

Exhibit No. 14P

FILED
June 29, 2022
Data Center
Missouri Public
Service Commission

Liberty – Exhibit 14P
Drew Landoll
Surrebuttal Testimony
File Nos. EO-2022-0040 & EO-2022-0193

Exhibit No.: _____
Issues: Asbury Dismantlement,
Decommissioning, and AROs
Witness: Drew W. Landoll
Type of Exhibit: Surrebuttal Testimony
Sponsoring Party: The Empire District
Electric Company
Case Nos.: EO-2022-0040; EO-2022-0193
Date Testimony Prepared: May 2022

**Before the Public Service Commission
of the State of Missouri**

Surrebuttal Testimony

of

Drew W. Landoll

on behalf of

The Empire District Electric Company d/b/a Liberty

May 2022



****DENOTES CONFIDENTIAL****
20 CSR 4240-2.135(2)(A)4, 6

PUBLIC VERSION

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THE EMPIRE DISTRICT ELECTRIC COMPANY
BEFORE THE MISSOURI PUBLIC SERVICE COMMISSION
CASE NOS. EO-2022-0040 and EO-2022-0193

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SURREBUTTAL TESTIMONY OF DREW W. LANDOLL
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1 **I. INTRODUCTION**

2 **Q. Please state your name and business address.**

3 A. My name is Drew W. Landoll. My business address is 602 Joplin Street, Joplin,
4 Missouri 64801.

5 **Q. Are you the same Drew W. Landoll who provided Direct Testimony in Case No.**
6 **EO-2022-0193 (Asbury) on behalf of The Empire District Electric Company d/b/a**
7 **Liberty (“Liberty” or the “Company”)?**

8 A. Yes.

9 **Q. What is the purpose of your Surrebuttal Testimony in these now consolidated**
10 **securitization proceedings?**

11 A. I am responding to the Office of Public Counsel’s (“OPC”) rebuttal testimony
12 regarding the Company’s decisions post retirement of the Asbury Power Plant with
13 regard to decommissioning and dismantlement of the asset.

14 **Q. Before you present your Surrebuttal Testimony, do you have any corrections to**
15 **your Direct Testimony?**

16 A. Yes, two items:

- 17
- On page 10, line 5, “asbestos removal” should be stricken.
 - On page 14, line 20, item g “Removal of asbestos” should be removed from
19 the list of activities.

20 The scope of work for Phase 2 of the decommissioning plan should only include the
21 identification and quantification of asbestos containing materials, not the removal of

1 said materials. The scope of this work is included in the Phase 3 cost estimates (Direct
2 Schedule DWL-2). Further clarification of this is discussed below.

3 **II. POST-RETIREMENT ACTIVITIES AND OPTIONS**

4 **Q. OPC witness Marke stated in his rebuttal testimony that he believes the Company**
5 **did not try to sell the Asbury Power Plant. Do you agree with his assertion?**

6 A. No. As my Direct Testimony explains, Empire retained Black & Veatch Management
7 Consulting, LLC (“BVMC”) to perform an analysis of the market value of the Asbury
8 plant. That analysis determined that not only did Asbury have no sale value, *Empire*
9 *would have to pay* a third party approximately \$134 million to take ownership of the
10 operating plant given the market conditions and environmental obligations to continue
11 operations and ultimately decommission it.

12 **Q. Did the Company perform any marketing of the Asbury Power Plant?**

13 A. Yes. As discussed in my Direct Testimony and summarized on page 7 of Direct
14 Schedule DWL-1, the Company engaged BVMC to determine if there were any viable
15 parties interested in purchasing the equipment for another use. This process included
16 a review of the inventory of major equipment, spares, and all large assets, gathering of
17 operational information, and site visits. This work found that there is not a market for
18 a fifty-year-old cyclone boiler coal plant that would require dismantling, packaging,
19 shipping, re-engineering, rebuilding, and the requisite permitting.

20 **Q. Should the Company have ‘mothballed’ Asbury, as Dr. Marke asserts in his**
21 **testimony?**

22 A. No, Dr. Marke’s assertion is without support. As I explain in my Direct Testimony,
23 the total cost of mothballing the facility for 10 years would have been approximately
24 \$5.7 million, expressed in 2020 dollars, which is the total of an Abandon-in-Place Cost

1 Estimate, Abandon-in-Place Risk Register, and the Asbury Station Abandon-in-Place
2 Study.t. None of those costs include demolition, so the cost to retire Asbury would
3 simply increase by that amount. There was no reason to think that it would ever be in
4 our customers' best interests to reactive the plant at the time the decision was made to
5 retire it, nor is there any reason to think so now.

6 **Q. Are you aware of any utility that has recently mothballed a plant and brought it**
7 **back into service?**

8 A. No, I am not.

9 **Q. Have any new coal plants entered the market recently?**

10 A. No, there hasn't been a new coal plant brought online in the United States since 2014,¹
11 and the regulations governing coal plant operations have only increased since then,
12 which has increased the cost to operate. In addition to the changing regulations and
13 renewable energy standards, coal plant support vendors are increasingly abandoning
14 this line of service. Black and Veatch, the original design engineering firm, has
15 announced it will cease participation in any further coal-based power design and
16 construction.² Babcock and Wilcox, the original equipment manufacturer of Asbury

¹ <https://www.carbonbrief.org/mapped-worlds-coal-power-plants/>

² <https://www.bv.com/news/black-veatch-decarbonization-driving-repowering-power-industry>

1 and the world's leading coal boiler manufacturer has pivoted to renewables,
2 decarbonization, and set a 2050 net-zero greenhouse gas emissions goal.³

3 **Q. Is the Company looking to expand its generation or “other options” at Asbury, or**
4 **did the Company not even explore the options, as Dr. Marke asserts?**

5 A. Dr. Marke is not correct; it appears he choose to ignore my Direct Testimony. The
6 Company is always looking for the correct blend of generation and technology to
7 maintain a safe and reliable source of energy for our customers. In doing so, we spent
8 a lot of time in the first phase of the retirement planning to explore all options that were
9 available on site. This was described in my Direct Testimony, page 19, lines 19-24 and
10 page 20, lines 1-12. This is further, and more recently, illustrated in our recent
11 submission of the Integrated Resource Plan, in which we included specific generators
12 for reliability and a plan to co-locate resources at existing interconnection points
13 including Asbury.

14 **Q. Did the Company take all reasonable steps to come to the decision to dismantle?**

15 A. Yes. The Company performed a host of studies and cost estimates that informed its
16 decision to dismantle Asbury. These have been provided over the last three years
17 through this and other dockets, including in responses to data requests, and the
18 Company has kept stakeholders up to date with its plans.

³ https://www.babcock.com/assets/Uploads/BW_2022_Sustainability_ESG.pdf

1 **III. COST ESTIMATES AND FINACIAL INFORMATION REGARDING**
2 **ASBURY DECOMMISSIONING**

3 **Q. Has the Company provided an update to the cost estimate for decommissioning**
4 **of Asbury?**

5 A. Yes. In my Direct Testimony I provided two estimates, one for Phases 1 and 2 of **
6 **██████████**** and the updated Phase 3 estimate of ****██████████**** for a total of ****██████████**
7 **██████████**** for demolition of the Asbury Power Plant. The asbestos removal is included
8 in the Phase 3 estimate.

