



An **AEP** Company

BOUNDLESS ENERGY™

Via Email

September 15, 2023

**SUBJECT: Code of Virginia §10.1402.04 - Beneficial Use of CCR Proposal Review
Glen Lyn, Solid Waste Permit No. 222
100 APCO Road Glen Lyn, Giles County VA 24093**

To Interested Parties:

On behalf of Appalachian Power Company's (APCo) Glen Lyn Plant, please find the analysis completed for the qualified bidders that were considered by APCo for evaluating encapsulated beneficial use of CCR stored in the inactive CCR units at the Glen Lyn Plant pursuant to the provisions of subsection B of the Code of Virginia §10.1402.04. The actual proposals have been withheld from this posting due to the confidential nature of the information contained within them.

Please contact me at (318) 673-3816 or jcparker-witt@aep.com if you have any questions.

Sincerely,

A handwritten signature in cursive script that reads "Jill Parker-Witt".

Jill Parker-Witt, P.E.
AEP Environmental Services

Ec: Governor, the Secretary of Natural and Historic Resources, the Chairman of the Senate Committee on Agriculture, Conservation and Natural Resources, the Chairman of the House Committee on Agriculture, Chesapeake and Natural Resources, the Chairman of the Senate Committee on Commerce and Labor, the Chairman of the House Committee on Labor and Commerce, and the Director

First Biennial Report for Beneficial Reuse Proposal Analysis

for the

Glen Lyn CCR Units

Prepared for:

Glen Lyn Plant
Glen Lyn, Virginia

by



1 Riverside Plaza
Columbus, OH 43215

September 2023

Coal Combustion Residuals AEP Glen Lyn Plant Beneficial Use Assessment – Initial Biennial Report

August 24, 2023

Coal Combustion Residuals AEP Glen Lyn Plant Beneficial Use Assessment – Initial Biennial Report

Prepared for:

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Executive Summary

American Electric Power (AEP) requested proposals from qualified bidders to conduct beneficial use (BU) of the coal combustion residuals (CCR) stored in two inactive units at the Glen Lyn Plant in Glen Lyn, Virginia. The objective of the Request for Proposals (RFP) was to gather the following information:

- Identify viable options of beneficial use of the landfilled and/or impounded CCR at the Glen Lyn Plant
- Quantify the volume of CCR that may be suitable for beneficial use
- Establish the anticipated duration of a beneficial use project
- Evaluate transportation impacts and consideration for on-site and/or off-site beneficial use options
- Define the potential market demand for beneficially used materials, and,
- Provide anticipated costs associated with on-site or off-site beneficial use of CCR

Table ES-1 shows the volume of CCR (cubic yards) and area (acres) of the two units considered for beneficial use at the Glen Lyn Plant.

Table ES-1: Glen Lyn Plant - Site Information

Power Station	CCR Units	Estimated CCR Volume (CY)	Area (acres)
Glen Lyn Plant	Existing Landfill	4,650,000	46.0
	Auxiliary Pond	630,000	12.4
Total		5,280,000	58.4

This Initial Biennial Report describes the site investigation process conducted to gather CCR unit characterization data, the RFP solicitation process completed by AEP, and provides summaries and evaluation of proposals received from the bidders. Bids were evaluated to determine viability of the proposed beneficial use technologies and processes, establish the quantity of CCR to be beneficiated, identify potential transportation impacts, and estimate costs associated with beneficial use processing and end-product distribution. Market demand for the end-product was also evaluated and proposed beneficial use costs were compared to costs associated with construction of an on-site landfill.

Development of the RFP and this Biennial Report supports AEP's response to the Commonwealth of Virginia House Bill No. 443 (HB 443), enacted in 2020 and codified into legislation under section § 10.1-1402.04 of the Code of Virginia requiring closure by removal of the CCR units at the Glen Lyn Plant and disposal of the CCR materials either through an encapsulated beneficial use or placement of materials in a compliant on-site or off-site landfill. Considerations for the viability of a proposed beneficial use options include regulatory compliance, time required to achieve closure, risk feasibility,

stakeholder input, and evaluation of potential overall project cost savings when compared to the lowest cost alternative disposal option.

Site Investigation

Site investigations were conducted in March and June of 2022 to collect samples from the existing closed CCR units at the Glen Lyn Plant and characterize the material for potential beneficial use. A total of 21 borings were advanced and 61 samples were analyzed for conformance to ASTM C618 fly ash standards, typical cement kiln requirements, and additional chemical and physical parameters consistent with previously completed beneficial use studies. Results from the site investigations indicated that due to elevated moisture and carbon contents, and insufficient material fineness, additional processing would likely be required for beneficial use of the material.

RFP Process

AEP developed a solicitation process to obtain proposals from qualified contractors able to perform the full scope of work benefiting the CCR material from the Glen Lyn Plant. The solicitation process included identification and outreach to regional and national beneficial use vendors, preparing a comprehensive RFP package to obtain accurate and competitive pricing, and reviewing and evaluating proposals received by bidders. The full scope of work required to complete the project included both civil/construction elements and beneficial use tasks. Bidders provided proposals and pricing for excavation of CCR materials, processing the materials in preparation for beneficial use, and design, planning, construction, and operation of on-site or off-site beneficial use systems. Costs associated with transportation and marketing of the end-product were also included.

The solicitation process and related timelines are included in **Exhibit ES-1** and **Exhibit ES-2** below.

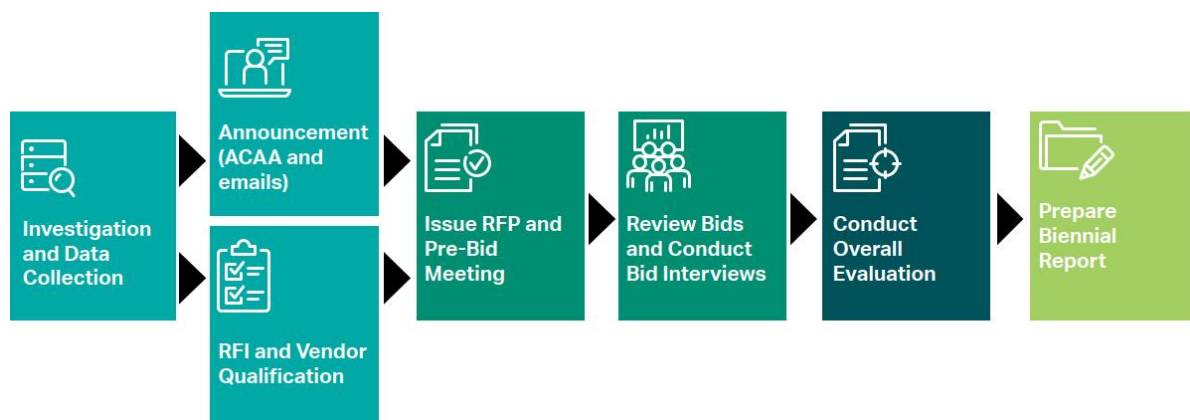


Exhibit ES-1: Beneficial Use Solicitation Process Flow Chart

Task	Duration	2022					2023										
		8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	
Outreach and Information Gathering	8/29/22-10/10/22	○	●														
Notice of RFP process distributed to regional and national BU vendors																	
39 vendors submitted questionnaires/BU RFI requests																	
35 vendors attended the informational meeting																	
RFP Development and Response	11/30/22-2/24/23				○	●											
RFP issued to 9 shortlisted BU vendors																	
Mandatory pre-bid meeting and site visits with BU vendors																	
12 RFI responses issued																	
3 Bids received																	
Bid Evaluation	2/24/23-5/26/23								○	●							
Initial Review																	
Interview/Follow-up questions																	
Biennial Report Development	4/21/23-10/1/23																
Submit report to Commonwealth of Virginia																	

Exhibit ES-2: Glen Lyn Plant Beneficial Use Solicitation Process Timeline

Following receipt of bidder proposals, a rigorous review of the offerings was conducted, incorporating the evaluation factors shown in **Exhibit ES-3:**

