Toxic Waters Run Deep

Coal Ash Open Dumps Still Open for Business?

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ENVIRONMENTAL INTEGRITY PROJECT

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Summary

More than 30 years ago, Congress prohibited disposal practices that posed unreasonable risks to public health, and required closure of illegal "open dumps" within five years.[i] In 1979, EPA defined "open dumping" to include any disposal that caused groundwater pollution to exceed Safe Drinking Water Act "Maximum Contaminant Levels" then in effect for arsenic and other pollutants.[ii] These standards were adopted under Resource Conservation and Recovery Act (RCRA) Subtitle D, which deals with non-hazardous solid wastes. This is the subtitle that coal and power industries have promoted as the best alternative for coal ash regulation. While EPA can set Subtitle D standards, the Agency is prohibited from enforcing them and provides no funds for State implementation.

Based on a review of recent (though limited) groundwater monitoring data from state agencies, at least 33 active coal ash disposal sites in 19 states meet the open dumping criteria for one or more of the following coal ash-related pollutants: arsenic, barium, cadmium, chromium, fluoride, lead, mercury, and selenium. This list includes chemicals that cause cancer, neurological damage, developmental problems, and other diseases. Groundwater that meets the open dumping criteria is toxic and unsafe to drink. Frequently occurring problems include:

- **Arsenic** is a potent carcinogen that can also cause neurotoxicity and other health effects. The current Maximum Contaminant Level (MCL) for arsenic is 10 parts per billion (ppb), but a decades-old 50 ppb standard is still in effect under the open dumping regulations. At least 20 sites show arsenic levels higher than the outdated 50 ppb limit (see attached table). These arsenic spikes can be found in Alabama, Florida, Iowa (2 sites), Illinois (4 sites), Indiana, Louisiana, North Carolina (3 sites), Nevada, North Dakota, Ohio, Oklahoma, Pennsylvania (2 sites), and South Dakota. Maximum arsenic readings at 10 of these sites have exceeded 100 ppb.
- **Selenium** is an essential element at low doses, but shows signs of toxicity, including hair and nail loss and nervous system effects, at higher doses. The outdated standard for selenium in the open dumping regulations is 10 ppb. As the science of selenium toxicity has changed, however, the standard has been revised upward, and the current MCL is 50 ppb. At least 10 sites show selenium above this 50 ppb threshold, with 9 sites having maximum concentrations of more than 100 ppb.
- **Lead** is a notorious neurotoxin, and it has also been identified by the EPA as a probable carcinogen. The open dumping limit for lead is 50 ppb, more than three times the limit in effect today. But at least 6 sites show lead concentrations higher than 50 ppb, with half of these reaching maximum concentrations greater than 100 ppb.

These preliminary data understate the extent of the problem in a couple of major ways. Many sites do not require monitoring of these pollutants, even though they are frequently found in high concentrations in coal ash. Nor does the analysis include extremely high concentrations of pollutants like boron, manganese and sulfate—pollutants known to be associated with coal ash and known to

present a health risk, but without MCLs in the open dumping regulations. Finally, while drinking water standards are based on total concentrations of contaminants, monitoring is sometimes limited to the dissolved fraction of a contaminant, underestimating the total concentration.

Under the law, these disposal sites are supposed to be closed (or should have been years ago) unless a State can make a specific finding that the contamination poses no threat to existing or future drinking water supplies.[iii] The fact that they continue to pollute is a testament to the failure of Subtitle D regulations in protecting the nation's groundwater.

1. Introduction

Clean, drinkable groundwater is an essential natural resource. We used to treat it as inexhaustible because it was hidden—we didn't know how much there was, and we didn't know how it moved. But our understanding of groundwater has improved. We now know that groundwater supplies are limited, and in many places declining, in both quality and quantity. Protecting the remaining sources of clean groundwater is imperative because this is a resource we cannot live without.

One major threat to groundwater quality is coal combustion waste, or coal ash. Coal ash contains toxic elements including arsenic, chromium, and selenium, and the burning of coal to produce electricity generates millions of tons of this toxic mixture every year.[iv] The disposal of all of this coal ash is not very sophisticated—it is either put in landfills or it is put in settling ponds (also known as surface impoundments). These landfills and impoundments are too often unlined or poorly lined, in which case toxic constituents of the coal ash are able to leach into underlying groundwater. We have solid waste laws to prevent unsafe disposal, but with very little enforcement these laws are routinely being violated.