9 **Q. Does the ****██████████**** estimate above include salvage value.**

10 A. No, it does not. The estimates provided in Direct Schedule DWL-2 include estimates
11 of salvage from Black and Veatch estimated at approximately ****██████████**** . These
12 values are based on estimated quantities from high-level drawing reviews and walk-
13 downs multiplied by a snapshot-in-time scrap pricing. This estimate is considered a
14 Class 4 Budget Estimate per the Association of Cost 5 Engineering guidelines, or -30%
15 to +50% accuracy.

16 **Q. Does the ****██████████**** estimate for decommissioning provided above include**
17 **the Asset Retirement Obligations (AROs) for the asbestos containing materials**
18 **(ACM) abatement?**

19 A. No, with some clarification on estimates and AROs. The estimate provided by Black
20 and Veatch in Direct Schedule DWL-2 for Phase 3 includes a line item for
21 “Cleanup/Abatement of Hazardous Waste” for ****██████████**** . This estimate was
22 assembled based on the specific scope of razing Asbury Unit 1. The estimate also does
23 not take into account any of the asbestos that may be on site but outside the scope of
24 razing Unit 1 such as; underground piping and wiring, other ancillary buildings, and

1 ACM containing materials remaining not within Unit 1. In response to Mr. Riley's
2 dispute on page 15 starting on line 14 of his Rebuttal Testimony, the line item
3 "Cleanup/Abatement of Hazardous Waste" is expected to be 'funded' from the
4 Company's Missouri jurisdictional "Additional Asbury Asset Retirement Obligation
5 Costs – Asbestos" of ** [REDACTED] ** is more appropriate estimate of the total Asbestos
6 costs. Acknowledging OPC's objection, the Company has removed the ** [REDACTED] **
7 line item from the Phase 3 cost estimate and left the Asbury Asset Retirement
8 Obligation Costs – Asbestos in the forecasted expenditures in its securitization
9 balances. For additional discussion related to the Company's total proposed
10 securitization amounts related to Asbury costs, please refer to the Surrebuttal testimony
11 of Charlotte. T. Emery.

12 **Q. Does the ** [REDACTED] ** estimate for decommissioning provided above include**
13 **the Asset Retirement Obligations (AROs) for the coal ash impoundments?**

14 A. No. The impoundments have been part of the compliance plan for Asbury since the
15 Combustion Residuals Rule (CCR) and the Steam Electric Power Generating Effluent
16 Guidelines (ELG) rule were promulgated and were irrespective of the retirement
17 decisions for Asbury, as discussed in ER-2021-0312, OPC Data Request 31. The
18 impoundment closure process has been estimated within our ARO budgets, and the
19 Company publicly updated the plan on our Company website⁴. The Company is
20 currently in the contract negotiation stage with the dirt work contractor for the closure
21 impoundment, with the bulk materials already procured. At this time the project is
22 expected to be within the ARO budget of approximately ** [REDACTED] **.

⁴<https://central.libertyutilities.com/uploads/2022%20Updated%20Asbury%20CCR%20Impoundment%20Closure%20Plan.pdf>

1 **Q. How will the Company contract the razing of Asbury Unit 1, and what is the**
 2 **current net cost estimate when including salvage and the asbestos ARO?**

3 A. On May 13, 2022 the Company submitted a contract bid package that was designed to
 4 have the demolition as a lump sum contract, inclusive of salvage value to be retained
 5 by the contractor, with a bid due date of July 15, 2022. This contract bid approach was
 6 utilized on the Riverton 7, 8, and 9 demolition and resulted in very competitive bids
 7 and it also lets the contractor bear the risk of the fluctuating scrap market, not the
 8 customers. Demolition companies are able to hedge scrap commodity pricing and/or
 9 stockpile in a way that the utility companies are not, therefore increasing their value of
 10 scrap and reducing cost risks to our customers. The contract is expected to include the
 11 ACM abatement as a lump sum bid as well. The ACM abatement price shall be based
 12 on the estimated quantities developed by a third-party ACM inspection company.
 13 These estimates are based on historical drawings and non-intrusive site walks. Based
 14 on the Company’s experience at Riverton the contract will also contain provisions for
 15 unit rate additions for out of scope ACM removal. In simpler terms, if the ACM
 16 quantity exceeds the bid package information then a unit rate will be utilized for change
 17 orders. The ACM work will be tracked separately and ‘funded’ through the ARO as
 18 discussed above.

19 The results of this bid process will be shared with stakeholders through the appropriate
 20 processes. Current Company estimates for the net cost of this work can be summarized
 21 in the table below:

Phase/Task	Line Items	Estimated Cost
Phase 1 & 2		
	Engineering, studies, permit and facility modifications, universal waste removal, safety measures	\$ 4,000,000

DREW W. LANDOLL
SURREBUTTAL TESTIMONY

Phase 3 - Demolition		
	Direct Costs	\$ 6,700,000
	Indirect Costs	\$ 1,700,000
	Total Direct and Indirect:	\$8,400,000
	Less ACM Line Item (ARO Covered)	\$ (2,000,000)
	Total:	\$6,400,000
	Less Scrap Value	\$ (4,705,000)
Asbestos ARO		
	Removal of asbestos	\$ 3,205,360

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Please refer to the Surrebuttal Testimony of Company witness Ms. Emery for further details on the proposed treatment of salvage value and any differences between the amount included for securitization and actual values.

Q. To remain operational was closure of the impoundment the only action that was required to keep Asbury compliant with CCR and ELG?

A. No. While developing the compliance plan for Asbury, it was determined that the impoundment would need to be closed to comply with the ELG and CCR as early as 2016.⁵ This was further confirmed with the failure of the location restrictions (40 CFR 257.64) for the impoundment.⁶ The compliance plan also required planning for a new landfill and a wet-to-dry bottom ash handling system conversion. These projects were originally budgeted to require an additional \$20-30 million of investments to comply with federal mandates. As the plans matured, the budget was refined to approximately \$20 million and included actual vendor bids and a phased approach to smaller landfill cell construction. This additional investment was able to be avoided when Asbury was retired; resulting in a benefit of reducing additional costs to customers.

⁵<https://central.libertyutilities.com/uploads/ccr/Asbury%20CCR%20Impoundment%20Closure%2010-2016.pdf>
⁶<https://central.libertyutilities.com/uploads/ccr/Location%20Restriction%2010.17.2018.pdf>

1 **Q. How will the Company contract the closure of the impoundment, and what is the**
2 **current cost estimate?**

3 A. The Company received the bids for the impound construction work and is currently in
4 the contractor selection and vetting phase. The contract was bid as a lump sum with
5 certain unit rates included. The Company's internally approved business case is
6 currently **[REDACTED]** for total cost and is expected to be 'funded' utilizing the
7 ARO – CCR Impoundment balance. This cost is expected to be included in the
8 securitization. The Company's business case is attached as **Surrebuttal Schedule**
9 **DWL-1**.

10 **Q. Does this conclude your Surrebuttal Testimony at this time?**

11 A. Yes.

VERIFICATION

I, Drew W. Landoll, under penalty of perjury, on this 27th day of May, 2022, declare that the foregoing is true and correct to the best of my knowledge and belief.

