

**Response to Dominion Energy Report entitled: Senate Bill 1398 Response, Coal
Combustion Residuals, Ash Pond Closure Assessment**

January 17, 2018

Dr. Kevin H. Gardner, P.E.
Professor, University of New Hampshire

Scott Greenwood
Research Engineer, University of New Hampshire

Introduction

At the request of the Southern Environmental Law Center and the Potomac Riverkeeper Network, we reviewed and analyzed the Dominion Energy report entitled: Senate Bill 1398 Response, Coal Combustion Residuals, Ash Pond Closure Assessment (the “Dominion Report”). Our analysis was limited to the Dominion Report’s consideration of closure by removal and beneficial reuse of ash. The relevant sections of the Dominion Report that we reviewed are Section 4.1 Closure by Removal and Beneficial Use, Section 5 Beneficial Use and Ash Market Assessment, 6.3.2 Closure by Beneficial Use for Bremo Power Station, 7.3.2 Closure by Beneficial Use for Chesapeake Energy Center, 8.3.2 Closure by Beneficial Use for Chesterfield Power Station, 9.3.2 Closure by Beneficial Use for Possum Point Power Station, and Technical Memorandum 1: Beneficial Use and Ash Market Study. We present the results of our analysis in this report.

Based on our review of the Dominion Report’s discussion of beneficial reuse of coal ash, we identified numerous instances of inconsistent and incorrect assumptions, unsubstantiated methodologies, and selective use of data which lead to biased interpretations and an overall flawed analysis that lacks credibility. Specifically, the Dominion Report:

1. Assumes that the beneficial reuse of ash is not economically viable if ash is transported more than 50 miles. This assumption is unsubstantiated and leads to significant bias in market estimates. It is also contrary to evidence included elsewhere in the Report where Dominion identified ash imports to Virginia from multiple locations more than 50 miles away, including South Carolina, West Virginia, Pennsylvania, Georgia, Tennessee, Ohio, and India, and the results of its own survey of market participants. This assumption significantly biases the Report’s conclusions in favor of dismissing beneficial reuse of ash as a feasible option for closure of Dominion’s coal ash ponds.
2. Selectively relies on a single, unsupported data point to minimize the demand for ash in the region, while ignoring other contrary data and information, including the data from Dominion’s own survey of market participants. The Report’s selective use of market survey information is unsubstantiated, and it biases the Report’s conclusions in favor of dismissing beneficial reuse of ash as a feasible option for Dominion’s coal ash ponds.
3. Ignores without suitable justification a credible, independent report prepared for the Carolinas Ready Mixed Concrete Association in 2017 that includes a market analysis of ash demand for North Carolina, South Carolina, and Virginia.
4. Interprets and characterizes information on annual demand from different ash end users in a biased manner that creates an unfounded sense of uncertainty and uses the uncertainty as grounds for dismissing beneficial use of ash as a feasible option for Dominion’s coal ash ponds.
5. Fails to provide logical, holistic closure solutions that include beneficial reuse by developing closure scenarios lacking the necessary control of leaching to groundwater

and surface water. The Report does not acknowledge that the control of leaching is necessary for all possible closure options for the Dominion coal ash ponds regardless of whether beneficial reuse of ash is included in the closure plan.

6. Ignores the possibility that rail transport could connect Dominion facilities to a regional ash beneficiation plant or that rail transport could be used to transport processed ash. The Dominion facilities are connected by rail, which delivers or has delivered coal for plant operation.
7. Ignores an important market for ash for cement production which is likely substantial in Virginia and the surrounding region. Thus, the Report significantly underestimates the market potential for beneficial reuse of ash.
8. Incorrectly adds together cost and revenue associated with beneficial reuse, significantly inflating the cost of closure using this option.

In light of these serious deficiencies, Dominion's assessment of the beneficial reuse of ash as a closure option for its ash ponds is not a credible, objective evaluation of whether the beneficial reuse of ash, such as recycling for use in concrete or cement production, is a feasible option for the closure of coal ash ponds at the Possum Point, Bremono, Chesterfield, and Chesapeake power plants. The body of this report provides a detailed accounting of the defects found in the Report.