2. Goals for this report

Recent research done by our staff and others has shown that coal ash disposal sites frequently contaminate surface water and groundwater.[v] This report addresses a more specific question, and it has to do with federal solid waste law. Subtitle D of the Resource Conservation and Recovery Act (RCRA) prohibits disposal of solid waste in a way that causes certain kinds of groundwater contamination. The details of the regulations involved are discussed below, but in essence this prohibition is supposed to protect groundwater quality and prevent groundwater from becoming undrinkable. Our question was simple: How many of these sites are contaminating groundwater in violation of the open dumping prohibition?

3. RCRA

Federal solid waste law is controlled by the Resource Conservation and Recovery Act (RCRA).[vi] RCRA, and regulations promulgated pursuant to RCRA authority, prohibit illegal waste disposal practices. These illegal practices are described with the statutory shorthand language of "open dumping."[vii] The RCRA regulations define open dumping by reference to a set of criteria—if a solid waste disposal practice violates one of these criteria, then that practice constitutes "open dumping" and it is illegal.[viii]

The RCRA open dumping criterion for groundwater contamination is intended to protect aquifers—both those that are being actively used for drinking water and those that might be used for drinking water in the future. Potential drinking water sources are defined to include all aquifers with concentrations of total suspended solids below 10,000 parts per million (ppm). As the EPA stated when it promulgated these regulations, "[a]ny future drinking water source would likely fall within [that] definition. . . It is the Agency's general policy that groundwater resources below that concentration be protected for possible use as a drinking water source."[ix] Almost all groundwater aquifers that we have looked at fit this definition and are therefore protected.

The regulations define acceptable water quality with a list of Maximum Contaminant Levels (MCLs)—pollutant-specific limits established by the EPA to protect health.[x] Eight of these MCLs cover pollutants commonly found in coal ash and in contaminated groundwater near coal ash dumps: arsenic, barium, cadmium, chromium, fluoride, lead, mercury, and selenium. Although the EPA has revised and expanded its list of MCLs over the years, the MCLs in the open dumping regulations are fixed. This means that the MCLs in the open dumping regulations do not perfectly correspond to the EPA's current MCLs. Table 1 compares current MCLs to open dumping MCLs for the nine coal ash-related pollutants.

Table 1: Maximum Contaminant Levels for coal ash pollutants in groundwater.

Pollutant	Open Dumping MCL[xi]	Current MCL[xii]
Arsenic	50 ppb	10 ppb
Barium	1 ppm	2 ppm
Cadmium	10 ppb	5 ppb
Chromium	50 ppb (hexavalent)[xiii]	100 ppb (total)
Fluoride	4 ppm	4 ppm
Lead	50 ppb	15 ppb (Action Level)[xiv]
Mercury	2 ppb	2 ppb
Selenium	10 ppb	50 ppb

Finally, the regulations target exceedances of these MCLs outside of the area in which solid waste is being dumped. When coal plants monitor groundwater, the wells are typically on-site, but outside of the solid waste area. When these wells show that coal ash pollutants have caused groundwater to exceed the MCLs identified in the open dumping regulations then the site is supposed to be "upgraded" or closed.[xv] The regulations do provide an exception—States can establish "alternative compliance boundaries" if they can show based on specific criteria that setting such a boundary will not "result in

contamination of groundwater which may be needed or used for human consumption."[xvi] Although we know of a few sites with 'compliance boundaries' and 'groundwater management zones,' we have not been able to identify any evidence of states setting alternative compliance boundaries as they are defined in the open dumping regulations.