/s/ Drew W. Landoll



Capital Project Business Case

Asbury Ash Impoundment Closure – PA-038

2022

Project Overview			
Project Name:	Asbury Ash Impoundment Closure	Date Prepared:	February 6, 2022
Project ID#:	PA038	Capital Cost Estimate:	\$22M
Project Sponsor:	Tim Wilson	Project Start Date:	February 6, 2022
Project Lead:	Shaen Rooney	Project End Date:	December 31, 2022
Prepared By:	Shaen Rooney	Planned or Unplanned Projects:	<input checked="" type="checkbox"/> Planned <input type="checkbox"/> Unplanned
Project Type (click appropriate boxes):	<input type="checkbox"/> Safety <input checked="" type="checkbox"/> Mandated <input type="checkbox"/> Growth <input type="checkbox"/> Regulatory Supported <input type="checkbox"/> Discretionary		

Project Scope Statement

The scope of the Asbury Ash Impoundment Closure includes dewatering of the ash impoundment, preparation of the coal combustion residual (CCR) subgrade, installation of a final cover system, construction of stormwater retention ponds, and reclamation of disturbed areas. Preparation of the CCR upgrade will require the contractor to move the CCR within the impoundment to place the CCR in accordance with the engineer's closure design. The purpose of the design is to minimize the amount of cover required while maintaining slope requirements intended to prevent erosion. Because the final cover system recommended has no soil component, stormwater retention ponds are required to manage runoff during heavy precipitation events.

The costs for this project will be recorded in the recently extended accounting authority order for Asbury, and it is the Company's intention to recover these costs through securitization. Completion of this project on the recommended timeline will support this objective.

Background

The Asbury Power Plant was a 200 net MW coal-fired power plant that entered commercial service in 1970. The plant, which is in Jasper County, MO was retired from service in March 2020. During its 50 years of service, the coal combustion byproducts were conveyed to an onsite impoundment for disposal. The U.S. Environmental Protection Agency's (EPA) Coal Combustion Residuals (CCR) Rule requires this impoundment be closed. Closure can be completed by removing all CCR and disposing of it in a landfill or by leaving the CCR in place and installing a final cover system. The purpose of the cover system is to minimize infiltration of surface water and prevent erosion of the stored CCR. The intent to close the Asbury CCR impoundment was made known on April 1, 2021 via posting to our public-facing website, as required by federal regulations. The intent to close was also made known to the Missouri Department of Natural Resources and the EPA.



Capital Project Business Case

Asbury Ash Impoundment Closure – PA-038

2022

Recommendation/Objective

Close the Asbury Power Plant ash impoundment in 2022 by dewatering the impoundment, preparing the CCR subgrade, and installing ClosureTurf as the final cover system. This will require the expenditure of \$20 million during 2022. Completion of the project requires the following actions:

- Purchase ClosureTurf
- Issue RFP
- Select contractor and award contract
- Prepare CCR subgrade
- Install ClosureTurf

Alternatives/Options

As stated previously, the CCR rule does allow for removal of all existing CCR from the impoundment for disposal in a landfill. To implement this alternative, Liberty would either have to identify a landfill to accept the CCR or construct a landfill. In either case, all CCR placed since 1970 would have to be removed from the impoundment and transported. A smaller proportion of the total CCR will need to be handled if it is left in place and closure is achieved by installing an EPA-compliant final cover. Liberty studied all of the alternatives, and ClosureTurf was the lowest cost option. Also, because of the lower vehicle miles traveled, closing the Asbury CCR impoundment with ClosureTurf will result in the least carbon emissions of any of the alternatives.



Capital Project Business Case
Asbury Ash Impoundment Closure – PA-038

2022

Financial Assessment/Cost Estimates

Next Anticipated Test Year	12/30/2023	Was this Capital Project included in the current year’s Board Approved Budget?	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
Regulatory Lag (Click appropriate box)	<input checked="" type="checkbox"/> Less than 6 Months <input checked="" type="checkbox"/> 6-12 Months <input type="checkbox"/> 1 to 3 years <input type="checkbox"/> Greater than 3 years MO=PISA, other states longer		

The total project estimate includes the following estimate plus approximately \$2 million in expenses on previously approved work orders related to ash impoundment closure. The following budget is considered a Class 4 Estimate:



Capital Project Business Case

Asbury Ash Impoundment Closure – PA-038

2022

Capital Line Item	%	Cost Code	Cost Code2	Description	Original Budget	Budget
Services		Contract Services	2-CS	Closure Bid - CCR Grading	\$ -	\$ 30,000
Services		Contract Services	2-CS	Closure Bid - Geosynthetics	\$ -	\$ 12,000
Services		Contract Services	2-CS	Kenny Singer	\$ -	\$ 40,000
Services					\$ -	\$ -
Services					\$ -	\$ -
Contract Work		Contract Labor	1-CW	Closure Bid - Geosynthetics	\$ -	\$ 2,378,330
Contract Work		Contract Fees	8-FE	Closure Bid-CCR Grading	\$ -	\$ 2,334,005
Contract Work		Contract Fees	8-FE	Closure Bid-Geosynthetics	\$ -	\$ 129,600
Contract Work		Contract Fees	8-FE	Closure Bid-Revegetation	\$ -	\$ 257,268
Contract Work		Contract Labor	1-CW	Groundwater monitoring-CCR Compliance	\$ -	\$ 190,000
Contract Work		Contract Fees	8-FE	Other Contractor Fees	\$ -	\$ 30,000
Contract Work		Contract Labor	1-CW	Other Contract Labor	\$ -	\$ 135,000
Engineering		Consulting Fees	3-CF	Closure Bid-CQA	\$ -	\$ 360,000
Engineering		Consulting Fees	3-CF	Closure Bid-Project Management	\$ -	\$ 120,000
Engineering		Consulting Fees	3-CF	Other - PPI	\$ -	\$ 44,000
Engineering		Consulting Fees	3-CF	MEC Compliance Support and closure design	\$ -	\$ 445,000
Engineering		Non-Union Labor	3-PRN	Internal Non-Union Support	\$ -	\$ 137,000
Labor & Support		Union Labor	4-PRU	Internal Union Support	\$ -	\$ 125,000
Labor & Support		Support Services	4-SS	Support Services	\$ -	\$ 3,000
Labor & Support		Vehicle Usage	4-V	Vehicle Usage	\$ -	\$ -
Labor & Support					\$ -	\$ -
Labor & Support					\$ -	\$ -
Owner Materials					\$ -	\$ -
Owner Materials					\$ -	\$ -
Owner Materials					\$ -	\$ -
Owner Materials					\$ -	\$ -
Owner Materials					\$ -	\$ -
Contractor Materials		Materials And Supplies	5-MS	Closure bid -Contractor Materials-Geosynthetics	\$ -	\$ 10,957,628
Contractor Materials		Materials And Supplies	5-MS	Closure bid-Revegetation	\$ -	\$ 90,810
Contractor Materials		Materials And Supplies	6-MS	Other-Contractor Materials	\$ -	\$ 80,000
Contractor Materials					\$ -	\$ -
Contractor Materials					\$ -	\$ -
Land					\$ -	\$ -
Land					\$ -	\$ -
Land					\$ -	\$ -
Land					\$ -	\$ -
Land					\$ -	\$ -
Other		Fee	8-FE	Other Fees	\$ -	\$ -
Other		Taxes	8-TX	Taxes	\$ -	\$ -
Other					\$ -	\$ -
Other					\$ -	\$ -
Other					\$ -	\$ -
Overheads	41.00%	Overheads	9-O	Overheads-Contract Work-Services	\$ -	\$ 149,650.00
Overheads	120.00%	Overheads	9-O	Overheads-Internal Labor	\$ -	\$ 314,400.00
Overheads	22.00%	Overheads	9-O	Overheads	\$ -	\$ -
Overheads					\$ -	\$ -
Overheads					\$ -	\$ -
Contingency	15.00%	Contingency	10-C	CW Work & Services	\$ -	\$ 830,430.45
Contingency	10.00%	Contingency	10-C	Engineering	\$ -	\$ 110,600.00
Contingency	10.00%	Contingency	10-C	Materials	\$ -	\$ 1,112,843.80
Contingency	10.00%	Contingency	10-C	Internal Labor	\$ -	\$ 26,200.00
Contingency					\$ -	\$ -
					\$-	\$ 20,442,765