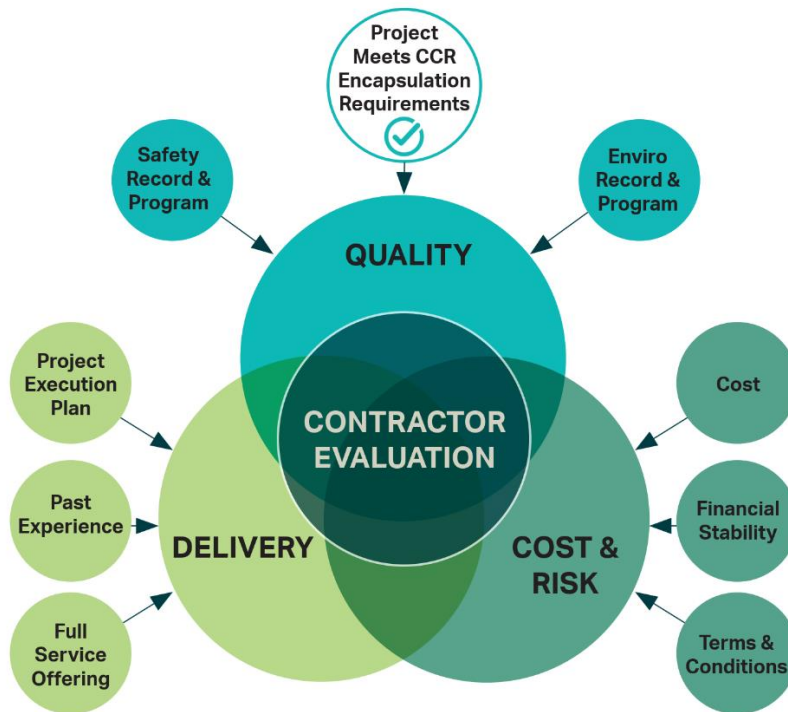


Exhibit ES-3: Bid Review Process

Table ES-2 provides a summary of CCR Rule encapsulated beneficial use compliance criteria and whether the individual bidders meet each of the criteria. Only one of the two bidders who provided complete responses to the RFP were able to provide sufficient evidence that their proposed technology or process met the encapsulated beneficial use criteria requirement in the RFP.

Table ES-2: Bidder Compliance with CCR Rule Beneficial Use Criteria

Does Bidder Meet CCR Rule Criteria?						
Bidder	Complete Proposal Response Provided	Provides Functional Benefit	Substitutes for a Virgin Material, Conserving Natural Resources	Meets Product Specifications, Regulatory/Design Standards (If Available)	When Standards Are Not Available, Not Used in Excess Quantities	Encapsulated Beneficial Use Binds CCR into a Solid Minimizing Mobilization into the Environment
Bidder #1	Yes	Yes	Yes	Unclear for Domestic Use	Yes	Demonstration Required
Bidder #2	Yes	Yes	Yes	Yes	N/A	Yes
Bidder #3	No					

CCR Beneficial Use Technologies and Products

Bidders proposed three different beneficiation options for encapsulating the CCR material at the Glen Lyn Plant. Bidder #1 proposed use a new technology utilizing decomposition reactors to combine the CCR material with imported raw materials to create a reactive pozzolan material for use in concrete ready-mix production. Bidder #2 proposed to transport unprocessed CCR material from the Aux Pond off-site for use as cement kiln feed. Bidder #3 proposed a thermal curing process to produce a concrete aggregate product; however, the bid was incomplete and non-compliant with the RFP requirements and therefore not further evaluated as a viable option.

CCR Beneficial Use Quantity and Project Duration

A summary of the volume of CCR to be beneficiated and the anticipated project duration is provided in **Table ES-3** below. Bidder #1 proposed to utilize CCR from both the Existing Landfill and Aux Pond, completing all work within 11.5 years. Bidder #2’s proposal considered use of a limited quantity of CCR from the Aux Pond over a project duration of 5 years.

Table ES-3: Beneficial Use Quantity and Project Duration

Bidder	Quantity (CY)	Duration (years)
Bidder #1	5,227,200	11.5
Bidder #2	333,333	5

Transportation Considerations

Bidders proposed to transport their end-product to market by use of truck, rail, or a combination of truck and rail transport. Use of a barge or other waterborne vessel is proposed by Bidder #1 for shipping material to the international market, if deemed necessary.

Bidder #1 proposed trucking approximately half of their end-product to the local ready-mix market within 250 miles of the Glen Lyn Plant. To meet the anticipated off-take volumes, Bidder #1 anticipates 75 pneumatic trucks trips per day on a 24-hour-per-day, 5-day-a-week hauling schedule. Bidder #1’s beneficial use process also requires significant importation of raw materials, with 139 triple-axle trucks anticipated per day for delivery of materials. The other half of Bidder #1’s ready-mix material would be transported by rail to an extended domestic market within 1,000 miles of the Plant.

The number of railcars required to meet this market has not yet been defined and coordination with the railroad has not yet occurred. All materials sent to the international market will be transported via rail to a port in Virginia and loaded onto barges or other waterborne vessels.

Bidder #2 proposes to haul unprocessed CCR material via truck to a cement kiln located in central Virginia. Bidder #2 estimates that 18 trucks per day will be utilized 9 months of the year to meet their proposed annual production rate.

CCR Beneficial Use Market

The two bidders providing complete proposals offered varying approaches for marketing the beneficiated CCR from the Glen Lyn Plant. Each bidder considered a different end-product and prepared a specialized marketing plan.

Bidder #1 intends to market their end-product across several local ready-mix markets, an extended domestic ready-mix market including gulf coast states, and an international market should oversaturation occur or if other domestic marketing challenges are encountered. The local ready-mix market identified by Bidder #1 includes Knoxville, Tennessee; Charlotte, North Carolina; and the Research Triangle in North Carolina. The extended ready-mix market states include Texas, Mississippi, Alabama, and Florida, while the international market includes the Middle East, Caribbean, and South America. Marketing of Bidder #1's end-product domestically for bulk sale is largely dependent upon receiving code certifications allowing its use in vertical construction projects in the United States. These certifications are not required for use as a building material in the international markets identified by Bidder #1.

Bidder #2 proposes to market unprocessed CCR to a central Virginia cement kiln at a rate of 80,000 to 100,000 tons of material per year, which represents the maximum annual intake rate for all CCR materials delivered to the kiln for use as a feedstock. Additional cement kilns were considered for marketing of CCR from the Glen Lyn Plant; however, anticipated transportation costs associated with trucking or railing material to these facilities limited the economic viability of that option.

Project Costs

Bidder #1's anticipated beneficial use cost is approximately \$25.02 per cubic yard (CY). This unit rate largely consists of construction, operation and maintenance of the on-site beneficiation system, construction of truck and rail load-out systems, and transportation costs of importing raw materials. The unit rate also includes leasing an off-site staging area, waste disposal costs, demolition of the beneficiation system, and costs associated with typical roadway maintenance. Bidder #1 indicated that all transportation costs associated with the sale of their ready-mix would be covered by the end-user, therefore these costs have not been included in the unit rate. A \$1 per ton credit for sale of the ready-mix sold is included in this unit rate.

Bidder #2's anticipated beneficial use cost is approximately \$35.53 per CY. This unit rate includes construction, operation and maintenance of a truck load-out area, and associated transportation

costs for off-site hauling of CCR to a cement kiln. An \$8 per ton credit for CCR sold as of cement kiln feed is reflected in the unit rate provided.

The costs associated with construction of an on-site landfill are based on two designs currently under consideration and range from approximately \$26 to \$45 per CY of CCR material excavated from the existing CCR units at the Glen Lyn Plant. The unit rate includes construction and installation costs associated with landfill design and permitting, operational costs associated with transporting and placing of CCR from the Glen Lyn Plant in the new landfill, and anticipated closure costs.

Conclusion and Recommendations

AEP completed a site investigation and developed an RFP solicitation process to identify viable options for the beneficial use of the CCR materials at the Glen Lyn Plant's Existing Landfill and Aux Pond in response to HB 443. Two complete bids were received and evaluated for this purpose.

Bidder #1 presented a potential cost savings when compared to the on-site landfill options but was unable to provide sufficient evidence that their end-product is fully compliant with the CCR Rule definition of encapsulated beneficial use and has not received the necessary certifications to allow for the use of their product in vertical construction in the United States. To further consider Bidder #1's technology as a viable option, a beneficial use demonstration should be considered using CCR material from the Glen Lyn Plant following the United States Environmental Protection Agency's (EPA) Leaching Environmental Assessment Framework (LEAF) protocols to establish leachability of metals and other constituents from their proposed end-product.

Bidder #2 proposed to beneficially use the CCR material as cement kiln feed; however, the annual off-take volume is significantly limited, and this option does not present a potential cost savings on a per cubic yard basis when compared to current on-site landfill estimates. Kiln feed may be considered during CCR unit closure activities to reduce landfill airspace requirements through a direct contract between AEP and the kiln to reduce costs and limit conflicts with unit closure operations.

