REPORT

CLOSURE PLAN ADDENDUM NO. 1

Martin Lake Steam Electric Station - Ash Ponds
Rusk County, Texas

Submitted to:

Luminant Generation Company LLC

Submitted by:

WSP GOLDER

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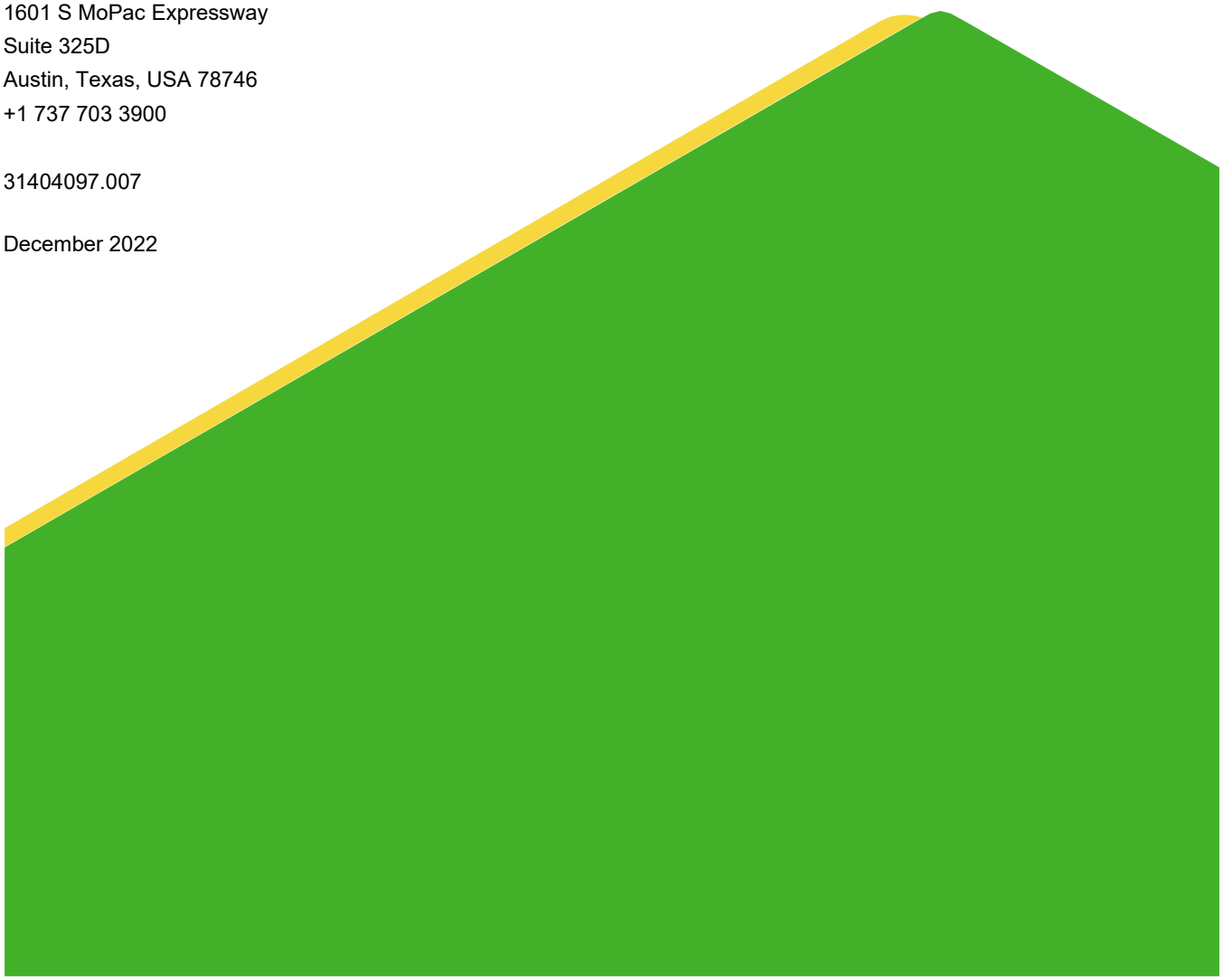
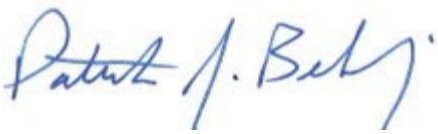
December 2022



PROFESSIONAL CERTIFICATION

This document and all attachments were prepared by WSP Golder under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I hereby certify that Addendum No.1 to the Closure Plan for the Ash Ponds at the Martin Lake Steam Electric Station has been prepared in accordance with the requirements of 40 C.F.R. §257.102(b).