Capital Project Business Case

Asbury Ash Impoundment Closure – PA-038

2022

Schedule		
Key Milestone Description	Forecast Start Date	Forecast End Date
Issue Closure Turf Purchase Order	February 28, 2022	February 28, 2022
Issue RFP	March 1, 2022	April 1, 2022
Select contractor	April 1, 2022	April 15, 2022
Final Award/NTP	April 15, 2022	May 15, 2022
Contractor mobilization	June 1, 2022	June 1, 2022
Closure Turf delivery	June 28, 2022	July 9, 2022
Construction	June 1, 2022	November 30, 2022
Risk Assessment		
(Please describe the risk of not completing the project)		
<p>The risk of not completing the project is that Liberty will be in violation of federal regulations with a daily maximum civil penalty of more than \$70,000 per day per violation. The risk of delaying the project is that future changes to the regulations may require more costly methods of closure, including removal of all CCR from the existing impoundment.</p>		
Trade Finance		
Not applicable.		
Supporting Documentation		
(Reference drawings, condition assessment reports, vendor quotations, etc. Attach document or where possible include hyperlink to file located on shared server or SharePoint)		
<ul style="list-style-type: none"> • Notification of Intent to Close CCR Surface Impoundments, by Midwest Environmental Consultants – April 1, 2021 • Asbury CCR Impoundment Final Cover Cost Study, by Midwest Environmental Consultants – February 2022 • Alternative Cover System Demonstration, by Midwest Environmental Consultants – December 2021 • Quotation for ClosureTurf Final Cover System for Asbury CCR Impoundment Closure, by Watershed Geosynthetics, LLC – February 8, 2022 		

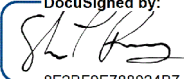


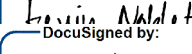

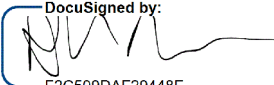


Capital Project Business Case

Asbury Ash Impoundment Closure – PA-038

2022

Approvals and Signatures¹

Approved By:				
Role	Approval Authority Limit	Name	Signature	Date
Manager / Staff (requisitioner/buyer):	Up to \$25,000			
Senior Manager:	Up to \$50,000	Shaen Rooney	 DocuSigned by: 4E8A4AC3A02E458...	2/16/2022
Senior Director/Director:	Up to \$250,000	Drew Landoll	 DocuSigned by:	2/16/2022
State President / Senior VP / VP:	Up to \$500,000	Tim Wilson	 DocuSigned by:	2/17/2022
Regional President:	Up to \$3,000,000	Kevin Noblet	 DocuSigned by:	3/3/2022
Corporate - Sr VP Operations:	Up to \$5,000,000	Gerald Tremblay	 4E8A4AC3A02E458...	3/4/2022
Corporate - Exec Team Member (CEO, CFO, COO, Vice Chair):	Over \$5,000,000	Johnny Johnston	 DocuSigned by: F2C509DAF29448E...	3/9/2022

¹ Approvals for work orders and purchase orders are subject to the limits set forth in the Approval Limits of Authority Policy owned and amended from time to time by the corporate procurement group.



Sound Environmental Solutions

April 1, 2021

The Empire District Electric Company
A Liberty Utilities Company
602 South Joplin Street
PO Box 127
Joplin, MO 64802-0127

Re: **Notification of Intent to Close CCR Surface Impoundments**
EPA CCR Rule Section 40 CFR 257.102 (g)
Empire District Electric Company – Asbury Power Plant
Asbury, Missouri

2009 E. McCarty St.
Suite 2

Jefferson City, MO 65101
voice: 573.636.9454

fax: 573.761.4200

1350 E. Kingsley St.
Suite E

Springfield, MO 65804
voice: 417.886.9200

fax: 417.886.9876

www.mecpc.com

To Whom it May Concern:

The following provides Notification of Intent to Close the CCR Impoundment located at the Empire District Electric Company's Asbury Power Plant. This letter serves as certification that the facility is in compliance with 40 CFR 257.102(g) of the EPA CCR.

257.102(g) No later than the date the owner or operator initiates closure of a CCR unit, the owner or operator must prepare a notification of intent to close a CCR unit. The notification must include the certification by a qualified professional engineer or the approval from the Participating State Director or the approval from EPA where EPA is the permitting authority for the design of the final cover system as required by § 257.102(d)(3)(iii), if applicable. The owner or operator has completed the notification when it has been placed in the facility's operating record as required by § 257.105(i)(7).

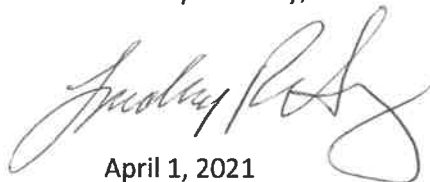
Empire is providing Notification of Intent to Close the CCR Impoundment as of April 11, 2021. This certification has been prepared by a qualified professional engineer and placed in the facility's operating record as required by § 257.105(i)(7).

CERTIFICATION 257.102 (g)

The undersigned Professional Engineer (P.E.) is familiar with the requirements of 40 CFR Part 257. The above serves as Notification of Intent to Close the CCR Impoundment for the Empire District Electric Company's Asbury Power Plant. I hereby certify that the facility is in compliance with 40 CFR 257.102(g) and all information has been placed in the Operating Record. The owner or operator has completed the notification when it has been placed in the facility's operating record as required by § 257.105(i)(7).

Name: Lindsey R. Henry, P.E.

Signature:



Date: April 1, 2021

Registration Number: E-21592

State: Missouri

Seal



Asbury CCR Impoundment Final Cover Cost Study

Asbury Power Plant

21133 Uphill Road
Asbury, Missouri 64832

February 2022

Prepared For:

The Empire District Electric Company
602 S. Joplin Avenue
Joplin, Missouri 64801



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Appendix 1 – Cost Estimates

1.0 INTRODUCTION

On April 17, 2015 the United States Environmental Protection Agency (EPA) issued 40 CFR 257 – *Criteria of Solid Waste Disposal Facilities and Practices* and 40 CFR 261 – *Identification and Listing of Hazardous Waste*, known as the EPA CCR Rule. Coal combustion residuals (CCR) means fly ash, bottom ash, boiler slag, and flue gas desulfurization materials generated from burning coal for the purpose of generating electricity by electric utilities and independent power producers.

The EPA CCR Rule allows the closure of a CCR surface impoundment by leaving the CCR in place and requires the installation of a final cover system. If a CCR unit is closed by leaving CCR in place, the owner or operator must install a final cover system that is designed to minimize infiltration and erosion, and at a minimum, meets the requirements of paragraph 40 CFR 257.102(d)(3)(i) or the requirements of the alternative final cover system specified in paragraph 40 CFR 257.102(d)(3)(ii) of the rule.

This report will provide an analysis of final cover systems that meet the requirements of the EPA CCR Rule to determine which system provides the cost-effective, long-term alternative to meet the requirements of this rule.