1. The Dominion Report's evaluation of the market for ash has a number of unreasonable and unsubstantiated assumptions, compounded by faulty logic.

One of the major assumptions used in Dominion's market assessment is that the market for ash is local: the Report states that transportation costs are too high if distances are greater than 50 miles. This is an assumption that significantly alters the Report's conclusions, yet it has no justification, is contradicted by data included elsewhere in the Dominion Report, and is clearly biased to generate a smaller market estimate.

In particular, while Dominion used a 50-mile radius to evaluate the market, it also cites evidence that ash imports into Virginia come from South Carolina, West Virginia, Pennsylvania, Georgia, Tennessee, Ohio, and even India. Dominion uses the existence of this imported ash as proof that the market isn't there for the beneficial reuse of Dominion ash, when in fact it shows that indeed, there is a healthy market being filled by far-away and even foreign sources. Clearly, the market for ash is much larger than 50 miles, which the report itself states. And yet the authors ignore evidence cited in the very same report when developing final estimates of market potential.

Dominion's 50-mile assumption also contradicts its own survey results of market participants. In the market survey, which sought to ascertain a feasible distance to transport ash, responses

varied from 75 to 350 miles, with an average distance of “maximum acceptable transportation distance” of 138 miles. This survey does not support the conclusion that the market for ash is limited to 50 miles. Rather, the survey indicates the market is much greater than Dominion admits, with some respondents considering 350 miles as a feasible transportation distance.

Finally, there is also no internal consistency in the Report about which region exists for demand of ash and which exists for supply. For ash production that competes in the region where Dominion ash would be used, the Report cites North Carolina, Virginia, and Maryland, but does not include South Carolina. For Dominion ash demand, on the other hand, they use a 50 mile radius. They repeatedly assert the market will be “flooded” with ash when the Duke Energy ash pond mining and beneficiation facilities in North Carolina are operational. On page 5-3 of Technical Memorandum 1 they state, “The end result is that over the next 2 years as these three plants begin beneficiation, and through 2029, the regional market may be flooded with fly ash.” However, they systematically underestimate the market demand in the region and use market competition as evidence of a lack of a market. There is no justification for this inconsistency between the supply and demand regions nor for selectively citing new ash sources to the market while ignoring major regions and outlets for ash. Instead, these systematic judgements and decisions demonstrate a clear bias in the Report that appears to be intended to make the market demand appear as small as possible, the competition and supply as large as possible and, ultimately, to make beneficial reuse of ash appear less feasible than it is.

2. The Dominion Report ignores important data from their own market survey results and instead selectively picks unreported, unsubstantiated verbal responses that contradict their survey and other data in the Report.

The Dominion Report ignores Dominion’s own survey results described elsewhere in the report, where 12 out of 13 responses indicated that currently there is not enough ash supply in the region (respondents were from Virginia, Maryland, North Carolina, and Washington, D.C.; note that there was a total of 15 respondents but two did not respond to this question). Instead of using this data on the inadequate supply of ash in the region, the Report selectively quotes only one respondent as saying “Charah anticipates that in the region comprising the states of Virginia, Maryland, North Carolina, and South Carolina the supply will be approximately 1.6 million tons per year, but the demand will be 900,000 tons per year.” There is no additional support for the Charah estimate, no explanation of how it was arrived at, no explanation of what the data sources underlying the estimate were, and no text responses from any other survey respondents.

Although there were 15 survey responses included in Table TM1-11 (page 4-5 of Technical Memorandum 1), the report states that 174 potential end users were contacted to provide survey responses and responses were received from 105 participants. While there is some mention of aggregating sources, there is no provision of original data nor explanation of how results were aggregated. These methodological failures contribute to the lack of credibility of this report.