4. Limitations

Our ability to document this problem is limited by one major deficiency—groundwater quality data are not available for many coal ash disposal units. Many of these units are not subject to groundwater monitoring requirements, and so no groundwater data have ever been collected. The EPA estimates that monitoring is only required at 62% of existing coal ash landfills and 12% of existing coal ash settling ponds.[xvii] Other sites are subject to monitoring requirements and submit their testing results to state agencies, but the results were difficult or impossible for us to obtain.[xviii] Another subset of sites tests groundwater, but not for the pollutants relevant to RCRA open dumping regulations. Groundwater wells at the Curtis Stanton Energy Center in Florida, for example, are measured for various pollutants like manganese and sulfate, but not for any of the pollutants listed in Table 1. Other sites, like the Independence Steam Station in Arkansas and the Big Cajun 2 Power Plant in Louisiana, only measure one or two of the relevant pollutants. These sites do not generate enough information for us to assess their compliance with the open dumping regulations. Even the sites that we were able to include frequently measured only a subset of the relevant pollutants (See Table 2). And, as mentioned above, contaminants are frequently measured as dissolved, underestimating total concentrations.

Another common problem we encountered was the use of high detection limits. A detection limit is the concentration of a pollutant that can be detected by a test method. Concentrations below the detection limit are frequently reported as 'nondetect.' In some cases the detection limit is higher than the MCL, and in these cases MCL exceedances can be easily missed. One site, for example, used a detection limit of 1.25 mg/L for selenium, many times higher than the MCL of 50 ppb. This is not helpful information—the true concentration could be many times higher than the MCL and still show up as 'nondetect.'

5. Methods

Data. We have been collecting information from state agencies responsible for regulating coal ash disposal for various purposes and now have a substantial reference database. The database is not comprehensive, for reasons discussed above, but it can be considered representative of the industry. We collected groundwater reports from the sites in our files in order to determine which pollutants were being measured at each site. We then looked for the wells at each site with exceedances of open dumping limits in the past five years. Our comparison value for each pollutant was the higher of either the MCL fixed in the open dumping regulations or the current MCL, as described in more detail below.

Units. Groundwater contamination is frequently measured in units of micrograms per liter (µg/L) or parts per billion (ppb). These two units mean the same thing and are interchangeable. Some contaminants are found in greater quantities and are measured in units of milligrams per liter (mg/L) or parts per million (ppm), also interchangeable. In this report we use units of ppb and ppm.

Some evidence was excluded from our survey. In order to keep our emphasis on recent and ongoing violations of health-based limits, we excluded the following:

- **Exceedances over five years old.**

  Because we wanted to focus on current conditions, our analysis was limited to sites where MCLs had been exceeded in the last five years (since January, 2006). It should be noted, however, that some sites stopped monitoring contaminated groundwater without doing anything about it. The abandoned ash disposal "Area A" at the Johnsonville Fossil Plant, for example, showed high concentrations of arsenic, lead, and other pollutants in the early 1990s, but TVA stopped monitoring in 1994. The current quality of the groundwater near these disposal areas is unknown. Although we didn't include sites like these in our survey, they may represent additional examples of illegal open dumps.

- **Exceedances at closed sites.**

  We decided not to include groundwater data from closed sites because the disposal of coal ash at these sites has ceased. These closed disposal units may continue to leach pollutants, however, and aquifers can remain contaminated for a long time. For example, the Burton Island Landfill at the Indian River Generating Station in Delaware closed in 1980, but groundwater sampled in 2007 showed concentrations of arsenic, chromium, lead, mercury, and selenium that easily exceeded the threshold concentrations used in this report.[xix] Another example is the Industrial Excess landfill in Uniontown, Ohio, a mixed-waste landfill that also closed in 1980. Sampling for metals stopped in 2004, but sampling throughout the 1990s showed high concentrations of coal ash-related pollutants like arsenic, barium, chromium, and lead.[xx]

- **Exceedances of certain open dumping thresholds.**

  Since the goal of the groundwater criterion in the open dumping regulations is to preserve aquifers as drinking water sources, we chose to disregard legal violations that may not pose a health risk:

  The selenium MCL in the open dumping regulations was 10 ppb. Since that time the EPA has revised the MCL to 50 ppb. Selenium concentrations between 10 and 50 ppb suggest legal violations of the open dumping prohibition, but are not strong evidence of drinking water being unsafe to drink. We therefore decided to use 50 ppb as the threshold for defining selenium exceedances.

In the same way, the barium MCL in the open dumping regulations is 1 ppm while the current MCL is 2 ppm. We decided to use 2 ppm as the exceedance threshold for barium.

