data, we are aware of only one completed groundwater assessment for a CCW site – the East Bend facility – which was finished only months ago. The state has had evidence of violations and spreading contamination for years, but has not acted to enforce against violators or to reform its rules.

- Inadequate monitoring and review

  The rules blind Kentucky to problems in several ways.

  First, although ponds are the most likely to be leaking, the monitoring rules do not require groundwater monitoring around CCW ponds. Although the Division of Waste Management may require such monitoring, it *must* do so only for landfills.[24] As a result, contamination from ponds is only regularly measured where facilities have installed monitoring wells for other purposes.

  Second, the rules do not require regular monitoring off-site. Spreading contamination is a major problem, but the groundwater monitoring system requires a minimum of just three wells – one upgradient from the waste and two downgradient.[25] The rules do not explicitly require off-site monitors, even if contamination is detected onsite. For other forms of solid waste, three, not two, downgradient wells are required, along with surface water monitoring that might better catch contamination.[26]

  Third, the rules, as enforced, do not even cover all the contaminants that coal combustion waste may produce. The special waste rules on the books require monitoring for most (but not all) the metals in coal combustion waste in baseline testing, but not over time, as metals leach and dump sites age.[27] In practice, plants get away with very little monitoring. In several cases, metal monitoring requirements have simply been dropped from monitoring reports, leaving regulators in the dark. In others, such requirements were never included.

  Fourth, in assessing new applications, the Division of Waste Management does not appear to be tracking the most recent testing data for CCW's leaching risk. Both EPA and the National Research Council of the National Academy of Sciences have concluded that the "TCLP" test – a short term test that only assesses whether materials will leach under the conditions of a municipal landfill, and which Kentucky agencies regularly

[22] *See* 401 K.A.R. 45. 060, 45:070, & 45:110 (all requiring compliance with environmental performance standards in 401 K.A.R. 30:031); 401 K.A.R. 30:031 § 5 (groundwater requirements); 401 K.A.R. 8:250 (incorporating federal MCLs).
[23] *See* 401 K.A.R. 45.160 § 5.
[24] 401 K.A.R. 45:160 § 1.
[25] *Id.* § 2.
[26] *See* 401 K.A.R. 48:300.
[27] *See id*. § 7.

accept – underestimate these risks over the long time periods and varied conditions that CCW ponds and landfills face.[28] Indeed, several EPA reports, published from 2006 to 2009, provide conclusive evidence that this single-point pH test is not sufficient for evaluating potential impacts from the disposal and reuse of coal combustion waste. According to the EPA, the single-point leach test, the Toxicity Characteristic Leaching Procedure (TCLP), should be replaced by a test that more accurately predicts the levels of toxic metals that can leach out of coal ash when the ash is improperly disposed and re-used.[29]

These failures are just the tip of the iceberg. Kentucky's rules are due for a major overhaul, commensurate with the scale of the coal combustion waste crisis.

Conclusions and Recommendations

State regulation of coal combustion waste is failing in Kentucky. CCW ponds and landfills around the states appear to be leaking and coal companies are clamoring to build even more CCW disposal sites – often at ratepayer expense. Meanwhile, Kentucky's regulatory system fails to require even basic monitoring for many sites, much less the quality engineering that would reduce contamination risk. This situation must come to an end. We recommend that Kentucky:

1. Recognize that coal combustion waste, including ash, slag, and scrubber sludge, is toxic and advocate for strong federal regulation of these substances as hazardous waste.
2. Immediately commence a detailed file review and field testing program to identify all relevant data for all CCW sites in Kentucky and analyze this information for evidence of possible leaks and contamination. Where information is inadequate, Kentucky should require companies to submit additional monitoring data.
3. Ensure that this review is open to the public and conducted through a participatory process that encourage citizens to report possible damage cases
4. Revise its special waste statutes and regulations to treat coal combustion waste as a public health and environmental threat warranting strict control, including:

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[28] *See* NRC, *Managing Coal Combustion Residues in Mines* (2006); *see also* Tom FitzGerald, *Current Issues in the Regulation of Coal Ash*, World of Coal Ash Conference (2009) (discussing leaching results.

[29] EPA fully describes its transition to a more sensitive and accurate leaching test for coal ash in the following studies:

Characterization of Coal Combustion Residues from Electric Utilities Using Wet Scrubbers for Multi-Pollutant Control" (EPA/600/R-08/077) July2008, available at: http://www.epa.gov/nrmrl/pubs/600r08077/600r08077.htm.

(2) "Characterization of Mercury-Enriched Coal Combustion Residues from Electric Utilities Using Enhanced Sorbents for Mercury Control" (EPA-600/R-06/008) February 2006; available at:http://www.epa.gov/nrmrl/pubs/600r06008/600r06008.pdf

(3) U.S. EPA, Characterization of Coal Combustion Residues from Electric Utilities Using Multi-Pollutant Control Technology – Leaching and Characterization Data (EPA-600/R-09/151) December 2009, available at http://www.epa.gov/nrmrl/pubs/600r09151/600r09151.html

a. Banning all new CCW ponds. Require a swift transition to dry handling of coal ash and phase-out dangerous wet storage in ponds, which pose the greatest danger of contaminating groundwater and surface water, as well as the risk of catastrophic collapse.
b. Banning all new permit-by-rule beneficial use areas where unencapsulated ash is used as structural fill, for road-building, for mine stabilization and reclamation, or in other circumstances that could contaminate ground or surface water.
c. Requiring that all dry landfills use composite liner systems, appropriate and durable cover materials, and effective leachate collection systems.
d. Providing for detailed and systematic monitoring of all coal combustion waste sites, including hydrogeological baseline monitoring before disposal begins and offsite groundwater and surface water monitoring to track any contamination plumes. Monitoring and analysis of coal combustion waste should include appropriate leaching tests that accurately characterize long-term leaching potential over varied conditions.

5. Close the "water loophole" by making clear that the Division of Water must follow federal law and strictly control metals and other pollutants in any leachate discharge.
6. Swiftly investigate and implement measures to reduce the production of coal combustion waste by transitioning to cleaner energy sources.

Kentuckians deserve clean, healthy drinking water and thriving, healthy rivers and streams. It's time for the Commonwealth to take action to protect its citizens from coal combustion waste.

Part 2 - File Review Summary – Individual Sites

2.1 Cincinnati Gas and Electric / Duke Energy, East Bend Station, Rabbit Hash

Location
6293 Beaver Road
Rabbit Hash, Kentucky 41005
Boone County
GPS Coordinates: 38°54'26"; 84°50'25"

Summary
Groundwater data indicate multiple exceedances of groundwater standards as early as 1981 for arsenic, mercury, iron, and TDS. Monitoring programs for a sanitary landfill, an ash pond, and sludge ponds were terminated sometime between 1981 and 1994 even though there was evidence of leakage from the bottom of those waste disposal units, and there was groundwater contamination. An unmonitored ash pond is situated within approximately 400 feet of the Ohio River. An increase of contaminants downgradient of the coal combustion waste landfill indicates that the landfill is leaking. Groundwater elevation and temperature data suggest that the ash pond is leaking and resulting in mounding of the groundwater in the area. A groundwater and risk assessment was performed for the ash pond 10 years after the assessment was first required. That assessment concluded that there were no risk to human and ecological receptors but the assessment was substantially flawed – it failed to consider heavy metals that have been detected at high concentrations in the groundwater, failed to consider groundwater discharge to a nearby small receiving stream, and included very limited ash pond water samples.

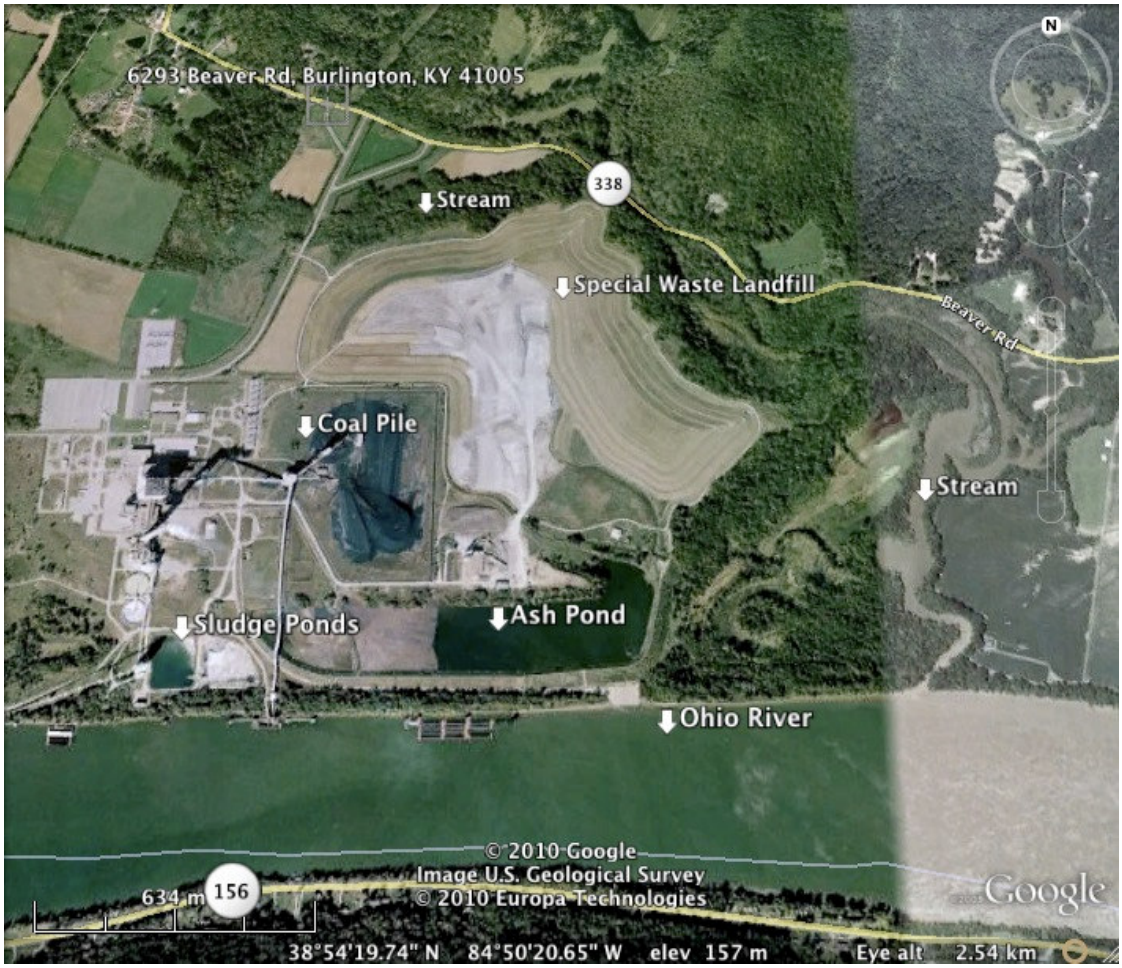
Type(s) of Waste Management Units and Wastes Present
Special waste landfill that contains unspecified coal combustion wastes. Correspondence in the file suggests that groundwater monitoring wells were installed in 1980. The landfill is situated approximately 1,300 feet north of the Ohio River.