Moreover, the unsubstantiated estimate by Charah cited in the Report is refuted by data about past use that the Report itself cites. For example, Dominion states elsewhere that “[r]egulated utilities and other power generators sold an average of 1.3 million tons per year of fly ash, from 2011 to 2015, which is the most current information available.” [Page 5-3 of Technical Memorandum 1; note that this appears in the section “North Carolina Fly Ash Sources,” so it’s a reasonable assumption that this data specifically applies to North Carolina fly ash sales only, but it is not explicitly stated in the Report.] In a retrospective analysis, Leming (2017) concludes that “About 2.05 million tons of fly ash per year on average were apparently consumed in NC, SC, and VA from 2014 to 2016.” Thus, the actual evidence and data demonstrate that the personal communication by Charah cited was not only unsubstantiated, it was also unreasonable. Nonetheless, Dominion cites this anecdotal conversation as important information on the ash market in the region, and summarily dismisses other available sources, such as the Leming (2017) report, which is published and widely available and includes a detailed set of methods, procedures and assumptions that can be evaluated (see next point below). Dominion’s reliance on a single anecdotal source is unjustified in light of other available data and analysis, and its market analysis is not credible as a result.

3. The Dominion Report ignores a credible independent report without reasonable cause.

The Dominion Report presents the Leming (2017) study, conducted in 2017 for the Carolinas Ready Mixed Concrete Association, and the data from that study but summarily dismisses its market analysis. There is simply no reasonable basis to do so. Rather, it appears Dominion dismissed the report not because of any purported errors, but because the Leming report provides a much greater annual demand in North Carolina, South Carolina, and Virginia—an average of over 2.2 million tons per year in 2015-2019, 2.8 million tons per year in 2020-2024, and 3.5 million tons per year in 2025-2030.

Dominion identifies two purported errors in the Leming study; one of these is a minor calculation that Dominion itself corrected, and the other is not an error at all. Neither of these purported errors justify dismissing the Leming study. Dominion cites an error in Leming’s calculations for 2025-2030 (he used 5 years but it is actually a 6-year time frame). But the Dominion Report corrects his calculations for that period and present the corrected data in Table TM1-9 (page 4-3 of Technical Memorandum 1), so that is a non-issue. Dominion also notes that Leming uses a different method for percent replacement of fly ash in cement (in some cases, % replacement is given as a % of total cementitious material (e.g. fly ash + Portland Cement) and in some cases it’s as % of Portland Cement only). These are equivalent methods: it’s just important to know the definition of “%” that is being used. Leming’s 35% replacement rate corresponds to a 25.9% replacement rate as defined in the Dominion Report – essentially half way between the Dominion (and Portland Cement Association) 20%-30% replacement ranges. These so-called “errors” appear to be pretext for dismissing the entire Leming study—a report that would otherwise justify a much larger ash market than Dominion is prepared to admit.

Furthermore, Dominion ignores the major driver of cement (and therefore coal ash) demand. The Report stated the following: “According to the PCA report (PCA, 2016), long-term total cement consumption estimates are driven by two key factors: population growth and cement consumption per capita.” The Dominion Report then ignores, without justification, the role of population growth in its estimates. Leming (2017) included population growth (using widely accepted and available Federal data) as a factor, and it contributes significantly to cement and ash use in the coming decades. Leming (2017) estimated the ash market in North Carolina, South Carolina, and Virginia to be 2.9 million tons per year in 2020-2024, and 3.5 million tons per year in 2025-2030 (note also that the potential ash market for Dominion ash is larger than just these three states). These estimates are much higher than estimates in the Dominion Report. Dominion offers no reasonable justification for ignoring the Leming (2017) report to the Carolinas Ready Mixed Concrete Association and it appears that it is ignored because it provides a much higher estimate for the ash market in the region.

4. The Dominion Report misrepresents and misinterprets the data to create a sense of market uncertainty.

The Dominion Report creates a false sense of market uncertainty that is not reflected by actual market data. For example, Dominion states that, “However, the regional quantity of fly ash that is currently in demand is highly variable, ranging from approximately 1,300 to 18,000 tons per year and for one concrete company, up to 375,000 tons per year of unprocessed ash.” [Page 4-6 of Technical Memorandum 1.] However, this statement does not indicate there is any market uncertainty; it simply states the obvious fact that different users require different amounts of ash. It is analogous to saying water use is highly variable because a thermoelectric power plant uses a million gallons a day and a homeowner uses 100. The total use itself is not highly variable.