Through completion of the RFP solicitation process and continued communication with bidders, it has been determined that several factors present limitations to beneficial use options at Glen Lyn. These factors include, but are not limited to, site constraints, regional market competition for beneficially used CCR material, and limited existing rail and natural gas infrastructure available on-site. Based on the review and analysis of information collected throughout the development of this Initial Biennial Report, there is currently not a viable beneficial use process providing a clear cost savings when compared to the identified lowest-cost approved alternative, an on-site landfill.

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Acronyms and Abbreviations

ACAA	American Coal Ash Association	LEAF	Leaching Environmental Assessment Framework
AEP	American Electric Power	MW	megawatt
Aux Pond	Auxiliary Pond	N/A	Not Applicable
BU	beneficial use	NP	not provided
CCR	coal combustion residuals	PC	Portland Cement
CSM	Conceptual Site Model	RFI	Request for Information
CY	cubic yard(s)	RFP	Request for Proposal
DEQ	Virginia Department of Environmental Quality	SAI	Strength Activity Index
EPA	Environmental Protection Agency	VDOT	Virginia Department of Transportation
HB	House Bill		
ICC	International Code Council		

1 Introduction and Objective

American Electric Power (AEP) conducted a site characterization investigation and issued a formal request for proposal (RFP) package to aid in the completion of a beneficial use assessment for coal combustion residuals (CCR) currently stored at the inactive Glen Lyn Plant in Glen Lyn, Virginia. Commonwealth of Virginia House Bill No. 443 (HB 443), enacted in 2020 and codified into legislation under section § 10.1-1402.04 of the Code of Virginia, requires AEP to accept and review proposals from beneficial use vendors and provide reporting on the evaluation of the received bids. The RFP included beneficial use of CCR material from two inactive CCR units at the Glen Lyn Plant. A third CCR unit identified as the Bottom Ash Pond was not included in the beneficial use assessment. The intent of the beneficial use assessment is to summarize and evaluate the information gathered during the site investigation and RFP process, and to:

- Identify viable options for beneficial use of the landfilled and/or impounded CCR material at the Glen Lyn Plant,
- Quantify the volume of CCR that may be suitable for beneficial use,
- Establish the anticipated duration of a beneficial use project,
- Provide anticipated costs associated with on-site or off-site beneficial use of CCR,
- Define the potential market demand for beneficially used materials, and,
- Evaluate transportation impacts and considerations for on-site and/or off-site beneficial use options.

Table 1 provides information on the Glen Lyn Plant’s CCR units included in the site investigation and RFP process.

Table 1: Glen Lyn Plant - Site Information

Power Station	CCR Units	Estimated CCR Volume (CY)	Area (acres)
Glen Lyn Plant	Existing Landfill	4,650,000	46.0
	Auxiliary Pond	630,000	12.4
Total		5,280,000	58.4

1.1 Objective

The objective of this assessment is to determine the viability of beneficially using CCR materials from the two CCR units at the Glen Lyn Plant and to collect information related to beneficial use options by requesting proposals from potential bidders capable of executing the full scope of work presented in the RFP.

This initial Biennial Report presents a detailed timeline of the RFP development and solicitation process and summarizes the information received from the bidders, including potential options for beneficial use of landfilled or impounded CCR, the quantity of CCR that can be beneficiated, as well

as benefited product market demand, transportation impacts, and the related costs, as provided by the bidders, for beneficial use of the material.

Development of the RFP and this Biennial Report supports AEP's response to HB 443, Closure of Certain Coal Combustion Residuals Impoundments; Giles and Russell Counties.

1.2 Virginia House Bill 443 (2020)

HB 443, enacted by the General Assembly of Virginia and signed by Governor Ralph Northam on March 31, 2020, requires closure by removal of CCR units in Giles and Russell Counties and establishes cost recovery guidelines for electric utility providers.

The bill requires that the owner or operator of CCR units that had not completed final closure and post-closure care activities prior to January 1, 2019, move forward with the closure of all CCR units by removing all CCR from the existing landfills or impoundments and disposing of the material either by recycling the CCR via encapsulated beneficial use, disposing of the CCR material at a new on-site landfill meeting all Virginia Solid Waste and federal standards (composite liner and leachate collection system), or by transporting the material off site to an approved waste disposal facility capable of handling CCRs. Beneficial use of the CCR material must be considered, and per the house bill, *“the owner or operator shall beneficially reuse CCR removed from its CCR unit if beneficial use of such removed CCR is anticipated to reduce costs....”* The bill also requires operators to complete closure of the units within 15 years of the start of excavation activities.

Additional conditions of HB 443 include the following items:

- Development of a transportation plan for projects that involve off-site transportation of CCR to *“minimize impacts to adjacent property owners and surrounding communities.”*
- Acceptance and review of proposals for encapsulated beneficial use every four years beginning July 1, 2023.
- Prioritization of local workforce utilization.
- Completion of a biennial report containing summary and analysis of the beneficial use proposals received within a two-year reporting timeframe beginning no later than October 1, 2023. The biennial report is to be submitted to the Commonwealth of Virginia and posted on a publicly accessible website.

1.3 Beneficial Use Criteria

The CCR units at the Glen Lyn Plant are not currently regulated under the federal CCR Rule, however the rule provides the framework for the definition of encapsulated beneficial use that is accepted as the industry standard and meets the requirements of HB 443. The federal CCR Rule requires beneficial use applications to meet specific criteria, as shown in **Exhibit 1**.

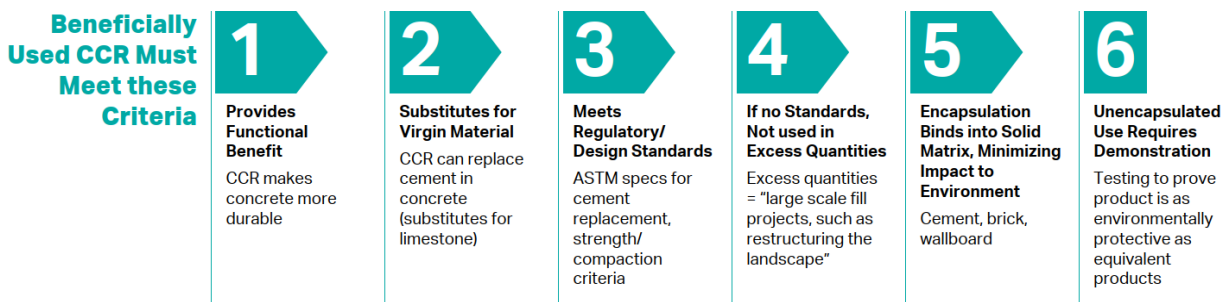


Exhibit 1: CCR Rule Beneficial Use Criteria

The RFP issued by AEP required encapsulated applications of beneficial use of CCR due to the environmental protections provided by encapsulation. Based on the AEP requirement and these criteria, the most common processes that may be appropriate for the CCR at Glen Lyn are the creation of a building/construction product (such as brick or aggregate), the processing of the CCR to meet fly ash standards for use as a Portland cement (PC) substitute in concrete, and direct kiln feed of unprocessed CCR for cement manufacturing at an off-site facility.

1.4 Project Requirements

The project requirements included in the RFP ensure that production of beneficiated CCR materials from the Glen Lyn Plant meet all regulatory requirements while offering complete environmental protection throughout the project life cycle. These project requirements include meeting the CCR Rule definition of encapsulated beneficial use, developing a transportation plan in accordance with HB 443, and completing beneficial use activities within a timeframe that allows any additional closure activities to be completed within the 15-year regulatory timeframe. The RFP also required vendors to become signatories to the National Maintenance Agreement, to support the prioritization of local labor and establish union labor rates for the project. Details related to the RFP’s scope of work and AEP proposal requirements are provided in **Section 3** of this report.

1.5 Biennial Report Contents

This Biennial Report describes the site investigation process in **Section 2**, the beneficial use solicitation process in **Section 3**, summarizes and evaluates individual bid offerings in **Section 4**, including compliance with HB 443 requirements and descriptions of incomplete bids. **Section 5** provides information and costs related to construction of an on-site lined landfill, which has been identified as the lowest cost alternative to beneficial use of the CCR materials at the Glen Lyn Plant. A conclusion evaluating the viability of beneficial use options presented by qualified bidders and their potential to provide a cost reduction when compared to the lowest-cost alternative (on-site landfill) is provided in **Section 6**.

2 Site Investigation Process

On behalf of AEP, AECOM Technical Services, Inc. (AECOM) conducted a site investigation of the CCR materials currently located in the existing closed fly ash landfill (Existing Landfill) and closed Auxiliary Fly Ash Pond (Aux Pond) units at the Glen Lyn Plant. Previous data collected from historical site investigations and available geotechnical reports were reviewed and utilized to guide the investigation process. Samples collected from drilled boreholes were analyzed for physical and chemical characteristics to determine suitability for beneficial use.