Correspondence in the file and current aerial photography (attached) indicates that an ash pond exists approximately 400 feet north of, and adjacent to, the Ohio River. The file review did not specify what types of ash are disposed of in the ash pond.

Correspondence in the file also suggests that a sanitary landfill and a sludge pond existed at one time; however, their locations were not determined by the file review.

According to Duke Energy's March 30, 2009 CERCLA 104(e) response to EPA's request for information, the East Bend plant has two (2) flue gas desulfurization (FGD) ponds that were commissioned in 1980, and one fly ash pond that was commissioned in 1980.

Aerial Photo – East Bend



Monitoring Requirements

The oldest correspondence from the file that provided groundwater data for the facility is 1981. The monitoring system at that time included 6 wells at the solid waste disposal area (Well 1 was upgradient, Wells 2 through 6 downgradient); one upgradient well (Well 7) at a sanitary landfill; a downgradient well (Well 8) at a sludge pond B; two downgradient wells (Wells 9 and 10) at an ash storage area; and two production wells (TW-1 and TW-2) at the plant. Groundwater monitoring in 1981 consisted of these parameters:

pH	Fluoride	Arsenic
Specific conductance	Chemical Oxygen Demand	Barium
Total dissolved solids	Chlorides	Beryllium
Calcium (dissolved)	Sulfate	Cadmium
Iron (dissolved)	Suspended Solids	Chromium
Magnesium (dissolved)	Phosphorus	Lead
Manganese (dissolved)	Total Organic Carbon	Mercury
Potassium (dissolved)	Aluminum	Nickel

Sodium (dissolved)	Iron	Selenium
Alkalinity	Calcium	Silver
Nitrate (as Nitrogen)	Copper	Thallium
Hardness	Antimony	Zinc

Correspondence in February 1997 stated that 12 wells and two piezometers were decommissioned in January 1996 because as of July 1994, the new KPDES permit no longer required groundwater monitoring and that wells were not suitable (by construction or location) to monitor the landfill. A new monitoring system consisting of 7 wells was installed in August / September 1996 and first sampled in November 1996.

Sometime between 1988 and 1997 (based on file review data gap), the parameter list was expanded to also include these parameters:

Bicarbonate	Calcium (as calcium carbonate)

Beginning in 1999 and lasting to the end of 2006, the required sampling parameter list was drastically *reduced to only include* these indicator parameters – none of which has an EPA primary Maximum Contaminant Level (MCL) drinking water standard:

Temperature	Chlorides
Specific conductance	Total dissolved solids (TDS)
Chemical Oxygen Demand (COD)	pH
Organic Carbon	Copper

Statistical analyses of groundwater data have been required since 1999.

Constituents Involved

Groundwater monitoring in April 1981 indicated multiple drinking water criteria exceedances, with these as major examples:

Parameter / Standard (mg/L)	**Well Exceedances (mg/L)**	
Arsenic (0.050, now 0.01)	MW-1 (0.04)	
Iron (0.3)	Well 001 (8.8) Well 004 (0.45) Well 007 (0.73) Well 008 (12.80, 43 times std.)	Well 009 (0.89) Well 010 (8.3) Well 011 (0.13)
Mercury (0.002)	Well 001 (0.5) Well 002 (0.5) Well 003 (0.58) Well 004 (0.60) Well 005 (0.60)	Well 008 (0.90, 450 times the std.) Well 009 (0.90) Well 010 (0.60) Well 011 ((0.05)
TDS (500)	Well 002 (514)	

	Well 004 (690)	
Lead (0.015)	Well 008 (0.024, 1.6 times std.)	
Silver (0.10)	Well 008 (6.6, 66 times std.)	

Parameters for these wells and substances were exceeded in the July 2009 sampling event:

Parameter / Standard (mg/L)	**Well Exceedances (mg/L)**	
TDS (500)	MW-3 (1,080, 2 times std.) MW-4 (571) MW-5 (697)	MW-6D (712) MW-100 (879)
Chlorides (statistically significant increase)	MW-5	

When the results of data from 1999 through the July 2009 sampling event are compared to the 1981 results, the data indicate that:

- Wells downgradient of the ash pond and the sludge pond are no longer sampled. As a result, there are no wells to monitor the MCL exceedances that were reported in 1981 for mercury in downgradient wells at the ash pond or the sludge pond.
- TDS concentrations have increased since 1981, particularly downgradient of the capped portion of the special waste landfill (MW-3).
- Statistically significant increases (SSIs) of chloride have also occurred in 1999 in MW-4 and MW-6D, which are downgradient of the special waste landfill.
- SSIs of Chemical Oxygen Demand (COD) have occurred in January 2008 at wells MW-4, MW-5, MW-6, and MW-6D, and for specific conductance in wells MW-5 and MW-6.

According to an April 6, 1999 Site Investigation Report obtained from the file review, the facility was required to submit a groundwater assessment plan to the Division by May 6, 1999. The assessment plan was submitted to the Division on December 21, 2009 – over 10 years after it was first due.

A Baseline Monitoring Report completed in December 1998 by Dames and Moore for Cinergy Corporation concluded that:

- The highest TDS concentrations were found in wells downgradient of the special waste landfill.
- The highest concentrations of chemical oxygen demand (COD) and calcium were also found in the wells downgradient of the special waste landfill.
- Sulfate concentrations up to eight (8) times higher than background were found downgradient of the special waste landfill.

Flawed Risk Assessment

A revised groundwater assessment plan that also included a risk assessment was submitted to the Department in December 2009. The risk assessment made the following conclusions:

Constituents of Probable Concern

- The only constituents of probable concern (COPC) were iron, manganese, and sulfate. These parameters only have secondary drinking water standards established by EPA.
- The risk assessment included no risk determinations for heavy metals that have been reported in the facility wells as early as 1981 above their respective drinking water standard: arsenic, mercury, lead, and silver.

Human Risk Assessment Conclusion

- The only possible human exposure pathway was from ingesting water containing the three COPCs from plant production wells that supply drinking water to the plant.
- The human health risk was acceptable for on-site workers but that any future residential use would not be acceptable.

Ecological Risk Assessment Conclusion

- The only ecological exposure pathway that was examined was groundwater discharge to the Ohio River.
- Iron and sulfate concentrations in groundwater do not pose a risk to ecological receptors in the Ohio River.
- Manganese concentrations in groundwater exceeded the Ohio River surface water screening criteria but that exceedance would not be expected once the groundwater reaches the Ohio River because of dilution from the river.
- The ecological risk assessment was acceptable for ecological receptors.

Upon review of the risk assessment, the conclusion of no risk to both human and ecological receptors is flawed because:

- The ecological pathway assessment did not even consider stream sampling and toxicity determinations for an un-named tributary nearest the ash pond and landfill. That stream represents the closest, most logical exposure pathway to fish and aquatic life - yet it was never even considered in the risk assessment.
- The assessment did not include arsenic, mercury, lead, and silver--heavy metals that have been reported in on-site wells in the past.
- The assessment did not include selenium, which is common in coal combustion wastes and is extremely toxic to fish and aquatic life at extremely low concentrations.
- The ash pond water samples included no testing from the bottom of the pond in the area of the highest COPC concentrations (northwest corner) and the lowest pH (2.79 at the surface). In fact, only one bottom sample was collected for the entire pond.
- The ash pond water surface water samples were collected after an un-specified “brief” plant outage and therefore may not be representative of the highest concentrations.

Hydrogeologic Conditions

The power plant location adjacent to the Ohio River suggests that shallow water table aquifer conditions exist. According to a February 11, 1997, report by Dames and Moore, perched water table and Ohio River valley aquifers occur at the plant. The wells that were installed in 1996 do not monitor the perched water table and therefore do not monitor the upper-most water-bearing zone.

Potentiometric surface diagrams have been prepared since at least 1997 for each sampling event. Those diagrams show that groundwater flows from the landfill to the southwest and southeast towards the Ohio River and even occasionally show flows away from the river to the northwest. A December 14, 1998 report by Dames and Moore concluded that the reversed groundwater flow direction was due to "infrequent strong rises" in the Ohio River; however, this fact was not supported by their data because the river stage that they reported for the same period "was relatively stable at approximately 455.5 feet". The reversed flow could also be due to pumping from plant groundwater production wells and mounding of groundwater from waste disposal unit(s), including the unlined ash pond.

The results of temperature measurements obtained during groundwater sampling in July 1998 indicate that the well nearest the ash pond (MW-4) had a groundwater temperature 15° F hotter (73.5° F) than the typical shallow aquifer well on-site (59° F) – suggesting that the ash pond is leaking to the shallow aquifer.

2.2 East Kentucky Power Cooperative, Spurlock Station, Maysville

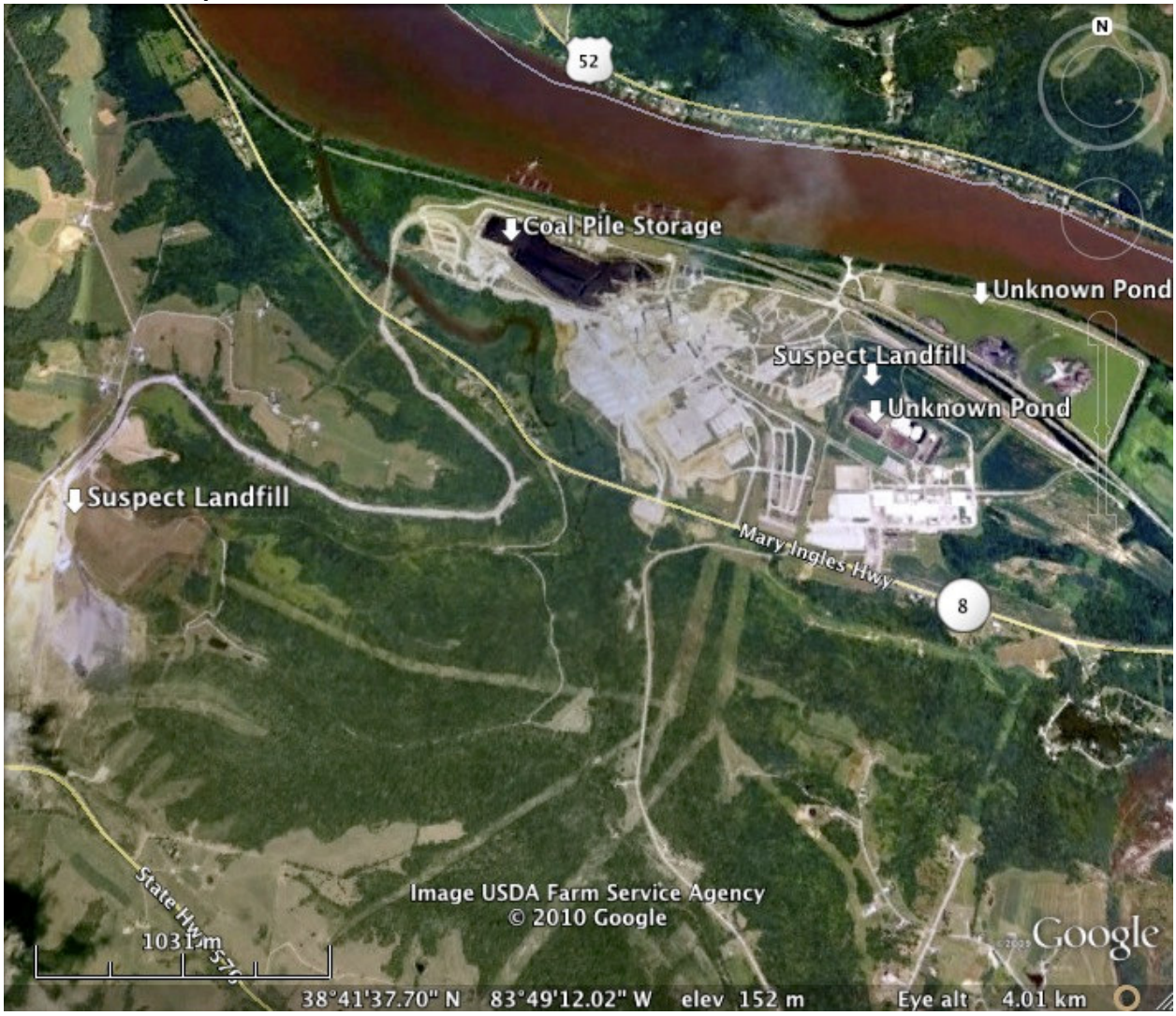
Location
Route 8
Maysville, KY 41056
Mason County
GPS Coordinates: 38°41'50"; 83°48'37"