Dominion uses what they characterize as “variability” to dismiss the reasonableness of beneficial use without engaging in any further analysis. On page 8-6 the Report summarizes, “There is a potential to beneficially reuse fly ash from the Dominion stations on a regional and non- regional basis and within the current market pricing. However, due to the variability in the market, the actual beneficiation quantity on an annual basis cannot be estimated.” This is simply not true. The existing data show a strong demand for ash that could be estimated had Dominion performed the proper analysis.

5. The Dominion Report ignores the necessity of managing leachate in the beneficial reuse scenarios, and subsequently uses the lack of leachate control as a reason that beneficial reuse is not an acceptable closure solution.

Managing leachate is necessary for all of the closure scenarios evaluated in the Dominion Report. Dominion assumes leaching will continue unmitigated with the beneficial reuse scenario and counts this as a negative attribute of the beneficial reuse option. But leaching

needs to be intercepted, treated, or otherwise managed with all the closure options considered in the Report. The rationale that beneficial reuse is not suitable because it would not intercept or manage existing leaching and future leaching during the ash removal and beneficiation process is only a failure of Dominion to construct rational and reasonable closure scenarios.

Furthermore, other management options considered the Dominion Report, such as cap-in-place, include unrealistic values for the duration of leachate management (10-30 years; see Table 11 on Page 4-11). This estimate of the length of time during which active leachate management would be required and the length of time that institutional and regulatory oversight would be required results in unrealistically low costs for these options (including the Monitored Natural Attenuation option). The 10-30 year post-closure monitoring is unsupported and unsubstantiated and represents an ungrounded assumption. The peer-reviewed literature indicates that Selenium transport leaching from ash materials through the subsurface can occur over hundreds of years. The figure below demonstrates Selenium may only migrate 2 meters over a 200-year period under unsaturated flow conditions (Carpenter et al., 2007). While the rate of transport of Selenium and other elements will depend on the groundwater flow conditions at the site and the characteristics of the soils through which the leachate passes, the assumption used by the report may underestimate the length of time that would be required to manage leachate by hundreds of years. Management that includes removal and beneficial reuse will eliminate the source of leaching and result in closure that is more protective of human health and the environment.

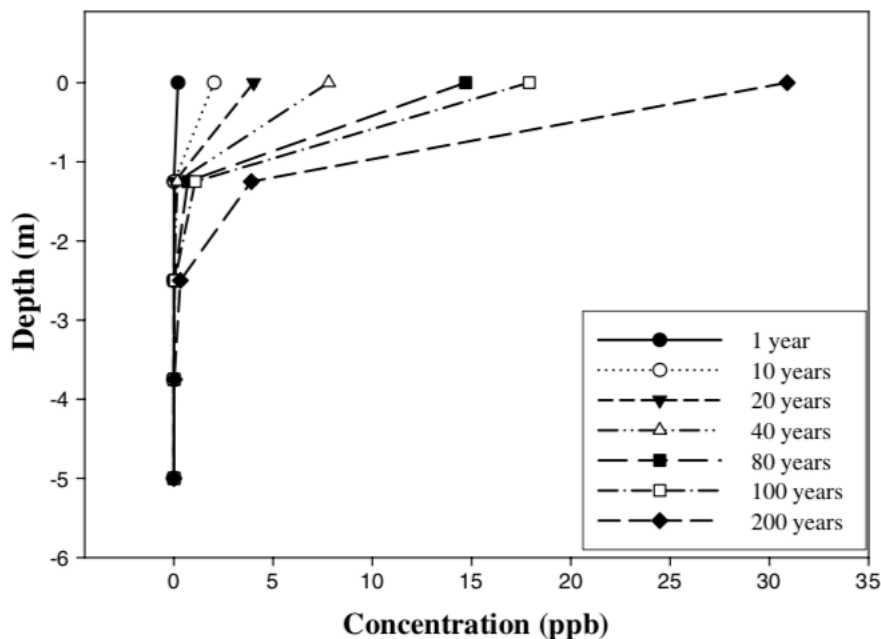


Fig. 5. Hydrus2D simulation for transport of Se from beneath the recycled materials layer in the road sub-base to groundwater (5 m below the recycled materials layer) over 200 years.

6. The Dominion Report does not combine more appropriate transportation options with beneficial use scenarios and thus creates closure scenarios that are sub-optimal and that appear less feasible.