2.1 Site History

The Glen Lyn Plant opened in 1918 when the first of six generating units were installed. Unit 5 was established and began producing power in 1944 at 100 megawatts (MW) and was, at the time, the largest power generator in the southeastern United States. A sixth unit was installed and began operation in 1957, adding an additional 238 MW of power generation to the plant. At peak capacity, the Glen Lyn Plant had a 338 MW power generation capacity and ceased power generation in 2015. Throughout its operation, the plant generated fly ash and bottom ash, which was placed in ponds onsite. The unit referred to as the Existing Landfill, was converted to a dry fly ash landfill following Virginia Department of Environmental Quality (DEQ) approval of an amendment to the Glen Lyn Plant's Solid Waste Permit in 1994. The Auxiliary Fly Ash (Aux) Pond was closed per Virginia Surface Water Protection rules between 2010 and 2014.

2.2 Field Investigations

An initial site investigation to characterize the CCR was completed between March 29th and April 4th, 2022, with 16 boreholes advanced at the site. Thirteen boreholes were located at the Existing Landfill, and three were located at the Aux Pond, with samples collected at 5-foot intervals. A total of 30 samples were analyzed in the initial investigation, with 25 of those samples analyzed from the Existing Landfill and 5 from the Aux Pond. A supplementary site investigation was performed between May 31st and June 2nd, 2022, when an additional eight borings were advanced at the Existing Landfill, and 31 samples were analyzed.

Upon completion of the drilling events, repairs were made to the closure cap system to return the units to their existing condition. New geotextiles were applied to each open borehole, welded to the existing system, tested for integrity using non-destructive methods, and covered with seed and straw following soil replacement.

2.3 Laboratory Analysis

The CCR samples were analyzed based on ASTM C618 (C618) specifications and other chemical and physical parameters consistent with previous CCR investigation work completed in Virginia in support of beneficial use evaluations.

The C618 standard is widely used because it clearly defines the material properties associated with the use of fly ash as a pozzolan material used as an admixture in concrete (ASTM, 2019). All data

collected during the investigation was compared to Class F fly ash criteria due to the calcium oxide (CaO) content of the CCR material found at Glen Lyn. Testing was completed on 61 samples for the chemical parameters and 32 samples for the physical parameters of C618, except for gradation, which was run on all 61 samples. The CCR samples were compared to the ASTM C618 criteria, and statistical analysis of each analyte was completed to include the range of concentrations and median values for each criterion, as seen in **Table 2** below.

Table 2: ASTM C618 - Summary of CCR Sample Analytical Data

Parameter	Sub-parameter	Criteria	Min – Max (%)	Median (%)	% of Samples Meeting Criteria
Chemical	Primary Oxide Sum ¹	Min 70%	74.0 – 90.1	82.7	100
	CaO	Max 10%	0.6 – 5.5	1	100
	Sulfur Trioxide (SO ₃)	Max 5%	0.1 – 0.5	0.3	100
	Moisture, as received	Max 3%	12.1 – 44.9	20.6	0
	Loss on Ignition (LOI)	Max 6%	3.6 – 20.2	10.5	5
Physical	Soundness	Max +/- 0.8%	0.1 – 0.2	0.1	100
	Fineness (% retained on #325 mesh)	Max 34%	8.2 – 90.6	28	70
	Water Requirement	Max 105%	93.0 – 101.2	96.7	100
	7-day Strength Activity Index (SAI)	Min 75%	75.1 – 102.0	88.1	100
	28-day SAI	Min 75%	77.9 – 103.8	91.7	100

¹ Primary Oxide Sum consists of Aluminum Oxide (Al₂O₃), Silicon Dioxide (SiO₂), and Iron (III) Oxide (Fe₂O₃)

As seen in the above table, the most common issues with the CCR material at Glen Lyn were high as-received moisture content, high carbon content (as measured by loss on ignition), and insufficient material fineness. Each of these parameters can be addressed through further processing of the material.

The sampling results were also compared to criteria typically used by the cement kiln industry for use as raw (unprocessed) kiln feed. Cement kilns commonly use CCR as a feedstock, burning unprocessed ash in combination with other raw materials to produce clinker, a precursor of Portland cement. Cement kilns can accept CCR with higher moisture content and LOI concentrations than those found in the C618 fly ash specifications. The CCR samples were compared to the cement kiln feed criteria, and statistical analysis of each analyte was completed to include the range of concentration and median values as seen in **Table 3**.

Table 3: Cement Kiln Feed - Summary of CCR Analytical Data

Parameter	Criteria	Min – Max (%)	Median (%)	% of Samples Meeting Criteria
Moisture	Max 20%	12.1 – 44.9	20.6	44
Particle Size	Max 1/2"	94.6 – 100	100	98
Loss on Ignition	Max 15%	3.6 – 20.2	10.5	95
Aluminum Oxide (Al ₂ O ₃)	20 – 30%	7.0 – 27.1	24.8	95
Silicon Dioxide (SiO ₂)	40 – 55%	46.0 – 73.0	51.7	82
Iron (III) Oxide Fe ₂ O ₃	5 – 15%	3.3 – 11.6	6.2	90
Mercury (Hg)	Max 0.7 ppm	0.04 – 0.5	0.3	100

Additional geochemical and physical analyses were performed on select samples to further characterize the CCR for beneficial use suitability. Certain beneficial use technologies have additional limits on parameters such as sulfur, mercury, ammonia, and other heavy metals that affect the technology's efficiency and present permitting and waste management challenges.

2.4 Data Visualization

AECOM developed visualization tools in the form of a C618 dashboard and a 3D graphic conceptual site model (CSM) to spatially analyze the data and operate as a general tool for supporting high-level decision making regarding potential beneficiation options.

2.4.1 C618 Dashboard

A summary dashboard was developed to provide a point of reference for the CCR unit's key C618 data. Depicted on the dashboard is background site information such as the CCR unit area and volume, number of borings completed, number of samples tested, a site aerial showing boring locations, and tables illustrating the parameters most often used to determine if CCR material is acceptable for beneficial use. The dashboard summary includes scatter point graphs showing concentrations for moisture content, loss on ignition, fineness, mercury content, sulfur, and calcium oxides, and the sum of primary oxides is presented with the y-axis depicting the elevations, which allows for quick analysis of site material. Two tables break down the C618 Class F fly ash properties, typical properties for cement kiln feed, and the number of samples taken during the investigation that meet and do not meet the criteria.

The data visualization provided in the dashboard is meant to assist in high-level decision making regarding the beneficial use of the CCR materials and does not correlate with the horizontal relationship between samples collected. The C618 dashboard and laboratory data collected during the site investigation were provided to bidders during the RFP process.

2.4.2 Conceptual Site Model

CTech's Earth Volumetric Studio™ was used to create 3D CSM rendering of the data collected from the Existing Landfill and Aux Pond investigations. The CSM incorporates site boundary information, top and bottom of CCR surface elevations, soil boring data, approximate groundwater elevations,

and ash characterization results. Analytes considered most relevant for beneficiation, such as the C618 and cement kiln feed parameters, were modeled in this tool and presented to bidders during the solicitation process to provide spatial context to locations within the Landfill and Aux Pond best suited for potential beneficial use.

3 Beneficial Use Solicitation Process

In June 2022, AEP and AECOM developed a solicitation process designed to obtain proposals from qualified contractors for beneficiation of ponded & impounded CCR from the Glen Lyn Plant. Proposals would need to include the quantity of CCR materials suitable for beneficiation, the costs for such beneficiation, and the actual market for the beneficiated materials. This process included:

- Identifying and informing qualified contractors,
- Preparing a comprehensive RFP package to obtain accurate, competitive pricing and market conditions,
- Summarizing the proposals, and,
- Evaluating the information provided by the bidders.

The solicitation process and related timeline are outlined in **Exhibit 2** and **Exhibit 3**.