Summary
Aerial photography suggests that un-permitted wastewater treatment ponds, a 0.7-mile long ash pond, and a landfill exist. Groundwater monitoring data indicate that one lined, permitted coal combustion waste landfill has been leaking since at least 2005, as indicated by coal combustion waste parameter concentrations that exceed EPA drinking water standards – particularly arsenic (16 times higher than the standard), sulfate (3.5 times the standard), iron (3 times the standard), and total dissolved solids (4 times the standard). Both the concentrations of contaminants and the number of contaminated wells worsened over time. Although statistical analyses are required to be performed on groundwater samples, EKPC only completed one analysis (in 2006) and later claimed that not enough data were available to perform a meaningful analysis – even though the 2006 analysis indicated multiple statistically significant increases (SSIs) in parameter concentrations. The Division does not require that a potentiometric surface diagram be submitted with groundwater reports and as a result, the Division is unable to determine the location of any well or the direction and rate of groundwater flow at the site. The site is located adjacent to the Ohio River.

Type(s) of Waste Management Units and Wastes Present
One (1) special waste landfill that contains unspecified coal combustion wastes is permitted for the site. According to the Division, a construction / operational permit was issued on September 20, 1982, and the landfill has a 2-foot, $1x10^{-7}$ cm/sec compacted clay liner. The site is located adjacent to the Ohio River. Aerial photography suggests that another landfill, two (2) wastewater treatment ponds, and one (1) ash pond also exist. The suspect ash pond is approximately 3,800 feet (0.7-mile) long and is approximately 200 feet from the Ohio River.

According to EKPC's March 24, 2009 CERCLA 104(e) response to EPA's request for information, the Spurlock plant has one (1) bottom ash pond that was commissioned in 1976, and fly ash and gypsum are also disposed of in an on-site landfill.

Aerial Photo – Spurlock



Monitoring Requirements

The oldest correspondence from the file that provided groundwater data for the facility is May 2005. The file review did not indicate any maps that illustrated where the wells were located. Groundwater monitoring consisted of these parameters:

Indicator Parameters	**Metals**
pH	Arsenic
Temperature	Cadmium
Chlorides	Calcium
Chemical Oxygen Demand (COD)	Copper
Total dissolved solids (TDS)	Fluoride
Total Organic Carbon (TOC)	Iron
Specific conductance	Lead
Bicarbonate alkalinity	Nickel
Carbonate alkalinity	Magnesium

Nitrate (as Nitrogen)	Manganese
Phosphorus	Mercury
Sulfate	Potassium
	Selenium
	Sodium
	Zinc

The monitoring system in 2005 included no upgradient wells, three (3) downgradient wells, and one (1) sidegradient well[30]:

IW-6 – downgradient	IW-8 – downgradient and sidegradient
IW-7 – downgradient	Well A – sidegradient

Statistical analyses of groundwater data have been required since at least 2005; however, the analysis was only performed one time in four (4) years. EKPC concluded in a January 2008 letter to the Division that "no meaningful statistics can be performed" because the data set was so small.

Constituents Involved

The file review identified conflicting results reported by EKPC for the same event and same wells. As an example, data reported in May 2005 and then later in January 2006 for the same March 15, 2005 sampling event reported different results for static water level, temperature, total dissolved solids (TDS), chlorides, and copper.

Groundwater monitoring in March 2005 indicated multiple drinking water criteria exceedances:

Parameter / Standard (mg/L)	**Well Exceedances (mg/L)**	
TDS (500)	IW-6 (608) IW-7 (1,850, 3.7 times std.)	IW-8 (632)
Sulfate (250)	IW-7 (854, 3.4 times std.)	
Arsenic (0.01)	IW-7 (0.022, 2 times std.)	
Iron (0.3)	IW-7 (3.29, 11 times std.)	

Arsenic concentrations in well IW-7 were greater than the EPA drinking water standard for every sampling event, and the concentrations ranged from 0.0193 mg/L (November 2008) to 0.16 mg/L (June 2009).

The only statistical analysis that was found in the file was for the April 2006 sampling event, and those results indicated statistically significant differences in well concentrations, although EKPC did not conclude as such. That analysis reported that:

[30] Here, as in several other sites, a potentiometric groundwater diagram is not in the file. The wells themselves are, however, labeled as "upgradient", "side gradient", or "downgradient." While a full diagram would be far preferable, this identification allows us to draw some conclusions on the basis of the company's own identifications.

IW-8 (considered by EKPC to be the "base well") Mean Concentration (mg/L)	Test Well Concentrations (mg/L)
Conductivity (625)	IW-7 (1,662, 3 times the mean)
Chlorides (14.4)	IW-6 (27.5, 2 times the mean)
Sulfate (130.8)	IW-7 (620, 5 times the mean)
Arsenic (0.001)	IW-7 (0.121, 121 times the mean)

The trend of groundwater results indicative of a release of coal combustion waste to the underlying groundwater worsened in terms of the number of wells contaminated through the most recent June 2009 sampling event as follows:

Parameter / Standard (mg/L)	Well Exceedances (mg/L)	
TDS (500)	IW-6 (820) IW-7 (2,190, 4.3 times std.)	IW-8 (505) Well A (533)
Sulfate (250)	IW-6 (276)	IW-7 (870, 3.5 times std.)
Arsenic (0.01)	IW-7 (0.16, 16 times std.)	

When the June 2009 data are compared to the 2003 results, the data indicate that:

- Wells downgradient of the landfill continue to indicate a release of coal combustion waste contaminants to the groundwater, as indicated by arsenic, TDS, and sulfate.
- The rate and direction of groundwater flow are unknown.
- Although required by their permit, EKPC rarely performs a statistical analysis of groundwater data. When the analysis was performed in 2006, the data indicated that statistically significant increases (SSIs) existed for the wells – indicating a release of coal combustion wastes to the underlying groundwater.
- Given that there is no true reported upgradient well, the results of the statistical analyses likely indicate more significant contamination because there is no ambient, unaffected background well which to compare downgradient and sidegradient well results. Instead, downgradient wells are compared to wells that have already been affected by coal combustion wastes.

Hydrogeologic Conditions

The power plant location adjacent to the Ohio River suggests that shallow water table aquifer conditions exist. No potentiometric surface diagrams to determine the direction and rate of groundwater flow were found in the file because the Division does not require that they be prepared.

2.3 Louisville Gas and Electric / E. On, Cane Run Station, Louisville

Location
5252 Cane Run Road
Louisville, Kentucky 40216
Jefferson County
GPS Coordinates: 38°10'45"; 85°53'22"

Summary
The groundwater monitoring reports demonstrate that there have been multiple, continually repeated exceedances of groundwater standards since at least 2005. Existing unlined waste disposal units that have resulted in groundwater contamination include an unlined landfill approximately one (1) mile long and adjacent to the Ohio River, an unlined ash pond beneath the landfill, and an unlined ash pond adjacent to the landfill. Groundwater monitoring temperature results strongly suggest an interconnection between the ash pond, the landfill, and the groundwater beneath those units. The Division received a "horizontal expansion" landfill application to construct another 61-acre landfill to contain 5.7 million cubic yards of coal combustion wastes, even though the new landfill will be located approximately 1,500 feet from the existing landfill. No heavy metals tests are required for the groundwater sampling program to determine the concentrations of metals that are indicative of coal combustion wastes and are harmful to humans and fish and aquatic life at extremely low concentrations.