Patrick J. Behling, P.E.
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DOCUMENT REVISION RECORD

Issue No.	Date	Details of Revisions
Revision 0	October 2016	Original Document
Addendum 1	December 2022	Revised configuration of final cap/cover system for Ash Ponds, added equivalency determination for proposed alternative final cover systems, added cap settlement evaluation, added confirmation that cap slope stability will be modeled using site-specific geotechnical data during final closure design, removal of HELP Modeling from Closure Plan, revised closure schedule to state closure will be completed within five years and add estimated completion year, added section addressing the initiation of closure, and added section to address notification citations.

1.0 INTRODUCTION

On behalf of Luminant Generation Company LLC (Luminant), WSP Golder (Golder) has prepared this Addendum No. 1 to the Closure Plan for the East Ash Pond (EAP), West Ash Pond (WAP), and New Scrubber Pond (NSP) (collectively referred to as the "Ash Ponds") located at the Martin Lake Steam Electric Station (MLSES) in Rusk County, Texas (hereafter, the "Site"). Coal Combustion Residuals (CCR) including flue gas desulfurization (FGD) wastewater and bottom ash generated as part of MLSES operation are managed in the Ash Ponds. The Ash Ponds are regulated as Existing CCR Impoundments under 40 C.F.R. § 257, Subpart D (the "CCR Rule").

The original Closure Plan for the Ash Ponds was prepared in October 2016 in accordance with 40 C.F.R. §257.102(b) and placed in the MLSES operating record in accordance with 40 C.F.R. §257.105(h)(10) (PBW, 2016). This Addendum No. 1 updates the Closure Plan to reflect the following:

- Revisions to the configuration of the Ash Pond final cap/cover systems due to retrofits of the Ash Pond liner systems;
- Addition of equivalency determination for proposed alternative final cover systems for Ash Ponds;
- Addition of cap settlement evaluation;
- Confirmation that the slope stability of Ash Pond cap/cover systems will be modeled using site-specific geotechnical data during design of the final closure of the impoundments;
- Removal of HELP Modeling from Closure Plan;
- Revisions to the Ash Pond closure schedule to state closure will be completed within five years and add estimated completion year;
- Addition of section addressing the initiation of Ash Pond closure; and
- Addition of section to address notification citations.

2.0 ASH POND FINAL CAP/COVER SYSTEMS

The EAP, WAP and NSP are constructed partially above and partially below grade and are surrounded by engineered earthen dikes that extend above surrounding ground level. The EAP and WAP share an interior embankment and cover areas of approximately 10 acres and 15 acres, respectively. The NSP is an approximately 13 acre surface impoundment.

At the time the 2016 Closure Plan was prepared, the configuration of the liner systems in the EAP, WAP and NSP consisted of the following (from bottom to top):

- 18-inch thick compacted clay layer with a hydraulic conductivity of $1x10^{-7}$ cm/sec;
- a 60-mil HDPE geomembrane;
- a geosynthetic drainage layer;
- a second 60-mil HDPE geomembrane; and
- a 4-inch thick concrete revetment mat.

From 2020 through 2022, the EAP and WAP were each retrofitted with a new composite liner system meeting the alternative composite liner requirements of 40 CFR § 257.70(c) (HDR, 2021; HDR, 2022). The retrofitted liner system was installed on top of the existing liner system in each pond and consisted of the following (from bottom to top):

- a 6-inch thick layer of general soil fill material placed over the existing liner system;
- a polymer-enhanced geosynthetic clay liner (GCL) with a maximum hydraulic conductivity of $1x10^{-9}$ cm/sec and a minimum thickness of 6 mm; and
- a 60-mil HDPE geomembrane.