Technical Memorandum 1 includes the simple assumption that transport from each coal ash site will occur by truck transport. This assumption is not justified, is unreasonable, and inflates the impacts from closure by beneficial reuse. This assumption is particularly egregious when the Report considers the feasibility of a regional facility for beneficiation, which would process ash from several power plants, and subsequent sale of ash. Rail access has been used recently for Bremono, Chesterfield, Chesapeake, and Possum Point. In 2016, 2.5 million tons of coal was shipped to Chesterfield, for example. Chesapeake received close to 500,000 tons of coal as recently as 2014 (EIA, accessed 12/10/17). Rail is lower cost and less impactful than truck transport, and rail transport combined with a regional beneficiation facility or with rail transport of beneficiated ash are both important and likely more feasible options ignored in this report.

7. The Dominion Report ignores the use of ash for cement production and thus creates the impression that the market is smaller than it is.

The Dominion Report ignores the use of ash for cement production, which is a substantial market. In Virginia alone this could amount to using 200,000 tons of ash per year that does not require the same level of beneficiation as for use in concrete. The Roanoke Cement Company produces 1.2 million tons of clinker per year, and ash may be up to 17% of the feedstock, depending on the chemistry of their other feedstock materials. (Clinker is the major ingredient in cement. It is produced in the cement kiln, cooled and combined with a small amount of gypsum and finely ground to produce cement; the Portland Cement Association reports clinker production by state.) Contrary to the ash requirements for use in concrete, high-LOI ash is acceptable for use in cement production because the LOI will be burned off in the kiln (contributing fuel to the kiln depending on the LOI of the ash). There are other cement production plants in the region, also accessible by rail, that currently use ash, and the ash from the Dominion sources could compete for that market as well. On a national level, 15% of all ash used beneficially was for clinker production in 2015 (ACAA, 2015). There is no justification for ignoring the cement production market in this report, particularly because low quality ash (i.e. high LOI) is acceptable for this application. In fact, the R. Paul Smith Power Plant coal ash mining project is expected to be completed in 2020, reducing supply to Maryland cement kilns by hundreds of thousands of tons of ash per year and increasing the market potential for ash from Dominion.

8. The Dominion Report incorrectly adds together cost and revenue, which significantly inflates the cost estimate for closure by beneficial reuse.

On page 2-2 of Technical Memorandum 1, the Report states, "Competitive purchase price for fly ash meeting ASTM C618 standards typically ranges from \$30 to \$60 per ton with added transportation costs of \$7 to \$33 per ton (total \$37 to \$93 per ton), and fly ash was reported to

be transported between 60 and 200 miles.” This statement conflates one of the costs associated with beneficial reuse (i.e. the transportation required to its end use) with the price that Dominion (or entity acting on their behalf) would be paid for the ash. The price of the ash and the transportation costs will be off-setting, not additive. Ash sales would help offset the cost of excavating legacy ash ponds and constructing a beneficiation facility. The high degree of uncertainty in the cost estimates made and the simple errors in adding revenue to costs make it clear that any cost information included in the Dominion Report is not suitable for use in decision making about closure options.

References cited

American Coal Ash Association (ACAA). 2015. 2015 Coal Combustion Product (CCP) Production & Use Survey Report. https://www.acaa-usa.org/Portals/9/Files/PDFs/2015-Survey_Results_Table.pdf accessed January 16, 2018.

Carpenter, A.C., K.H. Gardner, J. Fopiano, C. H. Benson, T. Edil, “Life Cycle Based Risk Assessment of Recycled Materials in Roadway Construction,” *Waste Management: International Journal of Integrated Waste Management, Science and Technology* 27: 1458-1464 (2007).

Energy Information Agency (EIA). <https://www.eia.gov/beta/coal/data/browser/> accessed 12/10/2017.

Leming, M. (2017) Fly Ash in Concrete, An Overview of Benefits and Quantities Needed for Use in Portland Cement Concrete in North Carolina, South Carolina and Virginia. Retrieved from: <http://www.crmca.com/wp-content/uploads/2017/06/FlyAshStudyFullwithUpdate.pdf>