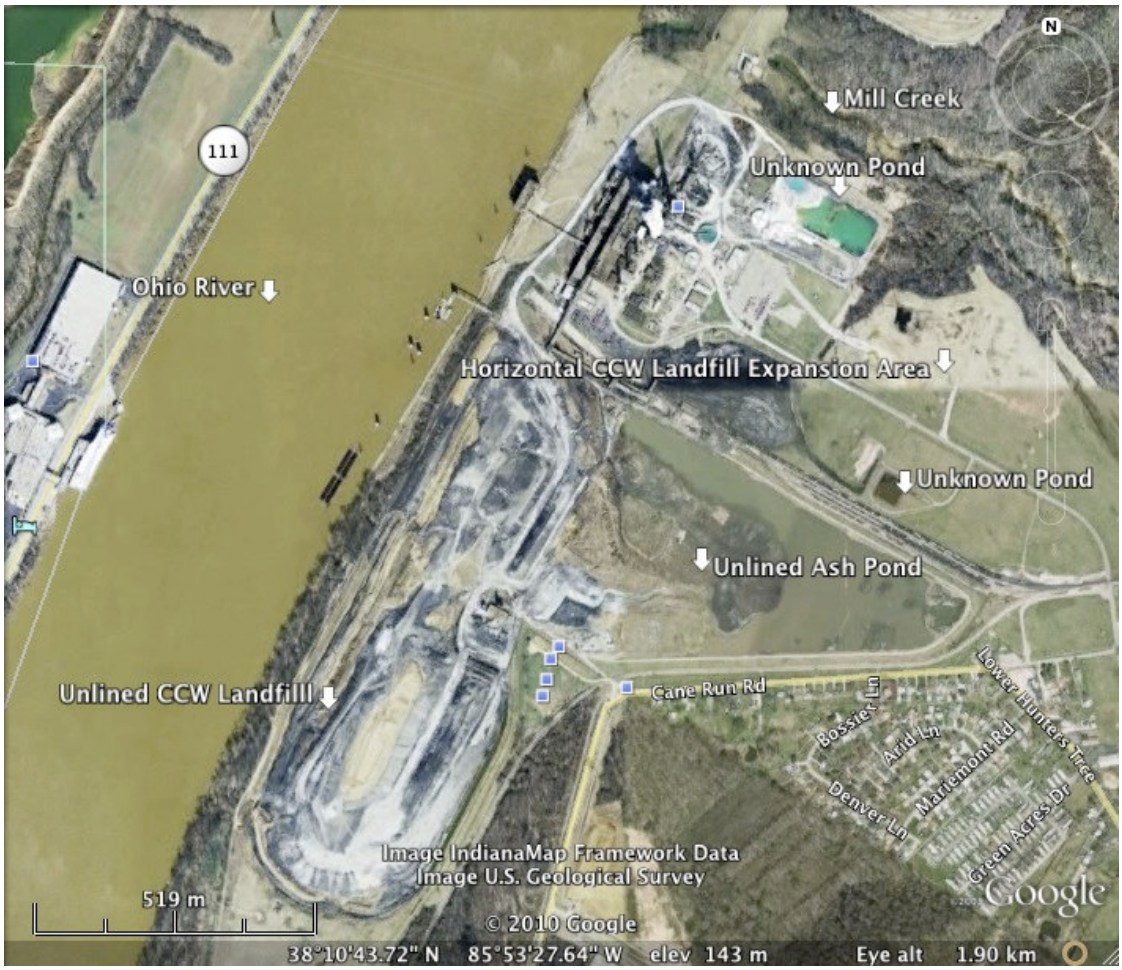
Type(s) of Waste Management Units and Wastes Present
A special waste landfill that contains coal combustion wastes of any type, according to the Division. An operational permit was issued for the landfill in 1982. The landfill is situated approximately 200 feet east of and parallel to the Ohio River for approximately one (1) mile. Approximately half of the landfill was constructed over and old unlined ash pond. A toe drain along the river-side of the landfill was installed to remove excessive groundwater seepage from within the landfill dike to improve the structural stability of the dike, but not as a groundwater remedial measure.

LG&E applied for a "horizontal expansion" of the coal combustion waste landfill for a separate 61-acre area located approximately 1,500 feet to the northeast. The Division received the expansion application on January 10, 2010. According to the Division, a 60-mil LLDPE liner (approximately 1/16-inch thick) is planned for the landfill. The storage capacity of the proposed landfill is 5.7 million cubic yards.

Correspondence in the file and current aerial photography (attached) indicates that a large ash pond exists adjacent to the landfill and approximately 1,000 feet east of the Ohio River. The file review did not specify what types of ash are disposed of in the ash pond. The aerial photography also shows that at least two other waste ponds of undetermined type exist.

According to E. On's March 25, 2009 CERCLA 104(e) response to EPA's request for information, the Cane Run plant has five (5) ponds: *1.)* an ash pond commissioned in 1972; *2.)* a clearwell flue gas residual pond commissioned in 1976; *3.)* a dead storage flue gas residual pond commissioned in 1976; *4.)* an emergency process water pond commissioned in 1977; and *5.)* a process water pond commissioned in 1976. The ash pond contains bottom ash, fly ash, boiler slag, coal fines, process water drainage, pyrites, and treated sanitary wastewater.

Aerial Photo – Cane Run



Monitoring Requirements

The oldest correspondence from the file that provided groundwater data for facility is November 2005. LG&E voluntarily monitors calcium, sodium, and sulfate because they believe that the parameters are more indicative of coal combustion wastes than those required by the Division. The file review did not indicate any maps that illustrated where the wells are located. Groundwater monitoring consisted of seven (7) parameters – none of which have an EPA Maximum Contaminant Level (MCL) drinking water standard, and the permit only requires that four (4) be monitored:

pH	Sulfate (voluntarily performed)
Specific conductance	Calcium (voluntarily performed)

Total dissolved solids (TDS)	Sodium (voluntarily performed)
Chlorides	Chemical Oxygen Demand (COD)

The monitoring system in 2005 included seven wells, MW-3 through MW-9, that are, according to the Division, located as such:

MW-3 – upgradient near plant entrance Designated as "background".	MW-7 – southern most well upgradient of floodwall. Designated as "background"
MW-4 – north of ash pond along dike	MW-8 – south corner landfill between landfill and river
MW-5 – between landfill and ash pond	MW-9 – north corner of landfill between landfill and river
MW-6 – between landfill and river	

Statistical analyses of groundwater data have been required since at least 2005.

Constituents Involved
Groundwater monitoring in November 2005 indicated multiple drinking water criteria exceedances:

Parameter / Standard (mg/L)	**Well Exceedances (mg/L, except pH)**	
Chlorides (250)	MW-5 (802)	MW-6 (848)
TDS (500)	MW-3 (568) MW-5 (4,592) MW-6 (4,606, 9 times std.)	MW-7 (544) MW-8 (1,150) MW-9 (2,006)
pH (6.5 to 8.5)	MW-5 (9.95)	
Sulfate	MW-5 (1,736, 7 times std.) MW-6 (1,725)	MW-8 (508) MW-9 (1,205)

Groundwater temperature measurements are not required by the permit or routinely performed; however, measurements were reported for a November 4, 2008 sampling event. The results strongly suggest an interconnection between the ash pond, the landfill, and the shallow groundwater beneath those units. The temperature of the groundwater reported for wells MW-5 and MW-6 downgradient of the ash pond and landfill were approximately 10° degrees Fahrenheit warmer than the four other wells in the same aquifer.

The trend of groundwater results indicative of a release of coal combustion waste releases to the underlying groundwater continued through the most recent June 2009 sampling event as follows:

Parameter / Standard (mg/L)	**Well Exceedances (mg/L, except pH)**	
Chlorides (250)	MW-6 (596)	

TDS (500)	MW-3 (504) MW-5 (3,740) MW-6 (3,776, 7.5 times std.)	MW-7 (500) MW-8 (820)
pH (6.5 to 8.5)	MW-5 (9.62)	
Sulfate	MW-5 (1,752, 7 times std.)	MW-6 (1,733)

When the results of 2008 / 2009 data are compared to the 2005 results, the data indicate that:

- Wells downgradient of the ash pond landfill continue to indicate a release of coal combustion waste contaminants to the groundwater, as indicated by chlorides, sulfate, pH, calcium, sodium, and TDS.
- The most downgradient wells indicative of waste contaminants above EPA standards are immediately adjacent to the Ohio River and suggest that contaminated groundwater reaches the river.
- Calcium and sodium concentrations indicative of coal combustion wastes are substantially higher in wells downgradient of the ash pond and landfill (MW-5 and MW-6). Calcium was approximately 5 times higher and sodium was approximately 30 times higher than other wells.
- No metals tests are performed to determine concentrations that are typically found in coal combustion wastes. Such metals are harmful to humans and fish and aquatic life at extremely low concentrations.

According to the Division, LG&E has agreed to complete a groundwater assessment of the landfill but there was no indication in the file that such an assessment has been performed or when one is due.

Hydrogeologic Conditions

The power plant location adjacent to the Ohio River suggests that shallow water table aquifer conditions exist. No potentiometric surface diagrams to determine the direction and rate of groundwater flow were found in the file because the Division does not require that they be prepared. The results of temperature measurements obtained during groundwater sampling in November 2008 suggest that the ash pond and landfill are leaking to a shallow aquifer.

2.4 Louisville Gas and Electric / E. On, Trimble Station, Bedford

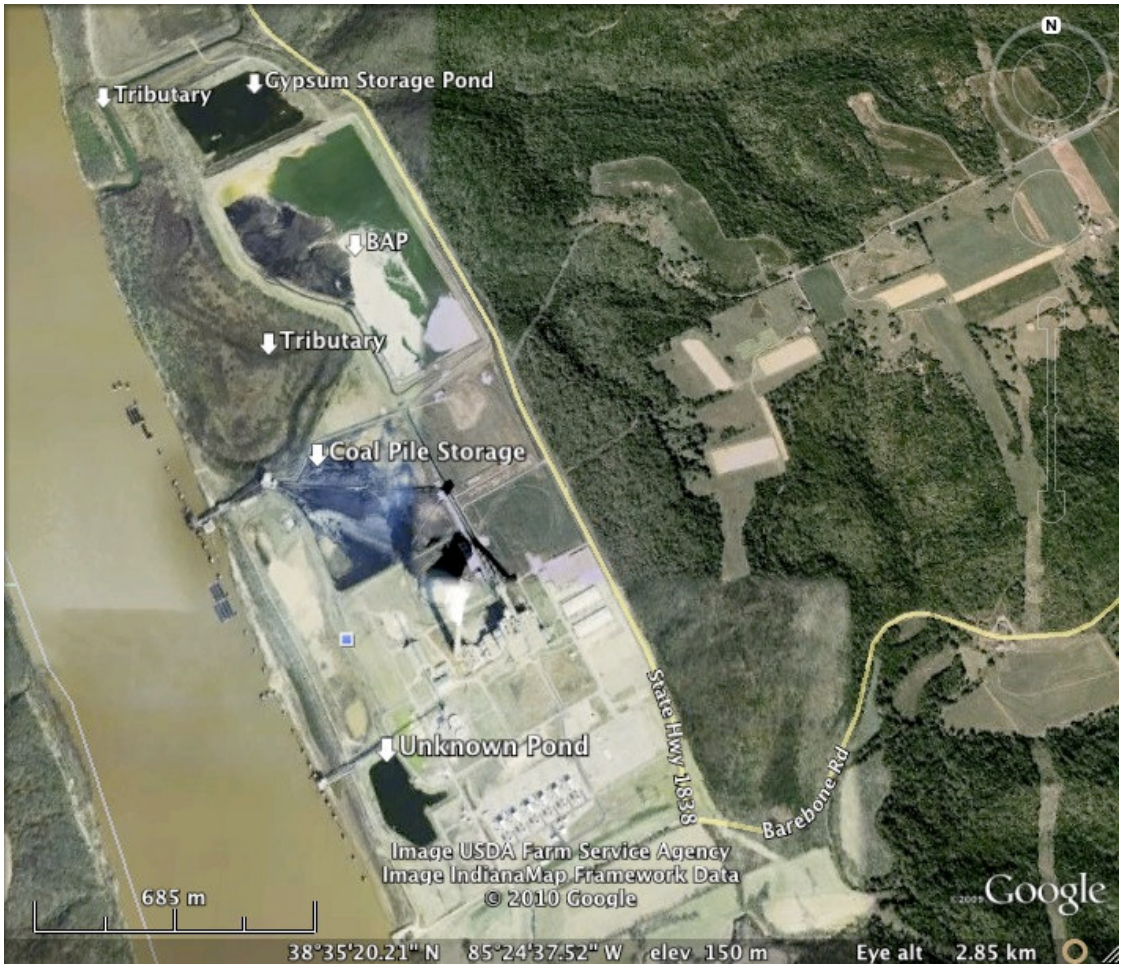
Location
487 Corn Creek Road
Bedford, KY 40006
Trimble County
GPS Coordinates: 38°35'16"; 85°24'57"

Summary
One unlined pond that is nearly ¾-mile long has been used to dispose of coal combustion wastes since the 1980s. LG&E proposed a 30-foot tall vertical expansion of that pond in 2009 – even though groundwater data since at least 2003 indicates that the pond is leaking, and drinking water standards have been exceeded in nine (9) of 12 wells on-site. Groundwater parameter concentrations are up to 10 times higher than allowable EPA standards for chlorides, total dissolved solids, and sulfates. The current monitoring program is less stringent in terms of required analyses than what was required in 1996 because no heavy metals testing has been required since at least 2003 – even though coal combustion waste constituents have been reported in the groundwater, and heavy metals are common in coal combustion wastes. The Division does not require a potentiometric surface diagram be submitted with groundwater reports and as a result, the Division is unable to determine the direction and rate of groundwater flow. The site is located adjacent to the Ohio River, and contaminated wells are located within 250 feet of a tributary stream to the Ohio River.