The chromium MCL fixed in the open dumping regulations is 50 ppb of hexavalent chromium, a relatively toxic species of total chromium. The current chromium MCL is 100 ppb of total chromium. We decided to use 100 ppb of total chromium as our exceedance threshold for two reasons: First, most sites measure total chromium and not hexavalent chromium. Second, most chromium leaching from coal ash dumps is hexavalent, so it is very likely that groundwater with 100 ppb of total chromium has at least 50 ppb of hexavalent chromium.[xxi]

6. Results

We found 33 sites that have recently violated the groundwater quality requirements of the open dumping regulations. Details are shown in the attached Table 2. Of these 33 sites, 20 showed arsenic contamination above the open dumping limit, sometimes by an order of magnitude or more. 10 sites showed selenium concentrations greater than 50 ppb. 11 sites exceeded open dumping limits for multiple contaminants. Water at these concentrations is generally unsafe to drink according to EPA guidelines.

Not shown in the table are additional sites where groundwater exceeded current MCLs but did not violate the open dumping criteria. The fact that the open dumping regulations have not been updated to reflect current MCLs is something of a technicality. Although these sites are technically in compliance with the law, they also present exactly the kind of problem that the RCRA open dumping prohibition intended to address. Five additional sites, for example, show groundwater concentrations of arsenic between 10 and 50 ppb, including the McIntosh Plant in Florida, the Pearl Station in Illinois, the Powerton Station in Illinois, the Boardman Plant in Oregon, and the Bruce Mansfield Plant's Little Blue Run Surface Impoundment in West Virginia and Pennsylvania.

5. Conclusions and discussion

These contaminated sites are the tip of the iceberg. As described above, our analysis was limited to sites for which sufficient groundwater quality data were available. This means that our universe of eligible sites was much smaller than the total number of coal plants in the country. We are continuously seeking and receiving new data, but at last count we had a total of only 61 sites with sufficient data to say something meaningful about open dumping compliance. This represents roughly 10% of the total number of coal plants in the United States.[xxii]

The contamination described in this report is only part of the story. We have focused on the pollutants that are relevant to RCRA open dumping regulations, but coal ash-impacted groundwater usually has unsafe levels of many additional pollutants. To choose an arbitrary example, we can look at the first site

on our list, the Colbert Fossil Plant in Alabama. In the past five years wells at this site have shown concentrations of antimony, boron, and manganese above relevant MCLs or U.S. EPA Health Advisories, all in addition to the arsenic, lead, and chromium contamination shown in Table 2.

Illegal coal ash disposal is creating a problem that will not go away. Poisoned groundwater aquifers don't heal themselves and closed ash dumps continue to release pollutants. This means that the problems we are seeing evidence of here will be around for a long time. The Venice Plant, for example, stopped dumping coal ash in its landfill in 1977, but groundwater around the site is still contaminated today—data from the mid-1990s through 2009 show that arsenic has consistently averaged over 50 ppb in three nearby groundwater wells with no evidence of a decline. The Indian River and Industrial Excess landfills described above provide additional dramatic examples of the persistence of groundwater contamination.

RCRA laws meant to protect groundwater quality have not been adequately enforced. Subtitle D of RCRA currently leaves enforcement authority with the States, and although the statute formally creates a federal funding mechanism, no funding has been provided since the early 1980s.[xxiii] With the resulting lack of state enforcement, the RCRA open dumping regulations amount to little more than a voluntary program. It clearly is not working as planned.

Illegal open dumps should be cleaned up or closed. Under RCRA, open dumping has been prohibited since 1979, and all open dumps should have been upgraded or closed by 1984.[xxiv] Three decades later most coal plants are not even required to monitor the groundwater around their ash dumps. The protection of groundwater from the threat of coal ash clearly requires a stronger federal presence.