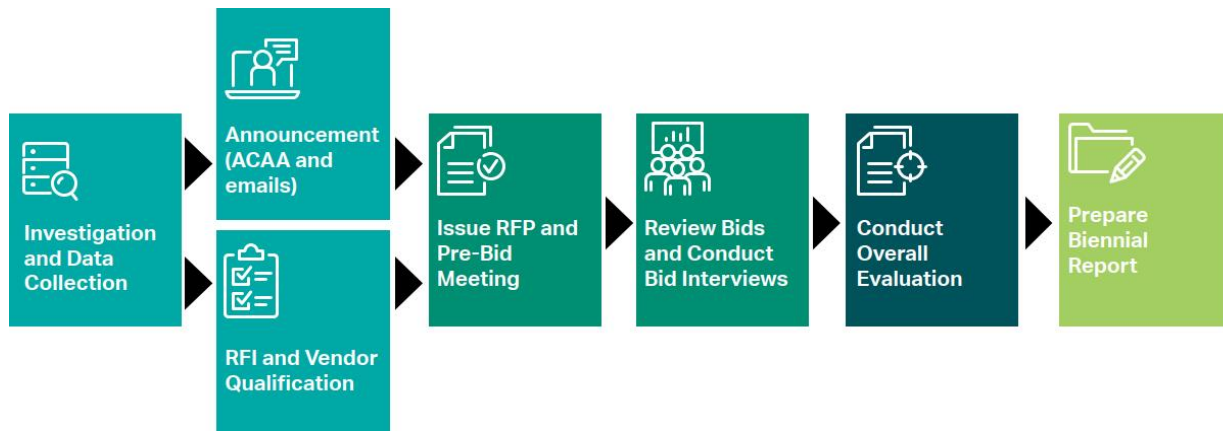


Exhibit 2: Beneficial Use Solicitation Process Flow Chart

Task	Duration	2022					2023									
		8	9	10	11	12	1	2	3	4	5	6	7	8	9	10
Outreach and Information Gathering	8/29/22-10/10/22	●	●													
Notice of RFP process distributed to regional and national BU vendors																
39 vendors submitted questionnaires/BU RFI requests																
35 vendors attended the informational meeting																
RFP Development and Response	11/30/22-2/24/23				○	●										
RFP issued to 9 shortlisted BU vendors																
Mandatory pre-bid meeting and site visits with BU vendors																
12 RFI responses issued																
3 Bids received																
Bid Evaluation	2/24/23-5/26/23									○	●					
Initial Review																
Interview/Follow-up questions																
Biennial Report Development	4/21/23-10/1/23															
Submit report to Commonwealth of Virginia																

Exhibit 3: Glen Lyn Plant Beneficial Use Solicitation Process Timeline

Following receipt of bidder proposals, a rigorous review of the offerings was conducted, incorporating the evaluation factors shown in **Exhibit 4** and applied to complete bids received as described in **Section 4** of this report.

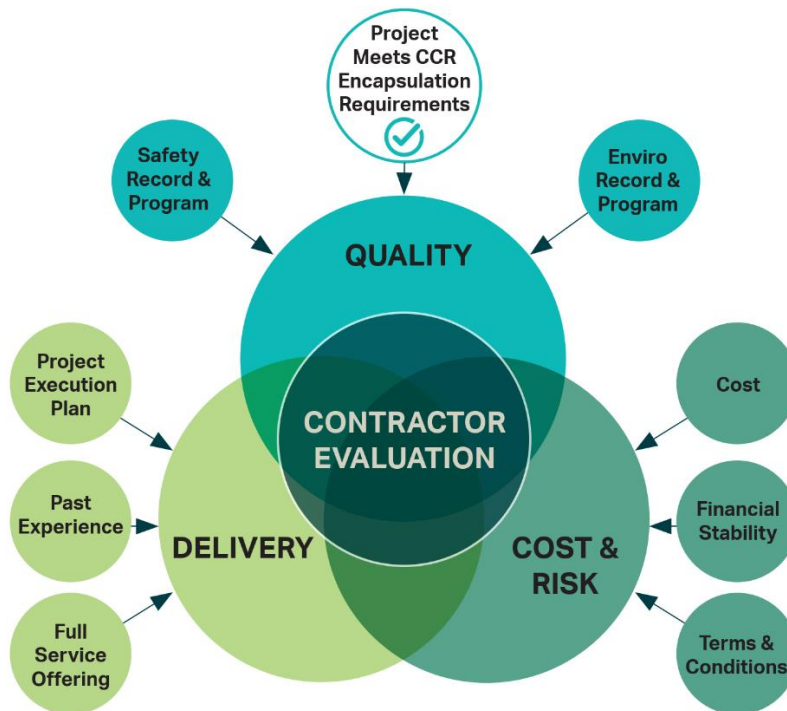


Exhibit 4: Bid Review Process

3.1 Initial Outreach

Initial outreach to potential bidders began on August 29, 2022. An email was sent to a list of previously identified beneficial use vendors with information related to the project, and the American Coal Ash Association (ACAA) advertised the potential beneficial use project to its members via an electronic newsletter. ACAA members include most regional and national firms involved or interested in management of CCR materials. The initial bidder list was developed based on firms known to have experience with similar projects including beneficial use vendors and CCR marketers, civil contractors experienced with CCR excavation/handling services, and dewatering/water treatment contractors. A flyer providing the date, location, and project background information related to an informational meeting with the request that suppliers RSVP by September 16, 2022, was created to accompany the announcement. Forty-eight contractors/firms were sent the project flyer after replying to the initial outreach and invited to the informational meeting.

A dedicated email address (AEP_BeneficialUse@aecom.com) was established for communications with interested parties on August 29, 2022. The email address was monitored daily, and responses to questions or other communications were promptly provided. The email address remained active for communications throughout the solicitation and evaluation processes.

3.2 Informational Meeting

AEP held the informational meeting on September 21, 2022, at the Charleston Convention Center, in Charleston, West Virginia, for vendors and contractors interested in bidding the beneficial use of CCR from the Glen Lyn Plant. Interested firms were asked to RSVP to attend, and attendance was limited to three personnel per firm. Prior to attending the meeting, each firm was required to sign and submit a non-disclosure agreement.

Out of the 39 firms that responded to the initial outreach, 35 firms and 66 individuals attended the informational meeting as prospective bidders. During the informational meeting, AEP and AECOM went through a presentation providing general project details including site background, the site investigation and data characterization, and provided an overview of the RFI/RFP process and anticipated schedule. Following the presentation attendees were able to ask questions, and contractors were encouraged to submit written questions via email following the meeting.

On September 22, 2022, a PDF copy of the slide deck presentation and list of meeting attendees were provided to all meeting attendees. A list of questions asked, and the subsequent responses provided during and closely following the meeting were provided to the potential bidders on September 30, 2022.

3.3 RFI Questionnaire

Of the 48 contractors/firms initially contacted, 39 responded and were sent a request for information (RFI) questionnaire. The RFI questionnaire was separated into Section I - Pre-Screening Criteria and Section II - Technology Assessment. Information requested in Section I included bidder contact data, a summary of the bidder's proposed beneficiation process/technology and end-product, and how the end-product meets the CCR Rule encapsulation requirements. Section II included information such as a description of the beneficial use process, anticipated environmental impacts and permit requirements, a statement of interest and potential teaming arrangements, annual throughput and market demand data, anticipated on-site layout and infrastructure needs, and CCR quality specifications for raw material delivered to the beneficial use process. The information was required to be submitted by October 10, 2022. Following the informational meeting, 23 RFI questionnaires were received, indicating continued interest in the project.

3.4 RFP Package

Out of the 23 RFI questionnaires received, 11 vendors were short-listed to receive the RFP package. Nine vendors completed all registration requirements and were provided the RFP through Ariba on November 30, 2022. Civil contractors were excluded from receiving the RFP but were provided the list of shortlisted beneficial use vendors upon request to encourage partnership between firms.

The RFP package solicited a full-service offering, including civil excavation and processing of CCR for beneficial use and was developed to obtain accurate, competitive, and comparative pricing for the scope of services. The RFP package included the following documents:

- Scope of Work
- Proposal Requirements
 - Proposal Instructions
 - Cover Letter Template
 - Required Forms (labor rates, equipment rates, subcontractors, exceptions)
 - Bid Form
- AEP Terms and Conditions
- AEP Safety and Health Requirements
- AEP Environmental Requirements
- Project Technical Requirements
 - Beneficial Use Project Technical Statement of Work, Drawings, and Technical Specifications
 - Pay Item Descriptions
 - AECOM Site Investigation Report, Data Visualization Dashboard, existing geotechnical information, and applicable permits
 - List of Civil Contractors
- AEP Project Control Requirements

To capture all tasks and costs required to beneficially use the landfilled/impounded CCR, the “full-service offering” was defined as:

- Obtaining applicable permits to start construction,
- Mobilization of personnel, equipment, and materials,
- Establishment and connection to required utilities,
- Excavation and removal of the protective cover layer soils and geosynthetics,
- Dewatering and management of generated contact water,
- Excavation and processing of CCR prior to beneficial use,
- Beneficial use of suitable CCR material,
- Stockpiling unsuitable materials within the CCR unit boundary,
- Transportation and disposal of unusable/waste products from the beneficial use process; and,
- Marketing and distribution of the end-product.