A similar composite liner system is currently being installed in the NSP.

The 2016 Closure Plan for the Ash Ponds included two options for final cap/cover systems: a compacted clay cap system and a geosynthetic cap system (PBW, 2016). Due to the retrofits of the Ash Pond liner systems described above, the final cap/cover systems for the EAP, WAP and NSP have been revised to consist of the following (from bottom to top):

- a geosynthetic clay liner (GCL) with a maximum hydraulic conductivity of $1x10^{-9}$ cm/sec and a minimum thickness of 6 mm;
- a 40-mil linear low-density polyethylene (LLDPE) textured geomembrane;
- a geosynthetic drainage layer; and
- a 18-inch erosion layer consisting of 12 inches of general fill overlain with 6 inches of soil capable of supporting native vegetation.

The proposed final cap/cover systems for the Ash Ponds are alternative final cover systems that must comply with the requirements of 40 C.F.R. §257.102(d)(3)(ii)(A) through (C):

(A) The design of the final cover system must include an infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in paragraphs 40 C.F.R. §257.102(d)(3)(i)(A) and (B).

(B) The design of the final cover system must include an erosion layer that provides equivalent protection from wind or water erosion as the erosion layer specified in paragraph 40 C.F.R. §257.102(d)(3)(i)(C).

(C) The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.

2.1 Equivalent Infiltration Reduction - Ash Pond Cap/Cover Systems

The final cap/cover systems for the Ash Ponds must include an infiltration layer that achieves an equivalent reduction in infiltration as the infiltration layer specified in paragraphs 40 C.F.R. §257.102(d)(3)(i)(A) and (B):

(A) The permeability of the final cover system must be less than or equal to the permeability of any bottom liner system or natural subsoils present, or a permeability no greater than 1×10^{-5} cm/sec, whichever is less.

(B) The infiltration of liquids through the closed CCR unit must be minimized by the use of an infiltration layer that contains a minimum of 18 inches of earthen material.

2.1.1 Permeability Comparison Between Ash Pond Cap Systems and Liner Systems

The final cap/cover systems for the Ash Ponds comply with the requirements of 40 C.F.R. §257.102(d)(3)(i)(A) based on the following:

- The retrofitted bottom liner system for each of the Ash Ponds includes an infiltration layer consisting of a GCL with a maximum hydraulic conductivity of $1x10^{-9}$ cm/sec and a geomembrane and the final cap/cover system for each of the Ash Ponds includes an infiltration layer consisting of a GCL with a maximum hydraulic conductivity of $1x10^{-9}$ cm/sec and a geomembrane. Since the infiltration layers in the bottom liner and final cap both consist of a GCL and a geomembrane, the permeability of the final cap/cover system is equivalent to the permeability of the bottom liner system.
- The GCL in the final cap/cover system has a maximum hydraulic conductivity of $1x10^{-9}$ cm/sec which is significantly lower permeability than the specified minimum of 1×10^{-5} cm/sec.

2.2.2 Infiltration Comparison of Ash Pond Cap Systems to 18-Inch Earth Infiltration Layer

Compliance of the final cap/cover systems to the requirements of 40 C.F.R. §257.102(d)(3)(i)(B) was determined by comparing the estimated liquid flow rate through the low permeability components of the Ash Pond final cap/cover systems to the estimated liquid flow rate through the specified minimum of 18 inches of earthen material. The results of the comparison are presented below.