2.0 REGULATORY REQUIREMENTS

The final cover system for the CCR impoundment must comply with 40 CFR 257.102(d)(3)(i). This regulation states:

The final cover system must be designed and constructed to meet the criteria in paragraphs (d)(3)(i)(A) through (D) of this section. The design of the final cover system must be included in the written closure plan required by paragraph (b) of this section.

- (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.*
- (C) The erosion of the final cover system must be minimized by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.*
- (D) The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.*

40 CFR 257.102(d)(3)(ii) outlines the requirements should the facility chose to utilize an alternative final cover system. This regulation states:

The owner or operator may select an alternative final cover system design, provided the alternative final cover system is designed and constructed to meet the criteria in paragraphs (d)(3)(ii)(A) through (C) of this section. The design of the final cover system must be included in the written closure plan required by paragraph (b) of this section.

- (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 (d)(3)(i)(A) and (B) of this section.*

(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 (d)(3)(i)(C) of this section.

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

3.0 FINAL COVER SYSTEM ALTERNATIVES

Alternative final cover systems meeting the EPA CCR Rule requirements were reviewed. Three alternatives were chosen and are presented below:

- EPA Soil Cap
- Composite Soil Cap
- ClosureTurf Cap

3.1 EPA Soil Cap

The EPA Soil Cap is defined in 40 CFR 257.102(d)(3)(i). The EPA Soil Cap consists of the following components, top to bottom.

- Vegetation
- Six inches (6") of soil capable of sustaining vegetative growth
- Eighteen inches (18") of compacted soil with a permeability no greater than 1×10^{-5} cm/sec
- Prepared CCR subgrade

3.2 Composite Soil Cap:

A Composite Soil Cap is comparable to a Subtitle D cap. A composite soil cap consists of the following components, top to bottom.

- Vegetation
- Twenty-four inches (24") of soil capable of sustaining vegetative growth
- A drainage layer (geocomposite)
- A flexible geomembrane liner (FML)
- Twelve inches (12") of compacted soil with a coefficient of permeability no greater than 1×10^{-5} cm/sec
- Prepared CCR subgrade

3.3. ClosureTurf Cap:

ClosureTurf is a patented, three component system that is EPA, Subtitle D compliant landfill closure solution that is specifically designed to address and solve soil erosion, slope integrity, installation and maintenance cost control, EPA regulation compliance, and longevity of structure and appearance. The anticipated design life of ClosureTurf is 100 years. ClosureTurf consists of the following components, top to bottom.

- Specialized sand infill
- An engineered artificial turf
- A flexible geomembrane liner (FML)
- Prepared CCR subgrade

There is another artificial closure system on the market that is similar to ClosureTurf. LiteEarth is a monolithic geocomposite capping system with a 40-mil Linear Low-Density Polyethylene (LLDPE) geomembrane, bonded to an advanced UV stabilized synthetic turf. The life of LiteEarth does not meet the anticipated life of ClosureTurf. LiteEarth has an anchoring system that requires penetration of the geomembrane on a 30-foot grid. This would equate to approximately 49 penetrations per acre. Assuming 10% of these penetrations leak the estimated cap infiltration compared to ClosureTurf would be twice as much.

ClosureTurf offers a benefit to easily convert the closed surface of the CCR Impoundment into a solar generation farm. The PowerCap system is a unique geotechnical approach to creating a highly stabilized solar system for landfills and impoundments. PowerCap provides a direct attachment method from the panel to the ClosureTurf surface with no penetration of the cover system.

4.0 FINAL COVER SYSTEMS ANALYSIS

The purpose of the cost study is to select a final cover system that is compliant with the EPA CCR Rule and is the most cost-effective for the facility. This includes initial construction cost, long-term maintenance, and environmental impact cost. The three final cover presented above meet or exceed the requirements of the EPA CCR Rule.

The table below includes a number of items that were reviewed to determine the best final cover systems for the Asbury CCR Impoundment. Further discussion of each of these items is presented below. The factors are presented alphabetically with no impact weight being given to any item. A + represents a positive impact while a – represents a negative impact. A cost analysis is also presented in this report.

Asbury Power Plant CCR Impoundment Closure - Comparison of Cap Options			
	EPA Soil Cap	Composite Cap	ClosureTurf Cap
Borrow Area Disturbance	-	-	+
Cap Infiltration (GW Impacts)	-	+	+
Carbon Footprint	-	-	+
Construction Time	-	-	+
CQA Oversight	-	-	+
MDNR/EPA Approval	+	+	+
Mowing	-	-	+
Other Utilities	-	-	+
Repair Erosion	-	-	+
Reseed & Fertilizer	-	-	+
Safety	-	-	+
Soil Cost	-	-	+
Solar Capabilities	-	-	+
Stormwater Quality	-	-	+
Truck Traffic	-	-	+

Borrow Area Disturbance: The construction of the EPA Soil Cap and the Composite Cap require large volumes of soil to complete the construction. This will require the development of a borrow area to provide this soil. The areas adjacent to the power plant have been extensively investigated as part of the permitting process for a CCR Landfill. MDNR issued a Construction Permit for an 88.9-acre landfill design in accordance with MDNR Regulations and the EPA CCR Rule. The area of the landfill and the permitted borrow areas must be left untouched or this permit may be rescinded. Should the current CCR regulations change or if there are certain environmental impacts from the CCR Impoundment the landfill may need to be built to be able to dispose of the CCR. Because of these concerns it was determined that these areas would not be disturbed.

During the borrow investigation for the landfill there were two other areas investigated that are owned by The Empire District Electric Company. The first area is located adjacent and north of the Power Plant. This area is an Old Law partially reclaimed strip mine. Test pits indicated the soils in this area would require screening and sorting to provide acceptable material. There was also concern that the soils may contain certain materials that could impact groundwater and may impact the ability to sustain vegetation.

The second potential borrow area is approximately 7.5 miles west of the Power Plant. The soils in this area are undisturbed and should provide the required permeability and also allow for vegetation to be established. A cost of soil should be considered in the analysis due to the detrimental impact to this property.

The third option would be to require the contractor to obtain their own soil for the project. Contractor supplied soil would cause timing issues with the construction of the soil cap because of the need to properly characterize and pre-approve the soils.

The chosen borrow area would require state permitting and final reclamation of the disturbed area. The time to obtain state approval of the borrow reclamation could take a number of years requiring an increased cost and longer environmental impacts to the utility.

The use of ClosureTurf would not require establishing an offsite borrow area.

Cap Infiltration (GW Impacts): The EPA Soil Cap is defined in 40 CFR 257.102(d)(3)(i) and further discussed in Section 3 of this report. The EPA regulation 40 CFR 257.102(d)(3)(ii) outlines what must be considered should an Alternative Cover System be used. One of the major items to address is the requirement to limit infiltration through the cover system. The U.S. EPA Hydrologic Evaluation of Landfill Performance (HELP) Model was utilized to estimate the amount of infiltration that would pass through the three final cover systems.

The HELP Model results showed an average annual percolation reduction of 91.6% for the ClosureTurf final cover system compared to the EPA Soil Cap. The average annual percolation results for the EPA Soil Cover System was 10.83 inches while the ClosureTurf Cover System was 0.91 inches. The percolation rate of the Composite Cap is similar to the ClosureTurf.

Minimizing infiltration into the CCR mass should result in improved groundwater quality in the area of the CCR impoundment limiting future environmental impacts and liability of the facility.

Carbon Footprint: There are published reports that claim the use of exposed geomembrane cover systems have a carbon footprint of approximately 20% of soil caps. The grading and reshaping of the CCR in the CCR Impoundment is not included since it is similar for all alternatives. Below are some factors for each of the final cover systems that would support that claim.