Two primary work components were identified to adequately evaluate the viability and cost of beneficiating the CCR material at Glen Lyn: the material handling/civil work required to excavate and

condition the CCR, and the beneficial use process component including transportation and distribution of the beneficiated end-product. Restoration of the CCR units and water treatment were not included in the scope of work but will be required to achieve clean closure of the units. The civil components include:

- Dewatering and contact water management,
- Excavation, handling, and any on-site transportation of the protective cover soil and CCR material,
- Handling and on-site transportation of unsuitable CCR or other materials to a stockpile, and,
- General conditions, mobilization, and demobilization costs.

The beneficial use process items include:

- Design, planning, permitting, construction, and operation of a beneficial use processing system,
- Furnishing, installing, operating, storing, and maintaining all buildings, systems, and infrastructure required to manufacture the beneficiated product, and,
- Costs related to marketing, distributing, and selling the end-product.

For the purposes of this Biennial Report, only the costs associated with the beneficial use of CCR materials were used in the comparison to the lowest-cost alternative presented in **Section 5**.

3.5 Pre-Bid Meeting and Site Visit

A mandatory pre-bid meeting was held for the shortlisted bidders registered in Ariba on December 13, 2022, in Princeton, West Virginia. AEP and AECOM personnel delivered a presentation summarizing the project overview; AEP requirements for safety and health, environmental compliance, contractor environmental documents, and project controls; project scope overview; RFP document review; and the contractor selection criteria. Bidder questions were answered and recorded. Twenty-two individuals from 12 firms, including the beneficial use vendors and their civil contracting partners, were present at the pre-bid meeting.

Immediately following the pre-bid meeting, a site visit was held at the Glen Lyn Plant. Bidders were transported to the CCR units by bus and provided tours by AEP personnel. Bidders were asked to submit any questions in writing to ensure that all bidders received the same information in written responses from AEP.

3.5.1 RFI Questions and Answers

Bidders submitted questions via RFIs after the pre-bid meeting and site visit, with final questions due January 20, 2023. AEP provided final responses to RFIs on January 16, 2023.

3.6 Bid Offerings and Bid Interviews

Bid responses were due to AEP on February 20, 2023. The bids were reviewed and summarized during this part of the solicitation process, and post-bid interviews were held to assist the AEP and AECOM project team during the evaluation process. Bid offering summaries and evaluation details are described further in **Section 4**.

3.6.1 Bid Responses

A total of three bidders provided responses to the RFP on or before February 20, 2023. A summary of bid responses is provided in **Section 4**.

3.6.2 Bid Interviews

Bidder interviews were conducted on April 13, 2023, at the AEP headquarters in Columbus, Ohio, for the two bidders who provided complete RFP responses meeting AEP proposal requirements. The post-bid interview aimed to provide bidders the opportunity to present proposal highlights and provide further clarification to their bid. Prior to the interviews, a list of clarification questions was provided to each vendor to help guide the in-person presentation. Bidders provided written responses to their proposal clarification questions following the interviews.

4 Beneficial Use Bid Offerings and Evaluation

A summary of bid offerings is provided for the Glen Lyn Plant in **Table 4**, with individual bid offerings described in the following sections.

Table 4: Glen Lyn Plant Compliant Bid Offering Summary

Bid Offering Summary	Glen Lyn Plant (5,280,000 CY)	
	Bidder #1	Bidder #2
Process/Technology	Thermo-electric Beneficial Use	Harvest CCR for Cement Kiln Feed
End-Product	Roman Cement for Ready-Mix Industry	Cement Kiln Feed
Meets CCR Rule Definition of Encapsulated Beneficial Use?	Demonstration Required	Yes
Volume of CCR BU (CY)	5,227,200	333,333
Product Market for BU CCR (CY/YR)	636,000	66,667
Geographic Market for BU CCR	Domestic: TN, NC, TX, LA, MS, AL, FL International: Middle East, Caribbean, South America	VA
Product Transportation Method	Rail & Trucking	Trucking
# of Trucks/Railcars	214 trucks/day	18 trucks/day
	Rail Information Not Provided	
Project Duration (Years)	11.5	5
Bid Pricing Summary		
Total BU Price/CY Pond Volume	\$25.02	\$35.53

BU = beneficial use; CCR = coal combustion residuals; CY = cubic yards;
PC = Portland cement; YR = year

4.1 CCR Rule Encapsulated Beneficial Use Compliance

Table 5 provides a summary of CCR Rule beneficial use compliance criteria and whether individual bidders meet each of the criteria.

Table 5: Bidder Compliance with CCR Rule Beneficial Use Criteria

Does Bidder Meet CCR Rule Criteria?						
Bidder	Complete Proposal Response Provided	Provides Functional Benefit	Substitutes for a Virgin Material, Conserving Natural Resources	Meets Product Specifications, Regulatory/Design Standards (If Available)	When Standards Are Not Available, Not Used in Excess Quantities	Encapsulated Beneficial Use Binds CCR into a Solid Minimizing Mobilization into the Environment
Bidder #1	Yes	Yes	Yes	Unclear for Domestic Use	Yes	Demonstration Required
Bidder #2	Yes	Yes	Yes	Yes	N/A	Yes
Bidder #3	No	N/A	N/A	N/A	N/A	N/A

4.2 Beneficial Use Technology Description

The two types of on-site beneficial use proposals for the landfilled/impounded CCR at Glen Lyn are (1) processing of the ash to produce a powdered ready-mix end-product for use in the concrete industry, and (2) thermal processing of the material to create a lightweight aggregate. The proposed method for producing a ready-mix material involves thermal curing and the implementation of thermoelectric reactor to break down both imported raw materials (limestone, gypsum, and bauxite) and CCR to their chemical components prior to recombination to produce a solid material that is then further processed to produce a powdered material. Cementitious product manufacturing processes include mixing the CCR with binders/reagents and thermal production of materials such as brick, block, or aggregate. Unprocessed CCR may also be used as direct kiln feed for the cement manufacturing industry.

General descriptions of these beneficiation processes are provided in the following subsections.

4.2.1 GreenMix™ (Portland Cement Alternative)

Decomposition reactors utilize electrosynthesis to separate feedstocks of imported raw materials (limestone and gypsum) and CCR material into their elemental forms prior to re-combining the reactive materials into a pozzolan material that can be used in the production of concrete. A separate proprietary technology enables removal of heavy metals typically seen in CCR.

4.2.2 Concrete Aggregate

Due to the cementitious properties of CCR materials, coal ash can be used as primary material in manufacturing concrete products such as blocks, bricks, and aggregate material.

4.2.3 Cement Kiln Feed

Unprocessed CCR material can be used as an alternate raw material directly fed into the cement kiln manufacturing process. The CCR replaces or supplements other raw feedstocks, such as clay and lime, to produce clinker materials used to create Portland cement. Available data show only one cement manufacturing plant (cement kiln) in Virginia (Roanoke Cement Company).

4.3 Complete Bid Offerings

Two bidders submitted complete bids. A summary of the bid offering and details of the beneficial use interviews can be seen below.

4.3.1 Bidder #1

Bidder #1 Bid Offering Summary

Bidder #1 proposes to excavate the entirety of CCR material in the Aux Pond and Existing Landfill (approximately 5,227,200 cubic yards) over a project duration of 11.5 years and beneficiate the CCR by combining the material with additives such as limestone and gypsum, in a thermo-electric reactor to create a cementitious ready-mix material that does not require the addition of Portland cement. An on-site beneficiation plant would be established first within the Aux Pond footprint to process approximately 2,500 tons of CCR material per day excavated from the Existing Landfill and then relocated to the Existing Landfill to beneficiate the Aux Pond. Based on information provided in the proposal, half of the material will be transported via pneumatic tanker trucks to local markets within a 250-mile radius, such as Knoxville, Tennessee; Charlotte, North Carolina; and the Research Triangle in North Carolina. The other half of the material will be railed and commercialized in ready-mix markets in Texas, Mississippi, Alabama, and Florida. Bidder #1 also presented an option that involved marketing up to 100% of the material internationally should the domestic market become oversaturated. To reach the international market, the end-product will be railed from Glen Lyn to the Port of Norfolk, where it will be shipped to markets in the Middle East, Caribbean, and South America.