- Estimated Liquid Flow Through Ash Pond Final Cap/Cover System

  The low permeability components of the Ash Pond cap/cover system are a GCL with a maximum hydraulic conductivity of $1x10^{-9}$ cm/sec and a minimum thickness of 6 mm and a 40-mil LLDPE geomembrane. The liquid flow rate through the cap (per acre of cap area) was estimated using the Giroud Equation as follows (Giroud, 1997):

  - Giroud Equation: $Q = N \times C [1 + 0.1(h/t)^{0.95}] \times a^{0.1} \times h^{0.9} \times k^{0.74}$

    where: Q = flow rate through the liner (m^3/s)

    N = number of geomembrane defects per acre of cap area

    C = contact coefficient (0.05 for excellent, 0.21 for good, and 1.25 for poor)

h = head above liner (m)

t = thickness of soil portion of the liner (m)

a = assumed area of defect in geomembrane through which leak occurs (m^2)

k = hydraulic conductivity of the GCL portion of the liner (m/s)

- Assumptions:

  1) The GCL is assumed to have a maximum hydraulic conductivity of $1x10^{-9}$ cm/sec and a minimum thickness of 6 mm.

  2) The hydraulic head above the cap geomembrane and GCL is assumed to be 12 inches (30.48 cm). This is a conservative assumption for the cap, since the final cap/cover system will be sloped and includes a geosynthetic drainage layer to divert water that infiltrates through the overlying erosion soil layer away from the cap.

  3) Geomembranes are nearly impermeable to liquids; however, liquids typically pass through holes/defects in the geomembrane. The area of a hole (defect) in the geomembrane was estimated to be 1 cm^2. For a typical geomembrane installed using good installation techniques, it is estimated that 4 defects (holes) occur per acre of geomembrane.

- Liquid Flow Rate Through Cap Geomembrane and GCL

  N = 4 per acre (assume good geomembrane installation)

  C = 0.21 (assume good contact between geomembrane and GCL)

  h = 1 foot x 30.48cm/ft = 30.48 cm (0.3048 m)

  t = 6 mm x 0.001 m/mm = 0.006 m for GCL

  a = 1 cm^2 (0.0001 m^2) for the area of the hole (defect) in the geomembrane

  k = $1x10^{-9}$ cm/sec ($1 X 10^{-11}$ m/sec) for GCL

  $Q = 4 X 0.21 [1 + 0.1(0.3048/0.006)^{0.95}] X 0.0001^{0.1} X 0.3048^{0.9} X (1EE-11)^{0.74}$

  $= 0.84 [1 + 4.1742] X 0.3981 X 0.3433 X 7.24EE-9$

  = $4.3 X 10^{-9}$ m^3/s per acre of cap or 0.10 gallons per day per acre of cap

- Estimated Liquid Flow Through 18-inch Earthen Infiltration Layer

  The 18-inch earthen infiltration layer is assumed to consist of compacted clay with a maximum hydraulic conductivity of $1x10^{-7}$ cm/sec. Flow rate through the infiltration layer was calculated using Darcy's Law for gravity flow through porous media as follows:

  - Darcy Equation: $Q=A X k X (h/t+1)$

    Where:

    Q = flow rate through the Infiltration Layer (m^3/s)

    A = Cap area perpendicular to the flow (m^2)

    h = head above Infiltration Layer (m)

    t = thickness of Infiltration Layer (m)

k = hydraulic conductivity of Infiltration Layer (m/s)

- Assumptions:

  1) The 18-inch infiltration layer is assumed to have a maximum hydraulic conductivity of $1x10^{-7}$ cm/sec.

  2) The hydraulic head above the infiltration layer was assumed to be 12 inches (30.48 cm). This is a conservative assumption for the infiltration layer, since the final cap/cover system will be sloped to divert water that infiltrates through the overlying erosion soil layer away from the infiltration layer.

  3) Cap area for evaluation is assumed to be 1 acre to match area used for the above Ash Pond geomembrane/GCL cap evaluation.

- Flow Rate Through 18-inch Infiltration Layer

  A = 1 acre (4046.86 m^2)

  k = $1x10^{-7}$ cm/sec (1 X 10^{-9} m/sec)

  h = 1 foot x 30.48 cm/ft = 30.48 cm (0.3048 m)

  t = 18 inches X 2.54 cm/in = 45.72 cm (0.4572 m)

  Q = (4046.86 m^2) x ($1x10^{-9}$ m/sec) x ((0.3048 m / 0.4572 m) + 1)

  = $6.75x10^{-6}$ m^3/s per acre of cap or 154 gallons per day per acre of cap

The final cap/cover systems for the Ash Ponds comply with the requirements of 40 C.F.R. §257.102(d)(3)(i)(B), since the estimated liquid flow rate through the final cap/cover system (0.10 gallons per acre per day) is significantly less than the estimated liquid flow rate through an 18-inch thick infiltration layer (154 gallons per acre per day).