The EPA Soil Cap would have the impacts below:

- Excavation and Loading Soil – 126 crew days
- Soil Hauling - 27,830 trips, approximately 417,450 miles
- Geosynthetic Delivery – 0 trucks
- Soil Placement, Grading and Compaction – 600 crew days
- FML Installation – 0 crew days
- Seeding – 65 crew days
- Mowing (5 times/year) – 76.9 crew days

The Composite Cap would have the impacts below:

- Excavation and Loading Soil – 189 crew days
- Soil Hauling – 41,745 trips, approximately 626,175 miles
- Geosynthetic Delivery – 100 trucks
- Soil Placement, Grading and Compaction – 600 crew days
- FML Installation – 75 crew days
- Seeding – 65 crew days
- Mowing (5 times/year) – 76.9 crew days

The ClosureTurf Cap would have the impacts below:

- Excavation and Loading Soil – 0 crew days
- Soil Hauling – 0 trips, 0 miles
- Geosynthetic Delivery – 100 trucks
- Soil Placement, Grading and Compaction – 0 crew days
- FML Installation – 75 crew days
- Seeding – 0 crew days
- Mowing (5 times/year) – 0 crew days

Review of the information above shows a reduction in carbon footprint for the installation of the ClosureTurf Cap Closure System.

Construction Time: The ClosureTurf Cap would have the shortest time to complete construction while the Composite Cap would have the longest time to complete construction. The soil component of both the EPA Soil Cap and the Composite Cap greatly influence the duration of construction. Review of the crew days presented in the Carbon Footprint section above easily shows the impact of soil on the schedule.

Impacts of wet and cold weather also will greatly influence the construction time for the construction associated with soil. The low permeability layer must be installed in compacted lifts of 6 to 8 inches at the proper moisture-density relationship to meet the permeability requirement of the soil. Also, freezing weather conditions can limit the construction schedule associated with placement of this low permeability layer.

CQA Oversight: Construction Quality Assurance (CQA) services are needed to be able to certify proper closure of the CCR Impoundment to the EPA. The soil portion of the cap discussed above is a large portion of the CQA services. Below is a brief summary the CQA services for each cap system.

- The EPA Cap would involve approximately 59 pre-qualification tests and a minimum of 1,569 moisture density tests along with numerous Atterberg limit tests. There would be no required testing associated with FML installation since no FML would be installed.
- The Composite Cap would have approximately 39 pre-qualification tests and a minimum of 1,044 moisture density tests with fewer Atterberg limit tests. There would also be approximately 440 destructive seam tests for the FML.
- The ClosureTurf would have no soil testing and approximately 440 destructive seam tests for the FML.

The soil portion of the construction of EPA Cap and Composite Cap would also require the presence of a CQA technician at the borrow area to ensure proper soils are being excavated for use at the CCR Impoundment. The construction time and testing associated with CQA oversight would be dramatically less with the ClosureTurf system.

MDNR/EPA Approval: All three of the cover systems would meet the requirements of MDNR and EPA.

Mowing: The EPA CCR Rule requires that vegetation on the closed impoundment cannot exceed 12 inches in height. Both the EPA Cap and the Composite Cap are required to be vegetated. It is estimated that the CCR Impoundment surface will need to be mowed approximately 5 times a year to be in compliance with the EPA CCR Rule. Mowing and other related maintenance of the reclaimed CCR Impoundment area would continue forever. No mowing is required for the ClosureTurf.

Other Utilities: The other regulated utilities in Missouri, Ameren and Evergy, have used ClosureTurf on many of their CCR Impoundment and Landfill closures due to the factors discussed in this report.

Repair Erosion: One of the requirements of the EPA CCR Rule contained in 40 CFR 257.104(b)(1) is to maintain the integrity and effectiveness of the final cover system. This includes repairing any erosion to the final cover system. Both the EPA Cap and the Composite Cap will require to be vegetated and will need to have repairs to the eroded areas of the cap on an annual basis.

The ClosureTurf Cap system will not be impacted by erosion but may require replacement of the sand infill on a periodic basis.

Reseed & Fertilizer: Post-Closure care to maintain the integrity and effectiveness of the final cover system will require periodic reseeding and fertilizing to maintain the vegetation on the cap to limit erosion. Both the EPA Cap and the Composite Cap will require the vegetation to be maintained.

The ClosureTurf Cap system will not be impacted lack of vegetation but may require replacement of the sand infill on a periodic basis.

Safety: The use of the ClosureTurf Cap system will eliminate 417,450 to 626,175 truck miles on the roads in the vicinity of the Asbury Power Plant. This will have a positive impact on safety in the area.

Soil Cost: The Empire District Electric Company owns the property that has been identified as the borrow area. Utilizing this property for borrow will have a detrimental impact on the property. The site is currently a hay field that will be taken out of production. Based upon RSMMeans cost data the cost to purchase borrow material is estimated at \$18.50 per bank cubic yard of material. A cost of soil should be considered in the analysis due to the detrimental impact to this property to determine the overall cost to close the CCR Impoundment.

There is no soil cost associated with the installation of ClosureTurf.

Solar Capabilities: The Empire District Electric Company has considered the placement of a solar generation farm on the CCR Impoundment Cap. ClosureTurf offers a benefit to easily convert the closed surface of the CCR Impoundment into a solar farm. The PowerCap system is a unique geotechnical approach to creating a highly stabilized solar system for landfills and impoundments. PowerCap provides a direct attachment method from the panel to the ClosureTurf surface with no penetration of the cover system.

The EPA Cap and Composite Cap Systems do not provide this capability. Should this area be converted to a solar farm the cap systems would have to be modified to construct the necessary ballasting, conduits, appurtenances, and other improvements. These additional improvements could result in damage to the cap resulting in more infiltration into the underlying CCR.

Stormwater Quality: Stormwater coming off the ClosureTurf is very clean with little to no suspended solids or settleable solids leaving the site. This should allow the facility to be in compliance with their NPDES Permit.

The EPA Cap and Composite Cap Systems will have more suspended solids and settleable solids leaving the site both during construction and during the establishment of vegetation on the cap. It could take a number of years for the vegetation to become fully established. Even after the site has established a good stand of vegetation the impact on stormwater leaving the site will be greater than the ClosureTurf.

Truck Traffic: The use of the ClosureTurf Cap system will eliminate 417,450 to 626,175 truck miles on the roads in the vicinity of the Asbury Power Plant. This large amount of truck traffic will have detrimental impacts on the road system between the borrow area and the power plant. There are approximately 1.6 miles (3.2 miles roundtrip) of gravel roads as part of the route. These roads will have to a dust suppressant such as magnesium chloride or similar to control dust caused by the haul trucks. There could be longer term maintenance of these roads to return them to their current condition. Safety in the area has been addressed previously in the Section.

5.0 COST ANALYSIS

Appendix 1 includes an estimate of construction costs for each of the three final cover systems. Also included is an estimate of ongoing maintenance costs for each final cover system. The

present worth of the maintenance cost is based upon the Liberty carrying charge over a 60-year period at 9.17%

5.1 EPA Soil Cap

The EPA Soil Cap has the lowest environmental factor score with only 1 positive factor out of a total of 15 of rated items. The estimated construction cost is the second highest at \$18,380,818 when a unit cost for soil purchase is included. The annual maintenance cost is tied for the highest annual cost. The present value of the construction cost and annual cost ranks the EPA Soil Cap at second at \$20,341,135.06.