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[i] 42 U.S.C. § 6945 (a).
[ii] 40 C.F.R. § 257.3-4.
[iii] *Id.* at § 257.3-4(b)(2).
[iv] National Research Council, Committee on Mine Placement of Coal Combustion Wastes, *Managing Coal Combustion Residues in Mines*, 1 (2006).
[v] Environmental Integrity Project (EIP), Earthjustice, & Sierra Club, *In Harm's Way: Lack of Federal Coal Ash Regulations Endangers Americans and Their Environment* (Aug. 26, 2010), *available at* http://www.environmentalintegrity.org/news_reports/documents/INHARMSWAY_FINAL2.pdf; EIP & Earthjustice, *Out of Control: Mounting Damages from Coal Ash Waste Sites* (Feb. 24, 2010), http://www.environmentalintegrity.org/news_reports/news_02_24_10.php
[vi] 42 U.S.C. §6901 et seq.
[vii] 42 U.S.C. § 6945 (a).
[viii] 40 C.F.R. § 257.3-4.
[ix] 44 Fed. Reg. 53438, 53448 (Sept. 13 1979).
[x] 40 C.F.R. § 257, Appendix I.
[xi] *Id.*
[xii] U.S. EPA, National Primary Drinking Water Regulations, available at http://water.epa.gov/drink/contaminants/upload/mcl-2.pdf.
[xiii] Chromium is found in various oxidation states. Hexavalent chromium is a relatively toxic form of total chromium.

[xiv] In place of an MCL, the EPA lists a treatment technique and an action level for lead. *See* U.S. EPA, *supra* note xi.
[xv] 42 U.S.C. § 6945 (a).
[xvi] 40 C.F.R. § 257.3-4(b)(2).
[xvii] Office of Resource Conservation and Recovery, US EPA, Regulatory Impact Analysis for EPA's Proposed RCRA Regulation of Coal Combustion Residues (CCR) Generated by the Electric Utility Industry, Exhibit 5A-9 (April 30, 2010).
[xviii] In some cases state agencies have failed to respond to our requests for information, while in other cases they have responded by saying that although the files exist, the only way for us to obtain them is to personally visit the relevant office and make photocopies.
[xix] Maximum concentrations were 1,450 ppb (arsenic), 211 ppb (chromium), 102 ppb (lead), 4.8 ppb (mercury), and 93.9 (selenium). Shaw Environmental, Inc., *Facility Evaluation Report: Indian River Generating Station, Burton Island Old Ash Landfill* (March, 2008).
[xx] EIP et al., *supra* note v, at 32.
[xxi] Earthjustice, Physicians for Social Responsibility, and EIP, *EPA's Blind Spot: Hexavalent Chromium in Coal Ash* (Feb. 1, 2011), *available at* http://environmentalintegrity.org/documents/CoalAshChromeReportFINAL.pdf.
[xxii] U.S. Energy Information Administration, Count of Electric Power Industry Power Plants, by Sector, by Predominant Energy Sources within Plant, 2001 through 2009, *available at* http://www.eia.gov/cneaf/electricity/epa/epaxlfile5_1.xls (showing 594 coal plants in 2009).
[xxiii] Pers. comm. From Robert Dellinger, Director, U.S. EPA Materials Recovery and Waste Management Division.
[xxiv] The open dumping statute, 42 U.S.C. § 6945(a), requires upgrade or closure within five years of publication of open dumping criteria. These criteria were published in 1979 (40 C.F.R. § 257). Open dumps should therefore have been closed by 1984.

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All data cited in this report or presented in the attached table is available from EIP upon request.

Table 2: Violations of RCRA open dumping criterion for groundwater quality. Shaded cells indicate the number of wells exceeding the relevant threshold and the highest reported concentration since January, 2006.Threshold concentrations listed under each pollutant are the higher of either the current U.S. EPA MCL or the MCL fixed in the RCRA open dumping regulations. [Data available from EIP upon request]