2.2 Equivalent Erosion Protection - Ash Pond Cap/Cover Systems

The final cap/cover systems for the Ash Ponds include an 18-inch erosion layer consisting of 12 inches of general fill overlain with 6 inches of soil capable of supporting native vegetation. This complies with the requirements of 40 C.F.R. §257.102(d)(3)(ii)(B), which states that the final cover system must use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

2.3 Settling and Subsidence - Ash Pond Cap/Cover Systems

40 C.F.R. §257.102(d)(3)(i)(D) states that the disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence. An evaluation of potential settlement for the final cap/cover systems for the Ash Ponds is attached as Appendix A to this Addendum. The Ash Pond Closure Plan will be updated to include a cap/cover system settlement evaluation using site-specific data during design of the final cap/closure systems for the Ash Ponds.

2.4 Slope Stability - Ash Pond Cap/Cover Systems

The Ash Pond Closure Plan will be updated to include cap/cover system slope stability modeling using site-specific geotechnical data during design of the final cap/closure systems for the Ash Ponds.

2.5 HELP Modeling in 2016 Closure Plan

The 2016 Closure Plan for the Ash Ponds included Hydrologic Evaluation of Landfill Performance (HELP) model evaluations to compare the permeability of the then-proposed cap options against each other and to the pond bottom liner systems in place at the time (PBW, 2016). The HELP model evaluations in the 2016 Closure Plan have been replaced by the infiltration evaluations presented above for the new cap/cover systems and have been deleted from this amended Closure Plan.

2.6 Conclusions

The final cap/cover systems for the Ash Ponds described above are alternative final cover systems that comply with the requirements of 40 C.F.R. §257.102(d)(3)(ii)(A) through (C).

3.0 ASH POND CLOSURE SCHEDULE AND NOTIFICATION UPDATES

The closure schedule for the Ash Ponds is described in Section 2.7 and Appendix E of the 2016 Closure Plan (PBW, 2016). The 2016 Ash Pond Closure Schedule is updated as follows:

- Initiation of Ash Pond Closure. For the purposes of the Ash Pond Closure Schedule, Luminant estimates that the MLSES will cease operations in approximately 2045. However, CCR and related waste will continue to be generated after plant operation has terminated as part of facility decommissioning and demolition and the CCR and related waste may be managed in the Ash Ponds. In accordance with 40 C.F.R. §257.102(e)(2)(i), the Ash Ponds will commence closure within two years of the date of final receipt of either CCR or non-CCR waste; however, in accordance with 40 C.F.R. §257.102(e)(2)(ii) an additional two years may be required to initiate closure provided Luminant provides written documentation that the Ash Ponds will continue to accept wastes beyond the original two-year period. For the purposes of the Ash Pond Closure Schedule, Luminant estimates that Ash Pond Closure will be initiated in approximately 2047.
- Completion of Ash Pond Closure. In accordance with 40 C.F.R. §257.102(f)(1)(ii), Luminant estimates that final closure of the Ash Ponds will be completed within 5 years of start of closure or in approximately 2052. It should be noted; however, that 40 CFR §257.102(f)(2) of the CCR Rule allow for extension of the closure schedule in the event that it is not feasible to complete closure of the Ash Ponds within the required timeframes due to factors beyond the facility's control.