The EPA Soil Cap has the second highest construction present value and has the greatest potential for long-term environmental impacts.

5.2 Composite Soil Cap:

The Composite Soil Cap has the second lowest environmental factor score with only 2 positive factors out of a total of 15 of rated items. The extra positive environmental factor is a very strong factor. The HELP Model results show a similar annual percolation reduction as the ClosureTurf final cover system compared to the EPA Soil Cap.

The negative environmental impacts are tied to the hauling of soil and the long-term maintenance of the soil portion of the cap. The Composite Soil Cap provides a high level of groundwater protection for the closure.

The estimated construction cost is the highest at \$32,151,496 when a unit cost for soil purchase is included. The annual maintenance cost is tied for highest annual cost. The present value of the construction cost and annual cost ranks the Composite Soil Cap at highest at \$34,111,813.06.

Even though the Composite Soil Cap provides a high level of groundwater protection it has the highest construction cost along with higher maintenance costs and high environmental impacts.

5.3 ClosureTurf Cap:

The ClosureTurf Cap System has the highest positive environmental factor score with a score of 15 out of a total of 15 of rated items. The estimated construction cost is the lowest at \$16,669,642 when a unit cost for soil purchase is included. The annual maintenance cost is the lowest annual cost of the three alternatives considered. The present value of the construction cost and annual cost ranks the ClosureTurf Cap as the lowest at \$16,995,561.54. Through discussions with the ClosureTurf providers a Direct Purchase Discount for the ClosureTurf materials was negotiated. This discount is reflected in the cost estimate.

When all factors are considered the ClosureTurf Cap system is considered to be the best alternative due to cost considerations along with present and long-term environmental impacts.

6.0 CONCLUSIONS

The use of the ClosureTurf Cap System meets the requirements of an alternative cover system design per the EPA CCR Rule. This final cover system is the least costly for construction and for long-term maintenance costs. It also provides for enhanced groundwater protection while having minimal other environmental impacts. The ClosureTurf Cap System allows for an efficient

transition of the closed CCR impoundment to a solar farm. The ClosureTurf Cap System is the best alternative of the final cover systems for the closure of the Asbury Power Plant CCR Impoundment.

APPENDIX 1

Cost Estimates

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The Empire District Electric Company
 Asbury Power Plant
 CCR Impoundment Closure
 Budgetary Construction Cost Estimate

ITEM	EPA Soil Cap				Composite Cap				ClosureTurf			
	UNIT	QUANTITY	UNIT COST	SUBTOTAL	UNIT	QUANTITY	UNIT COST	SUBTOTAL	UNIT	QUANTITY	UNIT COST	SUBTOTAL
CCR GRADING												
1. Mobilization/Demobilization	LS	1	\$ 30,000.00	\$ 30,000.00	LS	1	\$ 30,000.00	\$ 30,000.00	LS	1	\$ 30,000.00	\$ 30,000.00
2. Dewatering	DAY	60	\$ 1,000.00	\$ 60,000.00	LS	60	\$ 1,000.00	\$ 60,000.00	LS	60	\$ 1,000.00	\$ 60,000.00
3. Prescribed Burn	LS	1	\$ 30,000.00	\$ 30,000.00	LS	1	\$ 30,000.00	\$ 30,000.00	LS	1	\$ 30,000.00	\$ 30,000.00
4. Clear and Grub	Ac	80	\$ 2,000.00	\$ 160,000.00	Ac	80	\$ 2,000.00	\$ 160,000.00	Ac	80	\$ 2,000.00	\$ 160,000.00
5. Excavate and Haul CCR	CY	63,438	\$ 5.44	\$ 345,102.72	CY	63,438	\$ 5.44	\$ 345,102.72	CY	173,651	\$ 5.44	\$ 944,661.44
6. Dozer Push CCR	CY	343,151	\$ 4.00	\$ 1,372,604.00	CY	343,151	\$ 4.00	\$ 1,372,604.00	CY	240,336	\$ 4.00	\$ 961,344.00
7. Final Grade	Ac	0	\$ 700.00	\$ -	Ac	0	\$ 700.00	\$ -	Ac	120	\$ 700.00	\$ 84,000.00
8. Final Grade and Shape	Ac	120	\$ 1,200.00	\$ 144,000.00	Ac	120	\$ 1,200.00	\$ 144,000.00	Ac	0	\$ 1,200.00	\$ -
9. Compact Subgrade	Ac	120	\$ 700.00	\$ 84,000.00	Ac	120	\$ 700.00	\$ 84,000.00	Ac	120	\$ 700.00	\$ 84,000.00
10. Side Slope Riser	LS	1	\$ 10,000.00	\$ 10,000.00	LS	1	\$ 10,000.00	\$ 10,000.00	LS	1	\$ 10,000.00	\$ 10,000.00
SUBTOTAL			\$	2,235,706.72			\$	2,235,706.72			\$	2,364,005.44
SOIL CAP PLACEMENT												
1. Mobilization/Demobilization	LS	1	\$ 40,000.00	\$ 40,000.00	LS	1	\$ 40,000.00	\$ 40,000.00	LS	0	\$ 40,000.00	\$ -
2. Excavate, Haul and Place Soil (18" Layer)	CY	290,400	\$ 9.57	\$ 2,779,128.00	CY	0	\$ 9.57	\$ -	CY	0	\$ 9.57	\$ -
3. Grading 18" Layer (3 Lifts)	Ac	120	\$ 8,739.00	\$ 1,048,680.00	Ac	0	\$ 8,739.00	\$ -	Ac	0	\$ 8,739.00	\$ -
4. Compact 18" Layer (3 Lifts)	Ac	120	\$ 2,058.00	\$ 246,960.00	CY	0	\$ 2,058.00	\$ -	Ac	0	\$ 2,058.00	\$ -
5. Excavate, Haul and Place Soil (12" Layer)	CY	0	\$ 9.57	\$ -	CY	193,600	\$ 9.57	\$ 1,852,752.00	CY	0	\$ 9.57	\$ -
6. Grading 12" Layer (2 Lifts)	Ac	0	\$ 5,826.00	\$ -	Ac	120	\$ 5,826.00	\$ 699,120.00	Ac	0	\$ 5,826.00	\$ -
7. Compact 12" Layer (2 Lifts)	Ac	120	\$ 1,372.00	\$ 164,640.00	Ac	120	\$ 1,372.00	\$ 164,640.00	Ac	0	\$ 1,372.00	\$ -
8. Final Grading Compacted Soil	Ac	0	\$ 700.00	\$ -	Ac	120	\$ 700.00	\$ 84,000.00	Ac	0	\$ 700.00	\$ -
9. Final Smooth Drum	Ac	0	\$ 7,800.00	\$ -	Ac	120	\$ 7,800.00	\$ 936,000.00	Ac	0	\$ 7,800.00	\$ -
10. Excavate, Haul and Place Vegetative Soil (6" Layer)	CY	96,800	\$ 9.57	\$ 926,376.00	CY	0	\$ 9.57	\$ -	CY	0	\$ 9.57	\$ -
11. Excavate, Haul and Place Vegetative Soil (24" Layer)	CY	0	\$ 9.57	\$ -	CY	387,200	\$ 9.57	\$ 3,705,504.00	CY	0	\$ 9.57	\$ -
12. Final Grading Vegetative Soil	Ac	120	\$ 700.00	\$ 84,000.00	Ac	120	\$ 700.00	\$ 84,000.00	Ac	0	\$ 700.00	\$ -
13. Borrow Area Reclamation	Ac	30	\$ 3,027.00	\$ 90,810.00	Ac	40	\$ 3,027.00	\$ 121,080.00	Ac	0	\$ 3,027.00	\$ -
14. Borrow Area Seed Fertilize & Mulch	Ac	40	\$ 3,027.00	\$ 121,080.00	Ac	50	\$ 3,027.00	\$ 151,350.00	Ac	0	\$ 3,027.00	\$ -
15. Borrow Area Access & Road Maintenance	LS	1	\$ 150,000.00	\$ 150,000.00	LS	1	\$ 150,000.00	\$ 150,000.00	LS	0	\$ 150,000.00	\$ -
16. Borrow Soil Cost	CY	387,500	\$ 18.50	\$ 7,168,750.00	CY	580,800	\$ 18.50	\$ 10,744,800.00	CY	0	\$ 18.50	\$ -
SUBTOTAL			\$	12,820,424.00			\$	18,733,246.00			\$	-