Site	Parent Company	State	Arsenic	Barium	Cadmium	Chromium	Fluoride	Lead	Mercury	Selenium
			50 ppb	2 ppm	10 ppb	100 ppb	4 ppm	50 ppb	2 ppb	50 ppb
Colbert Fossil Plant	TVA	AL	3 (76 ppb)	No data	No data	1 (110 ppb)	No data	2 (160 ppb)	No data	No data
Flint Creek Power Plant	AEP	AR	0	0	0	0	0	0	0	2 (152 ppb)
Big Bend Station	TECO Energy	FL	2 (52.7 ppb)	0	0	No data	2 (10.3ppm)	0	0	0
George Neal Stat. North	Mid-American Energy	IA	2 (218 ppb)	0	No data	No data	No data	0	No data	0
George Neal Stat. South	Mid-American Energy	IA	1 (83.9 ppb)	0	No data	No data	No data	0	No data	0
Dallman Station	CWLP	IL	1 (93.6 ppb)	0	0	0	0	0	0	0
Joliet 9	Midwest Generation	IL	1 (100 ppb)	No data	0	No data	1 (4.8 ppm)	No data	No data	0
Marion Plant	SIPC	IL	No data	No data	5 (88 ppb)	No data	No data	No data	No data	No data
Meredosia Power Station	Ameren	IL	2 (148 ppb)	0	0	0	0	0	0	0
Waukegan Generating Station	Midwest Generation	IL	1 (54 ppb)	0	0	0	0	0	0	0
Gibson Generating Station	Duke Energy	IN	1 (53 ppb)	0	0	0	0	0	0	0
Shawnee Fossil Plant	TVA	KY	0	0	0	1 (150 ppb)	0	1 (120 ppb)	0	0
Brame Energy Center	CLECO Power	LA	3 (104 ppb)	No data	0	No data	No data	0	No data	0
Dolet Hills Power Station	CLECO Power	LA	0	0	No data	No data	No data	0	No data	2 (173 ppb)
Belews Creek Steam Stat.	Duke Energy	NC	2 (63.6 ppb)	0	0	0	0	0	0	6 (152 ppb)
Lee Steam Plant	Progress Energy	NC	2 (440 ppb)	0	0	0	0	0	0	0
Sutton Steam Plant	Progress Energy	NC	1 (290 ppb)	0	0	0	0	0	0	0
Leland Olds Station	Basin Electric	ND	1 (78.9 ppb)	0	No data	0	No data	1 (71.6 ppb)	No data	0
Sheldon Station	NE Public Power District	NE	0	0	No data	No data	No data	No data	No data	2 (713 ppb)

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Site	Parent Company	State	Arsenic	Barium	Cadmium	Chromium	Fluoride	Lead	Mercury	Selenium
			50 ppb	2 ppm	10 ppb	100 ppb	4 ppm	50 ppb	2 ppb	50 ppb
Reid Gardner Station	NV Energy	NV	26 (730 ppb)	No data	0	0	10 (24 ppm)	No data	No data	2 (280 ppb)
Cayuga Plant	AES	NY	0	0	0	0	0	0	0	1 (76. 2 ppb)
Cardinal Plant	AEP	OH	4 (161 ppb)	2 (6.5 ppm)	1 (218 ppb)	1 (216 ppb)	1 (10.5 ppm)	1 (104 ppb)	0	0
Gavin Power Plant	AEP	OH	0	3 (9.71 ppm)	0	0	0	0	0	0
Muskingum River Plant	AEP	OH	0	1 (3.65 ppm)	No data	No data	No data	No data	No data	0
Northeastern Station	AEP	OK	2 (94 ppb)	2 (8.69 ppm)	2 (95 ppb)	3 (417 ppb)	No data	2 (140 ppb)	0	5 (1,850 ppb)
Hatfields Ferry Power Station	Allegheny Energy	PA	3 (3,419 ppb)	0	0	1 (104 ppb)	0	0	0	2 (139 ppb)
Mitchell Power Station	Allegheny Energy	PA	0	0	0	0	1 (4.88ppm)	0	0	0
Hunlock Power Station	UGI	PA	3 (614 ppb)	0	0	0	0	1 (71 ppb)	0	0
Big Stone Power Plant	Otter Tail Power	SD	2 (132.2 ppb)	0	0	0	No data	0	0	0
Cumberland Fossil Plant	TVA	TN	0	0	0	0	0	0	0	1 (120 ppb)
Johnsonville Fossil Plant	TVA	TN	0	0	0	0	0	0	2 (2.1 ppb)	0
Trans-Ash Landfill	Trans-Ash, Inc.	TN	0	0	0	0	0	0	1 (7.48 ppb)	0
Fayette Power Project	Lower Colorado River Auth.	TX	0	0	0	0	No data	0	0	2 (212 ppb)