Type(s) of Waste Management Units and Wastes Present
LG&E was issued a landfill permit in 1984, and the permit was re-issued in May 1996; however, the landfill was never constructed. Although no landfill was constructed, a landfill permit was issued. An unlined ash pond (called the "Bottom Ash Pond" or "BAP") is used to dispose of coal combustion wastes including bottom ash, fly ash, boiler slag, flue gas emission control residuals, coal fines, process water drainage, and pyrite. The Division has issued a KPDES permit for that pond but considers the pond to have zero-discharge. The bottom of the Bottom Ash Pond is approximately 45 feet below the natural ground elevation in that area. A 30-foot vertical expansion of the pond was proposed by LG&E in 2009 for pond dikes heights that were already 40 to 75 feet high. A gypsum disposal pond located on an adjacent property to the north is also proposed. The site is adjacent to the Ohio River. Aerial photography suggests that another, un-permitted wastewater treatment pond exists to the southeast adjacent to the river. The Bottom Ash Pond is approximately 3,300 feet (0.6-mile) long and is approximately 1,300 feet from the Ohio River.

According to E.O On's March 25, 2009 CERCLA 104(e) response to EPA's request for information, the Trimble plant has one (1) ash pond that was commissioned in 1990, and the pond contains bottom ash, fly ash, boiler slag, flue gas residuals, coal fines, process water drainage, pyrites, and treated sanitary wastewater.

Aerial Photo - Trimble



Monitoring Requirements

The oldest correspondence from the file that provided groundwater data for the facility is October 2003. Groundwater monitoring from 1996 to sometime before 2003 consisted of these parameters:

Indicator Parameters	**Metals**	
Chloride	Aluminum	Lead
Fluoride	Arsenic	Magnesium
Nitrate	Barium	Manganese
Alkalinity	Boron	Mercury
Conductivity	Cadmium	Nickel
Sulfate	Calcium	Potassium
	Chromium	Selenium
	Copper	Sodium
	Iron	Silver
		Zinc

The monitoring system for the Bottom Ash Pond includes one (1) upgradient well, eight (8) downgradient wells, and three (3) sidegradient well. Wells MW-2 through MW-9 are located topographically and hydraulically downgradient of the Bottom Ash Pond and are within approximately 250 feet of a small stream / wetland area that discharges to the Ohio River. The monitoring well summary is as follows:

MW-1 – upgradient	MW-7 - downgradient
MW-2 – downgradient	MW-8 – downgradient
MW-3 – downgradient	MW-9 - downgradient
MW-4 – downgradient	MW-10 – sidegradient
MW-5 – downgradient	MW-11 – sidegradient
MW-6 – downgradient	MW-12 – sidegradient

Actual well locations were later clarified with Division personnel. The wells are generally located between the Ohio River and the Bottom Ash Pond and the Coal Pile. Only one well, MW-1, was not topographically downgradient of the facility operations area or the Bottom Ash Pond.

Sometime between 1996 and 2003, the required sampling parameter list was drastically *reduced* to only include these indicator parameters – none of which has an EPA Maximum Contaminant Level (MCL) drinking water standard:

pH	Chlorides
Specific conductance	Total dissolved solids (TDS)
Chemical Oxygen Demand (COD)	Copper
Total Organic Carbon (TOC)	Sodium
Calcium	Sulfate

There is no indication in the file that statistical analyses of groundwater data is required by the permit or performed by LG&E.

Constituents Involved

Groundwater monitoring in October 2003 indicated multiple drinking water criteria exceedances:

Parameter / Standard (mg/L)	**Well Exceedances (mg/L)**	
Chlorides (250)	MW-4 (330, 2 times std.)	MW-8 (281)
TDS (500)	MW-2 (1,354) MW-3 (850) MW-4 (4,296) MW-5 (1,656)	MW-6 (532) MW-8 (4,582, 9 times std.) MW-11 (720) MW-12 (682)
Sulfate (250)	MW-2 (692) MW-3 (330) MW-4 (2,045, 8 times std.)	MW-5 (605) MW-8 (1,990) MW-11 (328)

The trend of groundwater results indicative of a release of coal combustion waste to the underlying groundwater worsened in terms of the intra-well concentrations through the most recent October 2009 sampling event as follows:

Parameter / Standard (mg/L)	**Well Exceedances (mg/L)**	
Chlorides (250)	MW-4 (499.1, 2 times std.)	MW-8 (394.5)
TDS (500)	MW-2 (1,090) MW-3 (592) MW-4 (4,806, 10 times std.) MW-5 (1,196)	MW-8 (3,950) MW-10 (566) MW-11 (1,350) MW-12 (1,096)
Sulfate (250)	MW-2 (450) MW-4 (2,218, 9 times std.) MW-5 (350)	MW-8 (1,810) MW-11 (639) MW-12 (312)

When the current 2009 results of data are compared to the 1996 and 2003 results, the data indicate that:

- Wells downgradient of the Bottom Ash Pond continue to indicate a release of coal combustion waste contaminants to the groundwater, as indicated by chlorides, TDS, and sulfate.
- Testing for metals is not required even though metals can be harmful to human health and fish and aquatic life at very low concentrations.
- The rate and direction of groundwater flow are unknown by the Division.
- There is no indication in the file that statistical analyses of groundwater data are required or completed by LG&E.
- Contaminated wells can indicate the concentrations of groundwater discharges to the Ohio River.

Hydrogeologic Conditions

The power plant is location adjacent to the Ohio River suggests that shallow water table aquifer conditions exist. No potentiometric surface diagrams to determine the direction and rate of groundwater flow were found in the file because the Division does not require that they be prepared.

2.5 Tennessee Valley Authority, Paradise Station, Drakesboro

Location
Tennessee Valley Authority, Paradise Fossil Plant
13246 Highway 176
Drakesboro, Kentucky 42337
Muhlenberg County
GPS Coordinates: 37°15'40"; 86°59'06"

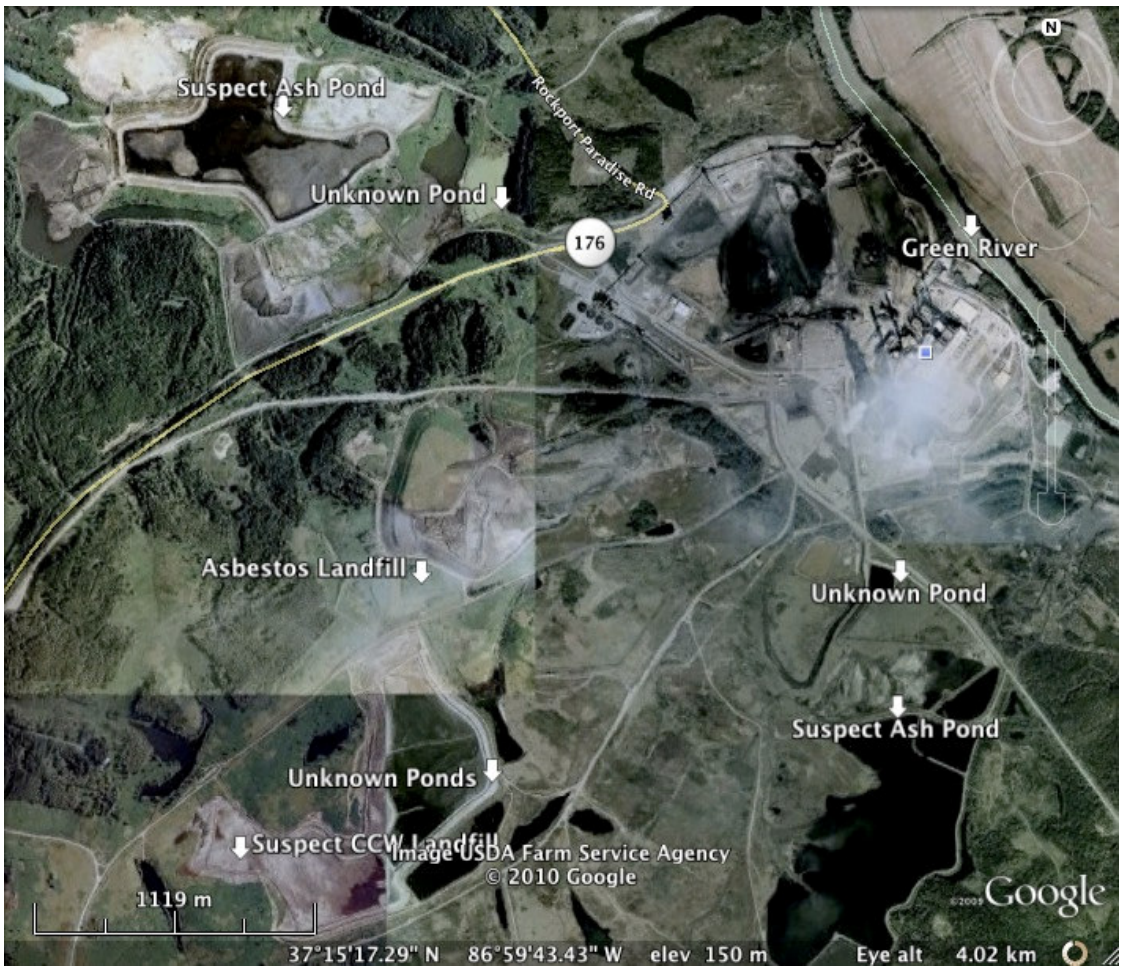
Summary
Although the site contains ash ponds for coal ash disposal, the Division did not know how many pond exist, which (if any) are lined, or where they are located. The only permitted land disposal unit is a landfill for asbestos waste disposal. Groundwater and surface water monitoring data for that landfill indicate coal combustion waste related parameters in the water. Division and EPA drinking water standards have been increasingly frequently exceeded since 2003 in upgradient and downgradient wells at the landfill for Total Dissolved Solids and pH, and chloride concentrations have continually increased in one downgradient well. The file review and groundwater data suggest that unidentified sources of groundwater contamination exist.