Bidder #1 proposes to utilize approximately 3,000 tons per day of imported materials, requiring 139 triple-axle trucks per day to deliver materials. To meet the project schedule and beneficiate the entirety of the CCR materials currently stored in the Existing Landfill and Aux Pond, Bidder #1's process will operate on a five-day-per-week, 24-hour-per-day schedule, receiving imported materials throughout the day and night.

Approximately 75 pneumatic trucks will export the end-product daily. Bidder #1 proposes to construct a pneumatic conveyor system to transport their end-product approximately 0.5 miles from the CCR units to a rail loadout facility serving an existing rail siding adjacent to the Glen Lyn Plant. Limited information was provided on the number of rail cars and rail trips required to transport materials to the domestic and international end-users identified in the proposal.

Bidder #1 was invited to attend a post-bid interview on April 13, 2023, following submittal of their proposal to allow further elaboration and to provide responses to proposal questions submitted before the meeting. Bidder #1 provided an overview of their project approach, key points from their proposal, and company information such as financial strength and safety ratings. The proposed beneficial use process and technology were discussed, and samples of the end-product were presented. Throughout the interview process, additional questions and comments regarding process viability were raised. Following the interview, Bidder #1 provided documentation, including

international off-take agreements for acceptance of the material, the interview presentation, as well as written responses to the provided proposal questions.

Bidder #1 Bid Offering Evaluation

Bidder #1 is proposing to produce a new-to-market cementitious material that is an alternative to Portland cement. This product is not a traditional Portland cement replacement, which is a proven beneficial use process approved by the United States Environmental Protection Agency (EPA) allowing for up to 40% of Portland cement used in concrete mixes to be replaced with C618 quality fly ash (US EPA, 2014). AEP requested testing data from Bidder #1 for any Leaching Environmental Assessment Framework (LEAF) documentation available for CCR materials previously processed through their beneficial use technology, which the vendor was unable to provide. Without this data, it is not clear if the technology meets the requirements for encapsulation, and further demonstration is necessary to support information provided in the proposal. The RFI questionnaire submitted by Bidder #1 included a different end-product than the GreenMix™ included in their formal proposal, which would be considered a Portland cement replacement and meets the definition of encapsulated beneficial use. Due to the price volatility of Portland cement, Bidder #1 is no longer producing this material.

The domestic market demand for GreenMix™ is difficult to define based on the information provided in the proposal. Letters of intent were provided for potential domestic material marketers showing interest in entering purchase agreements for the material if it can be proven to meet or exceed Portland cement material specifications, be purchased at a lower price than Portland cement, and logistical costs for transporting the material from Glen Lyn to their distribution centers are deemed reasonable. Bidder #1 has indicated that the GreenMix™ material is currently undergoing code rating by the International Code Council (ICC), but they have not received any certifications to date. These certifications allow for the GreenMix™ material to be specified for domestic projects, but it is unclear what additional steps may be required to push this product into the commercial market capable of handling the large quantities of GreenMix™ produced.

Due to the potential challenges associated with bringing this new product into the domestic market, Bidder #1 has produced a signed agreement with an international end-user capable of receiving 100% of the vendors end-product. This option would require all GreenMix™ to be transported by rail to a shipping terminal at the Port of Norfolk, prior to international distribution. The agreement clearly shows that the end-user will accept all materials and cover all transportation costs, therefore, it can be determined that although a domestic market may not be clearly defined, an international market is available to absorb the 1,050,000 tons of GreenMix™ produced annually at Glen Lyn.

The trucking required to import raw materials presents a significant increase in traffic to the Virginia Department of Transportation (VDOT) maintained secondary road that services the Existing Landfill and Aux Pond. Bidder #1 has indicated that they have coordinated with the Town of Glen Lyn to reduce traffic impacts; however, the wear and tear of continuous trucking over an extended project duration will require regular roadway maintenance and potential improvements, including additional VDOT-permitted site entry and exit locations. If the end-product is marketed domestically, Bidder #1 anticipates that an additional 75 trucks per day would be required and has provided a plan to stage

these trucks at an off-site location to coordinate loading of trucks to reduce or eliminate the potential for traffic back-ups on the primary and secondary roads servicing the site.

The existing accessible rail infrastructure at the Glen Lyn Plant is limited; however, the Plant is adjacent to a Norfolk Southern mainline, and an existing rail siding may be utilized. Improvements to the existing rail infrastructure are anticipated to allow for direct loading of rail cars from silos fed by the proposed pneumatic conveyor system. Bidder #1 has indicated that coordination with the railroad company has not commenced but is confident that modifications can be completed to construct their loading facility. Further coordination will also be required with AEP and the Town of Glen Lyn to maintain access to the Plant and a public road that serves a residential area adjacent to the property during train building operations.

Bidder #1's anticipated cost to beneficiate 6,272,640 tons of CCR material over 11.5 years is approximately \$25.02/CY. This unit rate includes construction and operation of the on-site beneficiation system, truck and rail load-out systems, leasing of the off-site loadout yard, transportation costs associated with importing of raw materials, waste disposal costs, and beneficial use plant demolition. As previously stated, this unit rate does not include any costs associated with off-site transportation of the end-product but does include anticipated costs to cover routine roadway maintenance. A credit of \$1/per ton of GreenMix™ sold is included in this unit rate. Based on Bidder #1's estimates, 10,560,000 tons of GreenMix™ will be produced from the combination of raw imported materials and CCR excavated from the units.

The unit rate provided by Bidder #1 does indicate that a potential cost savings is realized when compared to the anticipated landfill costs presented in **Section 5** of this report and beneficiates all the CCR material currently stored at the Glen Lyn Plant within the 15-year requirement. Several factors could significantly impact this unit rate based on assumptions made in the proposal and should be considered, including, but not limited to transportation costs associated with importing of raw materials, roadway and rail infrastructure improvements, rail loading and movement operations, and potential costs associated with extended transportation of the end-product to domestic markets. Based on information provided by the bidder in their proposal and subsequent interview, it is unclear if their bid includes the adequate contingencies to successfully complete the project at the price included their proposal.

4.3.2 Bidder #2

Bidder #2 Bid Offering Summary

Bidder #2 proposes to excavate 333,000 CY of CCR material from the Aux Pond over 5 years and market the unprocessed ash to a local cement kiln in Virginia as raw kiln feed. The duration of this process may be extended to beneficiate more material; however, the off-site disposal rate is static due to only having one cement kiln close enough to the site to justify the transportation costs associated with trucking the CCR material. Due to the physical and chemical properties of CCR, the cement kiln can only accept 80,000 to 100,000 CY of material annually to supplement the use of other raw materials in their process. Additional sampling of the Aux Pond will be required prior to

beneficial use to ensure the material to be excavated is consistent and meets the kiln's requirements for LOI and other constituents.

Bidder #2 was invited to attend a post-bid interview on April 13th to allow further elaboration on the proposed beneficial use option, and answer proposal questions that were submitted to them prior to the meeting. Bidder #2 provided an overview of their project approach and key points from their proposal as well as company information such as company background, history of working with CCR materials, and environmental and safety ratings. The beneficial use process was discussed, and responses to the provided questions were incorporated into the presentation. Following the interview, Bidder #2 provided written responses to the provided proposal questions. Additionally, meeting minutes were recorded to capture presentation details as well as additional questions/comments.

Bidder #2 Bid Offering Evaluation

Bidder #2 proposed to market 80,000 to 100,000 tons of CCR material per year to a central Virginia cement kiln. The offering is contingent upon the end-user's acceptance criteria, with no long-term assurance committing the bidder to produce a minimum volume of beneficiated material. The bidder considered additional cement kilns to increase the marketable volume of CCR material; however, due to the limited value of kiln feed and high transportation costs associated with long-haul trucking (>250 miles) or rail, this approach was not seen as economically competitive when compared to costs associated with an on-site landfill.

In response to the initial RFI questionnaire, Bidder #2 considered a thermal beneficiation option to produce a Portland cement substitute; however, upon receipt of further information provided in the RFP and completion of the site visit, thermal beneficiation was not deemed a viable option due to lack of existing utility infrastructure and logistical constraints presented by the site.

Bidder #2 proposed to subcontract nine on-road dump trucks to transport the CCR material to the cement kiln located approximately 60 miles from the site. Each truck would average two loads per day during a 9-month per year hauling window, generating approximately 400 tons of material sales per day. Per HB 443, a transportation plan detailing the proposed hauling routes and schedule is required prior to off-site beneficial use activities. The beneficial use option presented by Bidder #2 does not pose a significant increase to traffic volumes or require alternate trucking patterns required to enter and exit the site. Routine maintenance of the adjacent VDOT roadway and historical bridge located south of the site is included in the bid.