Luminant will provide the following notifications related to closure of the Ash Ponds:

- In accordance with 40 C.F.R. §257.102(g), Luminant will prepare a notification of intent to close the Ash Ponds. The notice will be prepared no later than the date of closure initiation, will be sealed by a qualified professional engineer, and will be placed in the MLSES operating record as required by 40 C.F.R. §257.105(i)(7).
- In accordance with 40 C.F.R. §257.102(h), Luminant will prepare a notification of closure of the Ash Ponds within 30 days of completion of closure. The notice will be sealed by a qualified professional engineer and will be placed in the MLSES operating record as required by 40 C.F.R. §257.105(i)(8).
- In accordance with 40 C.F.R. §257.102(h) Luminant will provide deed notification for the Ash Pond Closure.

4.0 REFERENCES

Giroud, J.P., “Equations for Calculating the Rate of Liquid Migration Through Composite Liners Due to Geomembrane Defects”, Geosynthetics International, Vol. 4, Nos. 3-4, pp. 335-348, 1997.

HDR (2021). Construction Completion and Construction Quality Assurance Report, CCR Impoundment Reline East Ash Pond, Martin Lake Steam Electric Station, May.

HDR (2022). Construction Completion and Construction Quality Assurance Report, CCR Impoundment Reline West Ash Pond, Martin Lake Steam Electric Station, June.

Pastor, Behling & Wheeler, LLC (PBW), 2016. CCR Closure Plan – Bottom Ash Ponds and New Scrubber Pond, Martin Lake Steam Electric Station. October.

APPENDIX A

Evaluation of Potential Cap/Cover System Settlement

Bullock, Bennett & Associates, LLC

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165 N. Lampasas St. • Bertram, Texas 78605 • (512) 355-9198

December 6, 2022

Mr. Pat Behling
WSP Golder
1601 S MoPac Expressway
Suite 325D
Austin, Texas, USA 78746

Re: Evaluation of Potential for Impoundment Cap Settlement, Bottom Ash Ponds and New Scrubber Pond – Martin Lake Steam Electric Station, Rusk County, Texas

Dear Mr. Behling:

As requested by WSP Golder, Bullock, Bennett & Associates, LLC (BBA) has evaluated the proposed cap system at the East Ash Pond and West Ash Pond surface impoundments (collectively hereafter referred to as the Bottom Ash Ponds, or BAPs) and New Scrubber Pond (NP) surface impoundment at the Martin Lake Steam Electric Station (MLSES) located in Rusk County, Texas – specifically in regard to the suitability of the proposed cap system to accommodate anticipated settlement. The BAPs and the NP are located adjacent to one another and will be capped as one unit. This evaluation is based on the most recent design drawings dated September 2016, provided to BBA by WSP Golder. No site-specific geotechnical data for the coal combustion residuals (CCR) fill material was provided to BBA for this analysis, and no site-specific consolidation or settlement data for on-site soils were provided; therefore, general assumptions regarding typical soil and CCR properties are made in this evaluation. It is BBA's understanding that site-specific soils and CCRs will be tested for engineering properties and that a detailed engineering settlement analysis using the on-site data and final design criteria will be completed prior to final cap construction activities.

The original Closure Plan for the BAPs and NP was prepared in October 2016 (PBW, 2016). The 2016 Closure Plan included options for two different cap configurations, one including synthetic components and the other including use of a compacted clay liner system. On December 6, 2022, WSP Golder prepared Addendum No.1 to the BAPs and NP Closure Plan and revised the final cap/cover system to be as follows, from bottom to top (WSP Golder, 2022):

- a geosynthetic clay liner (GCL) with a maximum hydraulic conductivity of $1x10^{-9}$ cm/sec and a minimum thickness of 6 mm;
- a 40-mil linear low-density polyethylene (LLDPE) textured geomembrane;
- a geosynthetic drainage layer; and
- an 18-inch-thick erosion layer consisting of 12 inches of general fill overlain with 6 inches of soil capable of supporting native vegetation.

The grades, slopes, etc. for the revised BAPs and NP final cap/cover system will remain as presented in the 2016 BAPs and NP Closure Plan.

The cap system will tie into the perimeter earth embankment system, which ranges between approximately 10- to 20- feet above the surrounding natural grades. The perimeter earth embankment was constructed in thin lifts of compacted embankment fill meeting engineering specifications.