Type(s) of Waste Management Units and Wastes Present
Correspondence in the file only lists one land disposal unit that is permitted by the Division, and that unit is a special waste landfill for the disposal of unspecified asbestos wastes. Current aerial photography (attached) indicates suspected multiple other disposal sites including ponds and landfills. The site is located adjacent to the Green River.

According to the Division, the site contains ash ponds for coal ash disposal. The Division did not know however, how many ponds exist, which (if any) are lined, or where they are located.

According to TVA's March 25, 2009 CERCLA 104(e) response to EPA's request for information, the Paradise station has one (1) gypsum / fly ash waste pond commissioned in 1986; two (2) fly ash ponds commissioned in 1997; and one (1) bottom ash pond commissioned in 1967.

Aerial Photo – Paradise



Monitoring Requirements

The oldest correspondence from the file that provided groundwater monitoring data is for a February 21, 2003 surface water sampling event and a June 4, 2003 groundwater sampling event for the asbestos residual landfill. The surface water monitoring programs includes these parameters:

Chlorides	Sodium
Specific conductance	Hardness
Total dissolved solids (TDS)	Sulfate
Biological Oxygen Demand (BOD)	Iron
Chemical Oxygen Demand (COD)	

The groundwater monitoring program for the asbestos landfill includes these parameters:

pH	Arsenic
Temperature	Barium
Specific conductance	Cadmium
Total dissolved solids (TDS)	Chromium

Chlorides	Lead
Chemical Oxygen Demand (COD)	Mercury
Iron	Selenium
Sodium	Nitrate
Total Organic Carbon	Asbestos

The groundwater monitoring system in 2003 included five (5) wells located as such:

94-42 – upgradient	97-45 - upgradient
94-41 – downgradient	97-43 - downgradient
97-44- downgradient	

Statistical analyses of groundwater data have been required since at least 2003.

Constituents Involved
Groundwater monitoring in June 2003 indicated multiple drinking water criteria exceedances, with the highest TDS concentration reported for an upgradient well:

Parameter / Standard (mg/L)	**Well Exceedances (mg/L, except pH)**	
TDS (500)	94-42 (4,600, 9 times std.) 97-45 (3,500) 94-41 (3,800)	97-43 (3,300) 97-44 (3,500)
pH (6.5 to 8.5)	97-45 (6.45)	94-41 (6.41)

Statistically significant increases (SSIs) in groundwater constituent concentrations have been reported in downgradient wells since at least 2003. SSIs have been reported for these parameters that are reported on a semi-annual basis: chlorides, nitrate, sodium, total organic carbon. TVA compares the results of downgradient well data to upgradient well data to determine if a SSI occurs, even though the groundwater data suggests that the upgradient wells have already been impacted by coal combustion wastes. As a result, the standard to which downgradient wells are compared is abnormally and unnaturally high.

Chloride concentrations have steadily increased in well 97-44 since 2003 (maximum concentration 91 mg/L) up to 15 times higher than other wells on-site, although the concentrations have not yet exceeded the EPA secondary MCL (250 mg/L).

Quarterly surface water monitoring results since 2003 indicated these TDS concentrations: 753 mg/L average; 1,174 mg/L maximum. Sulfate concentrations in surface water ranged from: 511 mg/L average; 1,040 mg/L maximum.

The trend of groundwater results indicative of a release of coal combustion waste to the underlying groundwater increased through the most recent June 2009 sampling event as follows:

Parameter / Standard (mg/L)	Well Exceedances (mg/L, except pH)	
TDS (500)	94-42 (5,000) 97-45 (3,300) 94-41 (3,800)	97-43 (5,500, 11 times std.) 97-44 (3,500)
pH (6.5 to 8.5)	MW-5 (9.62)	
Sulfate	MW-5 (1,752, 7 times std.)	MW-6 (1,733)

When the results of 2009 data are compared to the 2003 results, the data indicate that:

- Landfill area wells continue to indicate that a release of coal combustion waste contaminants has occurred to the groundwater, as indicated by chlorides, sulfate, pH, and TDS.
- Sulfate is not required for the landfill permit even though the parameter is present in surface water and is indicative of coal combustion wastes.
- Other landfills and ash ponds that have not yet been identified could possibly be the source(s) of coal combustion waste parameters in the groundwater because asbestos wastes would not necessarily be expected to contain such contaminants.

Hydrogeologic Conditions

Aerial photography suggests that the site has substantially disturbed by land development activities. Groundwater monitoring reports state that the aquifer underlying the asbestos landfill is in mine spoil, suggesting that mining was performed at the site. TVA reported that since 2003 the groundwater flow velocity in the mine spoil aquifer ranged from approximately 13 feet / year (average) to 18 feet / year (maximum).

2.6 Tennessee Valley Authority, Shawnee Station, Paducah

Location
7900 Metropolis Lake Road
Paducah, Kentucky 42086
McCracken County
GPS Coordinates: 37°09'24"; 88°47'01"

Summary
Two unlined ash ponds and two unlined landfills exist at the site for disposal of coal combustion wastes. The ponds and landfills are located adjacent to the Ohio River. The most recently permitted landfill was approved without a liner in July 2007, although groundwater contamination from an older unlined landfill and ash pond indicates that those disposal units are leaking. The new landfill is being built over old unlined ash ponds. Groundwater contamination above one or more standard exists in all eleven (11) downgradient wells. The most notable groundwater contaminants above regulatory standards include: boron (up to 7.5 times higher than the EPA health advisory); arsenic (slightly higher than the EPA MCL); and selenium (almost 2 times the standard). No potentiometric surface map was found in the file review to determine placement of wells, direction of groundwater flow, or gradient of the water table aquifer because the Division does not require this information to be submitted.

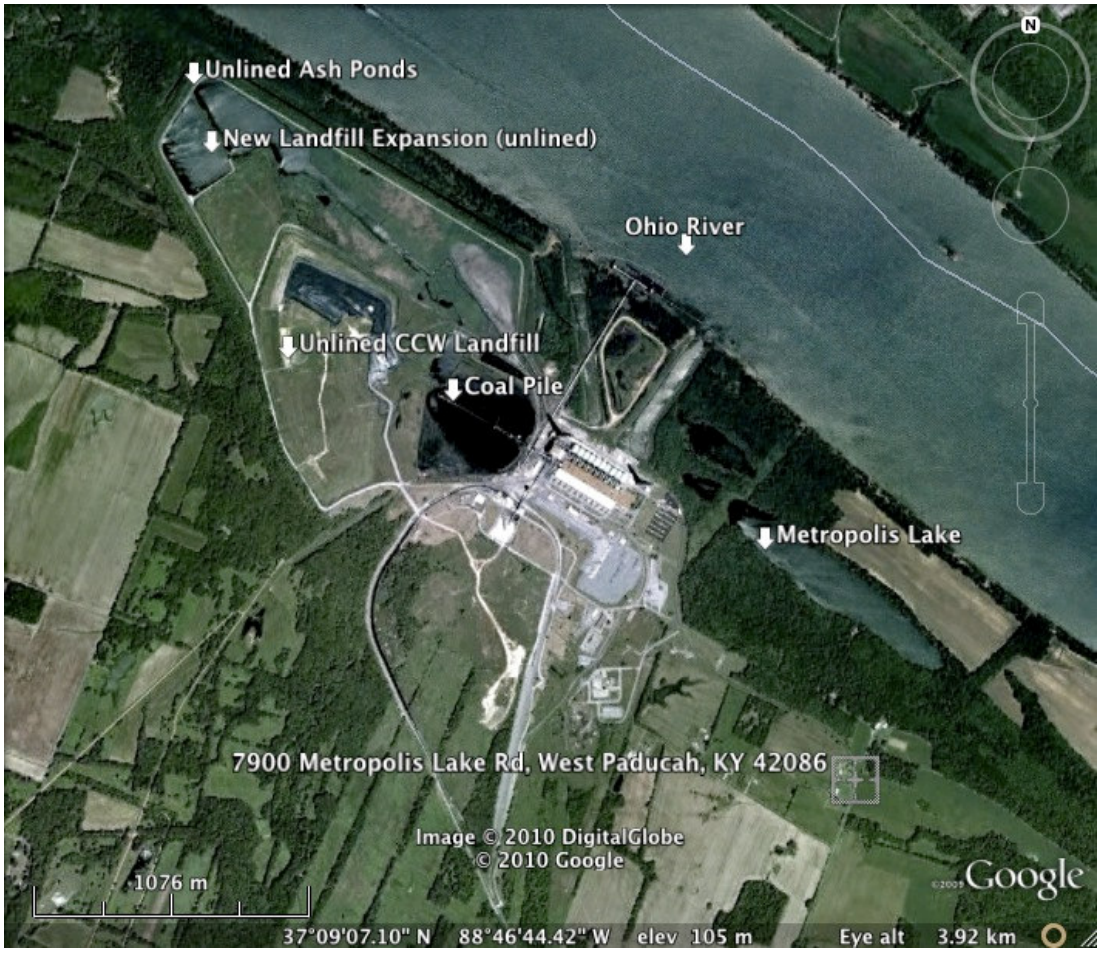
Type(s) of Waste Management Units and Waste Types
The Shawnee Fossil Plant has two (2) coal combustion waste landfills that are geographically contiguous. One landfill is nearing final closure. A new landfill was approved by the Division in July 2007 and is presently being operated. Neither landfill is lined. The waste type(s) is unspecified. The landfills operate under the same permit. The Division has designated the landfills as "special waste" landfills. The landfill closest to the ash ponds has a partial final cover. One landfill has southern and eastern boundaries that are Little Bayou Creek and water lines to the Paducah Gaseous Diffusion Plant located miles away. The landfills share a groundwater monitoring system with two adjacent ash settling basins.

The two ash ponds have historically been very large and filling has gradually, incrementally created a smaller wetted area on the surface. The ponds are unlined and are located approximately 700 feet from the Ohio River. The type(s) of ash disposed of in the ponds were unspecified in the file.

As a result, historical and new coal combustion wastes are being disposed of in unlined units at this location.

According to TVA's March 25, 2009 CERCLA 104(e) response to EPA's request for information, the Shawnee plant has one (1) ash pond commissioned in 1952 for the disposal of fly ash and bottom ash, and one (1) "dry stack" commissioned in 1984 for fly ash and bottom ash disposal.