The anticipated cost to beneficiate 400,000 tons of CCR material over 5 years is approximately \$35.53/CY. This unit rate includes construction and operation of a truck load-out area with weigh scales, and the associated operations and maintenance costs for off-site hauling. The unit rate provided by Bidder #2 also includes an \$8/ton credit to be presented to AEP as a cost savings for all materials successfully marketed to the cement kiln.

Based on the anticipated landfill construction costs presented in **Section 5** of this report, and the limited annual volume of CCR material to be marketed as kiln feed, there is no indication that hauling material off site as raw kiln feed will provide a cost savings over the life of the project. Extending the

duration of the hauling efforts may allow for reduction in the size of an on-site landfill but is offset by operational challenges associated with required pond closure activities in the 15-year timeframe dictated by HB 443.

4.4 Incomplete Bid Offerings

One bidder submitted an incomplete bid as part of the RFP process. A summary of the bid can be seen below.

4.4.1 Industrial Development Advantage, LLC (IDA) – Bidder #3

Bidder #3 proposed to beneficiate all CCR material at the Glen Lyn Plant and produce a concrete aggregate end-product through an on-site thermal curing and crushing process. This bid was deemed incomplete because the vendor did not properly submit the bid through the Ariba system, and not all required elements of the proposal were included in the package submitted to AEP via email. Additionally, the vendor submitting the bid had not been registered in Ariba to receive the RFP package. Bidder #3 had previously partnered with a pre-qualified vendor who notified AEP that they would not be submitting a bid response. Due to receiving a non-compliant bid and limited information related to the proposed beneficial use technology and project approach, Bidder #3 was not invited to participate in a post-bid interview or considered for further evaluation.

4.5 Unresponsive Bidders

Nine beneficial use firms participated in the pre-bid meeting and site visit, but only three bids were received. Following the pre-bid meeting, two bidders reached out to inform AEP they would not be submitting a bid, citing challenges associated with the Glen Lyn site location, lack of direct market access, and limited available infrastructure making it difficult for their beneficial use technology to financially compete with costs associated with an on-site landfill.

Following receipt of bids, AEP reached out to unresponsive bidders invited to participate in the RFP who did not previously drop out or submit a bid, requesting feedback on specific factors that led to their decision to not provide a proposal for the project.

Feedback received from vendors indicated their bids were not submitted due to one or more of the following factors:

- Extended distance to cement plants and other end-users,
- Site geography and topography,
- Lack of infrastructure (no existing rail loading facility, on-site storage, electricity, natural gas, or water),
- Lack of sufficient truck access from both primary and secondary roads,
- Project labor requirements (participation in National Maintenance Agreement),
- Lack of major consumers of construction materials within 100-mile radius of the site,

- Other beneficial use projects in Virginia out for bid concurrently with the AEP, and,
- Inability to provide a bid with project capital expenditure and transportation costs lower than those assumed for an on-site landfill.

5 Landfill Construction Cost Estimate

5.1 Landfill Background

AEP is currently in the design and permitting phase for construction of an on-site landfill to be located on a property in Mercer County, West Virginia, adjacent to the Existing Landfill and Aux Pond CCR units. The proposed landfill is designed in accordance with West Virginia Code of State Regulations Title 33, Solid Waste Management Rule Section 3.7 for a Class F landfill capable of storing all CCRs currently located in three CCR units at the Glen Lyn Plant (Existing Landfill, Aux Pond, and Bottom Ash Pond). Construction of the proposed Adair Run CCR Landfill meets the requirements of HB 443 by providing a modern, lined landfill with adequate leachate collection and treatment capacity and stormwater management controls. A vegetated final cover system will be installed upon landfill closure, and post-closure monitoring and maintenance will be implemented for a period of 30 years.

5.2 Summary of Costs

Engineer's estimates have been prepared for the proposed landfill based on two design options currently under consideration. Included in the estimate are construction costs associated with installation of erosion and sediment controls, construction of the landfill perimeter berm and access/haul roads, subgrade preparation, geosynthetic liner system installation, and leachate collection and removal system and stormwater management system construction. Operational costs associated with transportation of CCR from the existing units, placement and compaction of CCR material within the proposed landfill, and quality assurance/quality control testing and certification are also included in the estimate, along with closure costs for capping the landfill unit.

Costs associated with an approximately 79-acre landfill range from \$26 to \$29 per cubic yard of excavated CCR material, while the estimated costs for a smaller footprint landfill (64 acres) range from \$33 to \$45 per cubic yard. The range in these estimates is based on anticipated rock removal required to prepare the landfill subgrade.

5.3 Limitations

The cost estimates provided are not considered bid-level estimates and have been prepared for project cost planning and permitting purposes only. These estimates should be considered Class 3 estimates (+30/-20%) based on design quantity take-offs and best engineering practices. All costs are presented in 2023 United States dollars based on prevailing labor and equipment rates, and applicable price indices.

Project costs that have been excluded from the proposed landfill unit rate estimates include impoundment closure costs for clean closure of the Existing Landfill and Aux Pond CCR units, post-closure operations and maintenance, leachate treatment, and the Owner's project and management costs.

6 Conclusion and Recommendations

AEP completed a thorough site investigation and conducted a detailed RFP solicitation process to gauge interest and receive bids for potential beneficial use of CCR materials from the Existing Landfill and Aux Pond CCR units at the Glen Lyn Plant per HB 443 requirements. Through completion of the solicitation process, it was determined that due to site constraints, regional market competition for use of CCR as a Portland cement substitute, and limited existing rail and natural gas infrastructure, traditional on-site beneficial use options are not cost competitive with an on-site landfill option.

Of the two bids evaluated for this report, Bidder #1 was unable to provide proof that their end-product meets the requirement of the CCR Rule for encapsulation and was not able to provide evidence of certifications necessary to market their product to domestic end-users. Bidder #2 provided a proposal for an approved beneficial use as cement kiln feed; however, due to the limited annual CCR off-take volumes, and cement kiln quality requirements for unprocessed CCR, this option does not provide a clear cost savings on a per cubic yard basis when compared to an on-site landfill that would still be required to properly dispose of the large volume of non-beneficiated CCRs remaining.

The pricing provided by Bidder #1 does present a potential cost savings to AEP, and the proposed beneficial use technology is able to process the entirety of the CCR materials from the Existing Landfill and Aux Pond. However, Bidder #1 was unable to produce evidence the proposed technology has been previously successful at a commercial scale to beneficiate landfilled or impounded CCR, and the proposed schedule requires 11 years to complete construction activities, which includes extensive trucking and transportation impacts related to importing raw materials and exporting the end-product produced on-site both by truck and rail.

Although the market for raw kiln feed is limited to 100,000 tons/year, and the beneficial use costs provided by Bidder #2 did not indicate a cost savings when compared to the on-site landfill, there is a potential to pursue this option during pond closure operations to reduce the proposed landfill air-space requirements. A direct contract between AEP and the cement kiln may be established to provide CCR meeting the kiln's quality requirements with limited schedule, budget, or operational impacts to the contractor performing the Existing Landfill and/or Aux Pond closure work.

Definitive demonstration of Bidder #1s technology's ability to encapsulate heavy metals would be required for further consideration of their proposed process. Without this testing data available and without ICC certification that the ready-mix end-product can meet or exceed Portland cement standards to be included in project design specifications, it is not seen as a viable beneficial use technology at this time. Completion of EPA LEAF testing on CCR material from the Glen Lyn Plant processed through a demonstration or pilot system designed and operated by Bidder #1 should be considered (US EPA 2016), and their proposal re-visited per the requirements of HB 443.

7 References

ASTM Standard C618. 2019. *Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete*. DOI: 10.1520/C0618-19. ASTM International. West Conshohocken, PA. Available at www.astm.org

US EPA. 2014. *Coal Combustion Residual Beneficial Use Evaluation: Fly Ash Concrete and FGD Gypsum Wallboard* (EPA530/R-14/001). Office of Solid Waste and Emergency Response, Office of Resource Conservation and Recovery. Washington, DC. Available at https://www.epa.gov/sites/default/files/2014-12/documents/ccr_bu_eval.pdf

US EPA. 2016. *Methodology for Evaluating Beneficial Uses of Industrial Non-Hazardous Secondary Materials*. Office of Solid Waste and Emergency Response. Washington, DC. Available at https://www.epa.gov/sites/default/files/2016-10/documents/methodology_for_evaluating_beneficial_use_of_secondary_materials_4-14-16.pdf