Engineering Properties of CCR Fill Material Underlying the Proposed Cap System:

CCR fill material in the BAPs consist of bottom ash, and in the NP consists of flue gas desulfurization material (FGD, or gypsum). These CCRs are non-plastic and moderately to highly permeable (typically drain better than clays and silts) and are well suited as fill materials[1,2,3]. The coefficient of consolidation of bottom ash when compared to typical soils is typically low and decreases with incremental loading and time. This indicates the bottom ash possesses load taking ability and that structures, or in this case a cap system, lying above the ash will undergo gradual settling and not suffer large deformation - making ash well suited as a fill material.[1] According to the American Coal Ash Association approximately 3.63. million metric tons (4.0 million tons) of bottom ash were used in structural fill applications in 2006 (ACAA 2007). Structural fill and embankment material is the largest use of bottom ash in the US.[2] FGD material has engineering properties that also make it suitable for use as embankment fill.[3] BBA has experience in capping multiple impoundments and landfills in Texas containing bottom ash and gypsum and has performed annual engineering inspections for years following final capping activities at these facilities and has observed very little cap settlement.

Based upon review of the BAPs and NP bottom and proposed cap elevations, it appears there will be a layer of CCRs approximately 15- to 20-feet thick under the proposed cap system. These CCR materials will be dewatered prior to initiating cap construction activities.

Subsurface Conditions:

Based on results of subsurface investigations summarized in the Safety Factor Assessment 5-Year Update (WSP Golder, 2021) performed by East Texas Testing Laboratories (ETTL), and Golder in 2008 and 2012, respectively, the subsurface stratigraphy is described as consisting of interchanging layers of clays, sandy clays, clayey sands and non-plastic sands. The sandy clay and clay layers are described as firm to hard, low to high plasticity clays that vary in thickness from 2 to 38 feet. Loose to very dense, silty or poorly graded sand was encountered beneath or interlayered with sandy clay/clayey sand strata. A 100-foot-deep boring completed by ETTL showed deeper layers of very dense silty sand with intermittent layers of hard low plasticity clay.

Based on the description of subsurface conditions, large settlement of subsurface soils is not expected.

Based on review of the proposed cap system and technical specifications for materials and placement, evaluation of typical CCR engineering properties, the perimeter

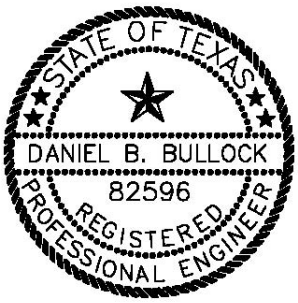
embankment system, and the site underlying subsurface conditions, it appears the cap design for the BAPs and NP is designed appropriately to accommodate settling and subsidence and will minimize the disruption of the integrity of the final capping system. Final cap grade designs include a 3% slope that will promote storm water drainage off the cap system, and these slopes appear sufficient to accommodate anticipated settlement while continuing to maintain positive surface water drainage. In addition, MLSES will conduct regularly scheduled cap inspections during post-closure care, and any settlement identified will be addressed to maintain cap design functions.

Please feel free to contact me at (512) 355-9198 if you have any questions about this submittal, or if I can be of any further assistance.

Sincerely,

Bullock, Bennett & Associates, LLC

Dan Bullock, PE (TX 82596)
Principal Engineer
Texas Professional Engineering Firm No. F-8542



12/06/2022

(1) One-Dimensional Consolidation of Sedimented Stowed Pond Ash, Devi Presad Mishra and Samir Kumar Das Document: Geotech Geol Eng (2012) 30:685-695 DOI 10.1007/s10706-011-9486-x
(2) User Guideline for Coal Bottom Ash and Boiler Slag in Green Infrastructure construction, Craig H. Benson and Sabrina Bradshaw. December 2011. Recycled Materials Resource Center, University of Wisconsin-Madison.
(3) User Guideline for Flue Gas Desulfurization Material in Green Infrastructure construction, Craig H. Benson and Sabrina Bradshaw. December 2011. Recycled Materials Resource Center, University of Wisconsin-Madison