Aerial Photo - Shawnee



Monitoring Requirements

The oldest data in the file dates to June 2003. The groundwater monitoring system consisted of three (3) wells from 2003 to September 2008. Since September 2008, fourteen (14) wells are sampled. The wells are sampled semi-annually. The sampling program does not include any metals or any parameter that has an associated EPA Maximum Contaminant Level (MCL), but some have Secondary MCL (SMCL) standards:

Temperature	Chlorides
Specific conductance	Total dissolved solids (TDS)
Chemical Oxygen Demand	pH
Organic Carbon (TOC)	Copper

Groundwater monitoring since September 2008 includes reporting for these additional parameters for each well:

Boron	Sulfate
Fluoride	Vanadium
Molybdenum	

According to TVA monitoring reports from September 2008 to current, the site has three (3) upgradient wells and eleven (11) downgradient wells:

Upgradient Wells	Downgradient Wells	
D-19	D-8A	D-74A
D-27	D-11	D-74B
D-77	D-11B	D-75A
	D-30A	D-75B
	D-30B	D-76A
	D-33A	

TVA is required to perform a statistical analysis of the groundwater data.

Constituents Involved

Groundwater monitoring results from 2003 through 2008 found one or more of these SMCL exceedances or statistically significant increases (SSI) when compared to background wells:

Parameter / Standard (mg/L)	Well Exceedances (mg/L, except pH)
TDS (500) Statistically Significant Increase	D-30 (1,810, 3.6 times std.)
pH (6.5 to 8.5)	D-11 (<6) D-27 (<6) D-30 (<6)
TOC (Statistically significant increase)	D-11
COD (Statistically significant increase)	D-11

TVA initiated background monitoring in August / September 2008 for new wells to determine "statistical background" concentrations for constituents of concern. During that background monitoring, numerous constituent concentrations were actually higher than the relevant standard. Groundwater monitoring results for these additional parameters monitored found one or more these MCL, SMCL, or health advisory exceedances:

Parameter / Standard (mg/L)	Well Exceedances (mg/L, except pH)	
TDS (500)	D-11B D-30A D-30B D-74A D-74B	D-75A D-75B D-76A (2,000, 4 times std.)
pH (6.5 to 8.5)	D-8A D-11 D-11B (5.4) D-19	D-30B D-74A D-75B D-75B

	D-27 D-30A	D-76A D-77
Boron (2 mg/L health advisory)	D-11B D-30A D-33A D-74A (10, 5 times std.)	D-74B D-75A D-75B D-76A (15, 7.5 times std.)
Sulfate (250)	D-11B D-74A D-74B	D-75A (1,000, 4 times std.) D-75B D-76A (1,400, 5.6 times std.)
Arsenic (0.01)	D-77 (0.012)	
Selenium (0.05)	D-74A (0.087)	D-74B (0.083)

Hydrogeologic Conditions

The Shawnee site and its ash ponds and landfills are located adjacent to the Ohio River. Shallow water conditions are expected. Two springs on-site that are contaminated with trichloroethene and technetium from the Paducah Gaseous Diffusion Plant are apparently groundwater discharge points for a three-mile long groundwater plume. This suggests groundwater migration potential from the Shawnee plant is also extremely high.

Other

Metropolis Lake is located adjacent to the power plant. The lake is contaminated with mercury (unknown cause). The lake is part of a park owned by the Kentucky State Nature Preserves Commission.

2.7 Big Rivers Electricity Corporation, D.B. Wilson Plant, Centertown

Location
5663 State route 85 W
Centertown, Kentucky 42328
Ohio County
GPS Coordinates: 37°27'08"; 87°04'50"

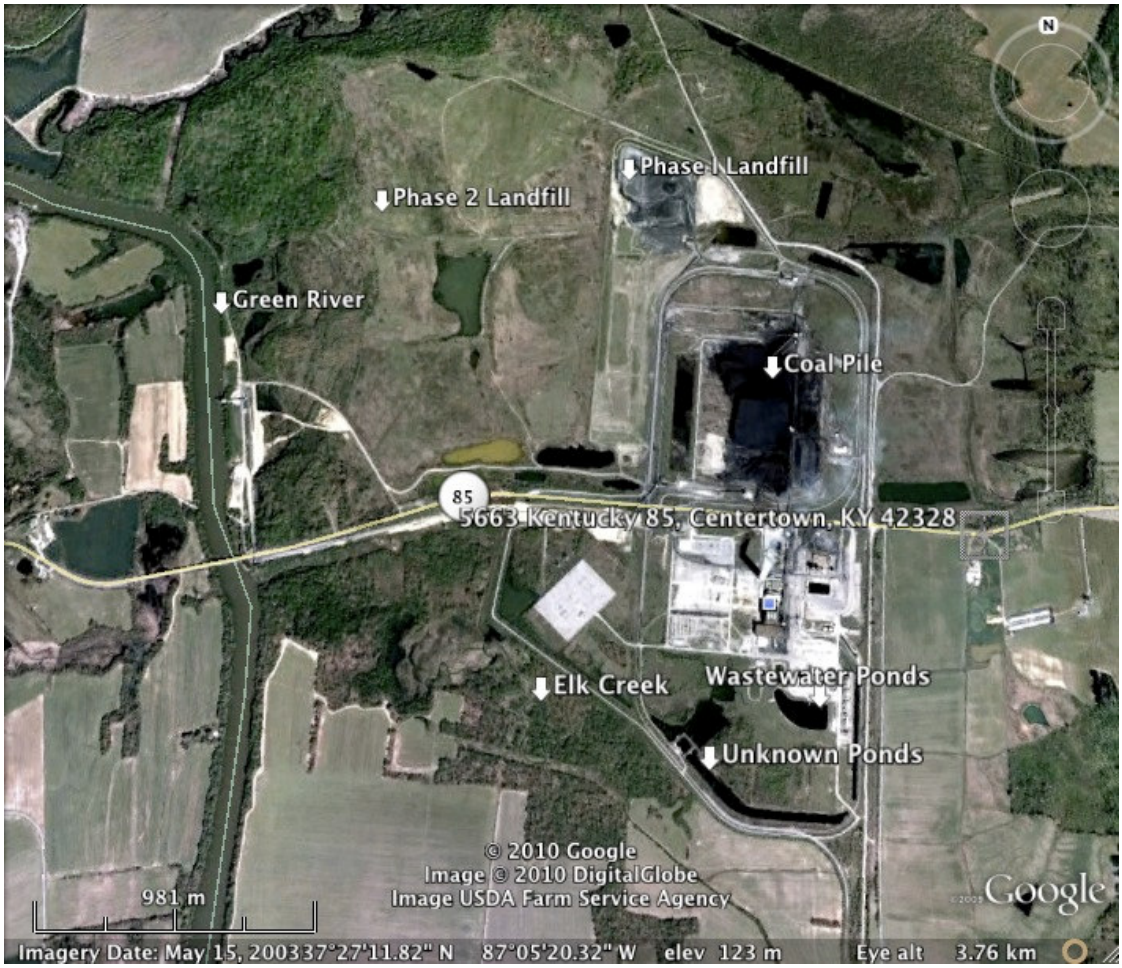
Summary
The station and all waste disposal units are constructed on an abandoned, un-reclaimed strip mine void of natural soil. The Division approved a horizontal expansion (Phase II) of an existing unlined landfill in 2008 / 2009 even though the expansion is not contiguous. Neither landfill is lined. The Phase II landfill is located within approximately 500 feet of the Green River. A comparison of groundwater data from 1982 (before the plant construction was finished) to 2009 indicates that the coal combustion waste landfill has further contaminated the underlying aquifer above Division and EPA drinking water standards. The current groundwater monitoring parameters are much less restrictive than those required at the plant in 1982.

Type(s) of Waste Management Units and Wastes Present
Two special waste landfills that contain fly ash, bottom ash, and flue gas desulfurization (FGD) sludges exist at the site. The first as-built landfill construction design approval was granted in 1979. The Division approved the most recent Phase II landfill (approval date undetermined but first waste placement was in August 2009) as a "horizontal expansion" of a landfill to the east, even though a 340-volt electric transmission line physically separates the two landfills. The file review did not indicate when waste was first placed in the initial phase of the landfill or what type(s) of coal combustion wastes was placed. The new landfill will be used to store flue gas desulfurization wastes. The Phase II landfill is situated approximately 500 feet east of the Green River.

Current aerial photography (attached) indicated that at least one suspect ash pond also exists at the site. Historic maps found in the file also illustrated wastewater treatment ponds south of the station, and those ponds are located approximately 250 feet north of Elk Creek, a tributary of the Green River.

According to the file review, the plant was constructed in 1984; the station and the waste disposal units were constructed over strip-mined areas; the ground surface is void of natural soils; the coal combustion waste is placed directly on top of the soil; and neither of the landfills has a liner.

Aerial Photo - D. B. Wilson



Monitoring Requirements

The earliest groundwater monitoring data recorded in the file dates to 1982 when the plant was under construction. This data would therefore be indicative of pre-landfilling operations. Nine (9) monitoring wells existed at unknown locations. Groundwater monitoring in 1984 consisted of these parameters:

Indicator Parameters		**Metals**
pH	Alkalinity	Arsenic
Conductivity	Chlorides	Barium
Total dissolved solids (TDS)	Sulfate	Cadmium
Calcium	Nitrate (as Nitrogen)	Chromium
Iron	Fluoride	Copper
Magnesium	Bicarbonate	Lead
Manganese	Carbonate alkalinity	Mercury
Potassium		Selenium
Sodium		Silver
		Zinc

Beginning in 1998, the required sampling parameter list was drastically *reduced to only include* these indicator parameters – none of which has an EPA Maximum Contaminant Level (MCL) drinking water standard:

Temperature	Chlorides
Specific conductance	Total dissolved solids
Chemical Oxygen Demand	pH
Organic Carbon	Copper

Constituents Involved

The 1982 results that were indicative of pre-combustion waste disposal resulted in these typical parameter concentrations:

Chlorides – 11 to 54 mg/L	Sulfates – 55 to 245 mg/L
TDS – 370 to 1,352 mg/L	Calcium – 29.2 to 192 mg/L

By 1986 upon completion of four (4) quarters of monitoring after the plant had become operational, the groundwater quality indicative of a coal combustion release to groundwater was already occurring according to these results:

TDS – 2 wells greater than 2,000 mg/L, up to 4,226 mg/L, or 8.5 times the std.	Sulfates – 2 wells greater than 1,000 mg/L, up to 3,790 mg/L, or 15 times the std.

Sampling in 1993 and 1994 resulted in these MCL or SMCL exceedances:

Parameter / Standard (mg/L)	**Well Exceedances (mg/L)**	
Cadmium (0.005)	MW-1 (0.009, 2 times std)	MW-3
Lead (0.015)	MW-3 (0.051, 3.5 times std.)	MW-4
Mercury (0.002)	MW-3 (0.0336, 17 times std.)	
Sulfate (250)	MW-1 (1,180, 5 times std.) MW-3	MW-4
TDS (500)	MW-1 (1,180, 2.4 times std.) MW-3 (1,117, 2.3 times std.)	MW-4

Sampling in March 2009 indicated further degradation of the groundwater by coal combustion wastes according to these results:

Parameter / Standard (mg/L)	**Well Exceedances (mg/L)**	
TDS (500)	MW-1 (4012, 8 times the std.) MW-2 (697) MW-3 (2,287)	MW-5 (3,141) MW-6 (2,868) MW-7 (1,517)

	MW-4 (3,008)	MW-8 (1,846) MW-10 (3,217)

When the results of March 2009 sampling event are compared to the 1982 results, the data indicate that:

- Parameters that had previously been reported at concentrations greater than the respective standard had been dropped from the sampling program.
- Heavy metal testing was no longer required even though drinking water standards had been exceeded.
- TDS concentrations indicative of coal combustion waste affects on the groundwater continued to increase.

Contrary to the results presented above, WK Energy argued in 2002 that TDS concentrations had not shown "discernable intra-well trends" and that TDS concentrations were the result of strip mine spoils– not from combustion waste disposal. WK Energy also argued that statistically significant increases (SSIs) in chloride concentrations and total organic carbon (TOC) in downgradient wells was also not related to the waste disposal. Further, WK Energy argued "chloride is not a parameter listed in 40 CFR 302.4, Appendix A and does not automatically trigger an assessment".

Hydrogeologic Conditions

According to a May 2008 Groundwater Monitoring Plan by FMSM Engineers, the upper-most aquifer occurs in the reclaimed mine spoil. None of the groundwater monitoring reports included a groundwater potentiometric surface diagram to illustrate the direction and slope of the groundwater flow because the Division does not require that such a map be prepared.

2.8 Big Rivers Electricity Corporation, R.D. Green Plant, Robards

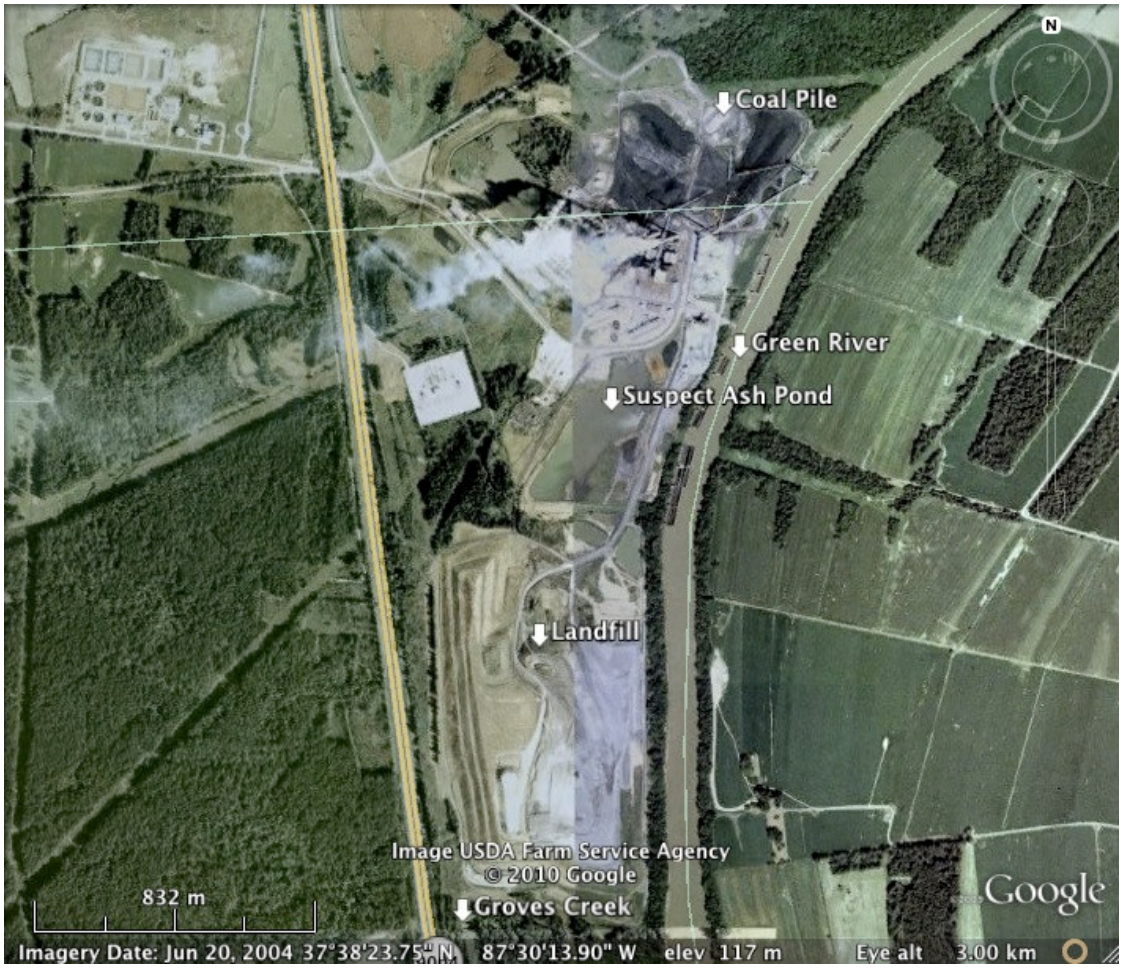
Location
9000 Highway 2096
Robards, Kentucky 42452
Webster County
GPS Coordinates: 37°38'08"; 87°30'12"

Summary
The groundwater monitoring program at the special waste landfill was drastically reduced in 1998 to include only eight (8) indicator parameters - despite lead and cadmium contamination at concentrations above Division and EPA drinking water standards. The landfill is located adjacent to and within approximately 200 feet of the Green River. The current monitoring program indicates that coal combustion waste indicator parameters (TDS and chlorides) have increased substantially in downgradient wells adjacent to the Green River.

Type(s) of Waste Management Units and Wastes Present
Special waste landfill that contains unspecified coal combustion wastes. The file review did not indicate when waste was first placed in the landfill. The landfill is situated approximately 200 feet west of the Green River and approximately 250 feet north of Groves Creek, a tributary of the Green River. Current aerial photography indicated that at least one suspect ash pond also exists at the site.

According to Big River's CERCLA 104(e) response (no date given) to EPA's request for information dated March 9, 2009, the Green plant has one (1) ash pond for the disposal of bottom ash, and design drawings for that pond are dated 1978 – suggesting that waste placement began about that time. No official ash pond commission date was given.

Aerial Photo – R.D. Green



Monitoring Requirements

Groundwater monitoring results were only reported for the special waste landfill. The groundwater monitoring system consisted of eleven (11) wells from 1988 to around May 1997. According to WK Energy, one well is upgradient (MW-1); MW-2 is located between the landfill and Groves Creek; MW-3, 4, 5, 6, and 7 are placed between the landfill and the Green River; and MW-8, 9, and 11 were placed in what is now a fill area. The wells are sampled semi-annually.

Groundwater monitoring in 1988 consisted of these parameters:

Indicator Parameters		**Metals**
pH	Sodium (dissolved)	Arsenic
Specific conductance	Alkalinity	Barium
Total dissolved solids	Chlorides	Cadmium
Calcium (dissolved)	Sulfate	Chromium
Iron (dissolved)	Nitrate (as Nitrogen)	Lead
Magnesium (dissolved)		Mercury
Manganese (dissolved)		Selenium

Potassium (dissolved)		Silver

Sometime between 1988 and 1997 (based on file review data gap), the parameter list was expanded to also include these parameters:

Bicarbonate	Lead
Cadmium	Mercury
Calcium (as calcium carbonate)	Nickel
Copper	Zinc
Iron	

Beginning in 1998, the required sampling parameter list was drastically *reduced to only include* these indicator parameters – none of which has an EPA Maximum Contaminant Level (MCL) drinking water standard:

Temperature	Chlorides
Specific conductance	Total dissolved solids
Chemical Oxygen Demand	pH
Organic Carbon	Copper

Constituents Involved

Groundwater monitoring for three quarters in 1988 indicated multiple drinking water criteria exceedances.

Parameter / Standard (mg/L)	**Well Exceedances (mg/L)**	
Cadmium (0.005)	MW-5 (0.007) MW-6 (0.024, 5 times std.) MW-7 (0.006)	MW-10 (0.009) MW-11 (0.014)
Lead (0.015)	MW-6 (0.017)	
TDS (500)	MW-1 (802) MW-2 (2,494) MW-3 (49.5) MW-4 (871) MW-5 (1,672)	MW-6 (7,842, 16 times std.) MW-7 (1,385) MW-9 (910) MW-10 (2,424) MW-11 (3,565)
Sulfate (250)	MW-2 (1,060) MW-5 (700) MW-6 (5,565, 22 times std.)	MW-7 (608) MW-10 (1,220) MW-11 (2,220)
Chlorides (250)	MW-2 (254)	
Nitrate (10)	MW-1 (14.4)	MW-6 (13.5)
Iron (0.3)	MW-1 (1.16)	

Concentrations for these well parameters were exceeded in a September 2009 sampling event:

Parameter / Standard (mg/L)	Well Exceedances (mg/L)	
TDS (500)	MW-1 (702) MW-2 (741) MW-3 (6,309, 13 times std.)	MW-4 (5,520) MW-5 (5,174) MW-6 (5,259)
Chlorides (250)	MW-3 (1,570, 6 times std.) MW-5 (350)	

When the results of September 2009 sampling event are compared to the 1988 results, the data indicate that only six wells are sampled (MW-1 through MW-6) and:

- Parameters that had previously been reported at concentrations greater than the respective standard had been dropped from the sampling program.
- No heavy metal testing was required even though drinking water standards had been exceeded.
- TDS concentrations had increased dramatically since 1988 for MW-3, MW-4, MW-5, and MW-6 – the most hydraulically downgradient wells from the landfill and nearest the Green River.
- The TDS concentration in the upgradient well MW-1 remained relatively unchanged from 1988 (802 mg/) to 2009 (771 mg/L).
- Chloride concentrations increased and the number of wells impacted increased.

WK Energy argued that TDS concentrations in each well had not shown "discernable trends" and that even though the SMCL was exceeded in all wells (and the concentrations increased), the concentrations should not trigger an in-depth assessment to determine if the landfill is leaking because they believed that the TDS was due to prior use of the property with oil wells with associated brine ponds. WK Energy further argued that the chloride concentrations cannot trigger an assessment because "chloride is not a parameter listed in 40 CFR 302.4, Appendix A and does not automatically trigger an assessment".

Hydrogeologic Conditions

The power plant location adjacent to the Green River suggests that shallow water table aquifer conditions exist. None of the groundwater monitoring reports included a groundwater potentiometric surface diagram to illustrate the direction and gradient of the groundwater flow.

Contact Information

To learn more, please contact

Sierra Club
408 C St NE
Washington, DC, 2003
202-675-7919

Kentucky Waterways Alliance
120 Webster Street, Suite 217
Louisville, KY 40206
502-589-8008

Global Environmental, LLC,
Mark Quarles,
Tennessee Licensed Professional Geologist (TN 3834),
5640 Stoneway Trail, Nashville, TN 37209

Acknowledgements
Special thanks to Lisa Evans and Jeff Stant for reviewing and improving this report. Thanks to Lyndsay Moseley for her photographs.