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ITEM	EPA Soil Cap				Composite Cap				ClosureTurf			
	UNIT	QUANTITY	UNIT COST	SUBTOTAL	UNIT	QUANTITY	UNIT COST	SUBTOTAL	UNIT	QUANTITY	UNIT COST	SUBTOTAL
GEOSYNTHETICS												
1. Mobilization/Demobilization	LS	0	\$ 12,000.00	\$ -	LS	1	\$ 12,000.00	\$ 12,000.00	LS	1	\$ 12,000.00	\$ 12,000.00
2. Geocomposite Drainage Layer (materials & install)	SF	0	\$ 0.88	\$ -	SF	5,227,200	\$ 0.88	\$ 4,599,936.00	SF	0	\$ 0.88	\$ -
3. 40 mil LLDPE (materials & install)	SF	0	\$ 0.60	\$ -	SF	5,227,200	\$ 0.60	\$ 3,136,320.00	SF	0	\$ 0.60	\$ -
4. ClosureTurf 40 mil for slopes < 4:1 (materials)	SF	0	\$ 2.26	\$ -	SF	0	\$ 2.26	\$ -	SF	4,356,000	\$ 2.26	\$ 9,844,560.00
5. ClosureTurf 50 mil for slopes > 4:1 (materials)	SF	0	\$ 2.72	\$ -	SF	0	\$ 2.72	\$ -	SF	871,000	\$ 2.72	\$ 2,369,120.00
6. ClosureTurf 40 mil for slopes < 4:1 (install)	SF	0	\$ 0.20	\$ -	SF	0	\$ 0.20	\$ -	SF	4,356,000	\$ 0.20	\$ 871,200.00
7. ClosureTurf 50 mil for slopes > 4:1 (install)	SF	0	\$ 0.23	\$ -	SF	0	\$ 0.23	\$ -	SF	871,000	\$ 0.23	\$ 200,330.00
8. Sand Infill ClosureTurf (120 T/acre) (material)	Ton	0	\$ 40.00	\$ -	Ton	0	\$ 40.00	\$ -	Ton	14,400	\$ 40.00	\$ 576,000.00
9. Sand Infill ClosureTurf (120 T/acre) (install)	SF	0	\$ 0.25	\$ -	SF	0	\$ 0.25	\$ -	SF	5,227,200	\$ 0.25	\$ 1,306,800.00
10. Anchor Trenches	LF	0	\$ 12.00	\$ -	LF	10,800	\$ 12.00	\$ 129,600.00	LF	10,800	\$ 12.00	\$ 129,600.00
11. Direct Purchase Discount for Closure Turf	%		0%	\$ -	%		0%	\$ -	%		15%	\$ (1,832,052.00)
SUBTOTAL			\$	\$ -			\$	\$ 7,877,856.00			\$	\$ 13,477,558.00
REVEGETATION AND STORM WATER												
1. Seed Fertilize & Mulch	Ac	150	\$ 3,027.00	\$ 454,050.00	Ac	150	\$ 3,027.00	\$ 454,050.00	Ac	30	\$ 3,027.00	\$ 90,810.00
2. Erosion & Sediment Control (Silt Fence)	LF	49,680	\$ 3.43	\$ 170,402.40	LF	49,680	\$ 3.43	\$ 170,402.40	LF	7,670	\$ 3.43	\$ 26,308.10
3. Temporary Seeding	Ac	120	\$ 1,720.62	\$ 206,474.40	Ac	120	\$ 1,720.62	\$ 206,474.40	Ac	0	\$ 1,720.62	\$ -
4. Rip Rap 18"	SY	10,480	\$ 110.00	\$ 1,152,800.00	SY	10,480	\$ 110.00	\$ 1,152,800.00	Ac	0	\$ 110.00	\$ -
5. Perimeter Ditches	LF	8,000	\$ 13.87	\$ 110,960.00	LF	8,000	\$ 13.87	\$ 110,960.00	LF	8,000	\$ 13.87	\$ 110,960.00
6. Stormwater Detention Pond	LS	2	\$ 60,000.00	\$ 120,000.00	LS	2	\$ 60,000.00	\$ 120,000.00	LS	2	\$ 60,000.00	\$ 120,000.00
7. Pond Improvements for E&S Control	LS	2	\$ 15,000.00	\$ 30,000.00	LS	2	\$ 15,000.00	\$ 30,000.00	LS	0	\$ 15,000.00	\$ -
SUBTOTAL			\$	\$ 2,244,686.80			\$	\$ 2,244,686.80			\$	\$ 348,078.10
PROJECT MANAGEMENT												
1. CQA - Pond	Mo	24	\$ 30,000.00	\$ 720,000.00	Mo	24	\$ 30,000.00	\$ 720,000.00	Mo	12	\$ 30,000.00	\$ 360,000.00
2. CQA - Borrow Area	Mo	6	\$ 20,000.00	\$ 120,000.00	Mo	5	\$ 20,000.00	\$ 100,000.00	Mo	12	\$ -	\$ -
3. Project Management	Mo	24	\$ 10,000.00	\$ 240,000.00	Mo	24	\$ 10,000.00	\$ 240,000.00	Mo	12	\$ 10,000.00	\$ 120,000.00
SUBTOTAL			\$	\$ 1,080,000.00			\$	\$ 1,060,000.00			\$	\$ 480,000.00
TOTAL			\$	\$ 18,380,817.52	TOTAL		\$	\$ 32,151,495.52	TOTAL		\$	\$ 16,669,641.54

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The Empire District Electric Company
Asbury Power Plant
CCR Impoundment Closure
Annual Maintenance Cost Estimate

ITEM	EPA Soil Cap				Composite Cap				ClosureTurf			
	UNIT	QUANTITY	UNIT COST	SUBTOTAL	UNIT	QUANTITY	UNIT COST	SUBTOTAL	UNIT	QUANTITY	UNIT COST	SUBTOTAL
Annual Maintenance												
1. Vegetation (mowing, reseed, fertilizer)	Ac	120	\$ 779.99	\$ 93,598.80	Ac	120	\$ 779.99	\$ 93,598.80	Ac	0	\$ 779.99	\$ -
2. Erosion & sediment repairs	Ac	120	\$ 723.69	\$ 86,842.80	Ac	120	\$ 723.69	\$ 86,842.80	Ac	0	\$ 723.69	\$ -
3. ClosureTurf Sand Replacement Top	Ac	0	\$ 200.00	\$ -	Ac	0	\$ 200.00	\$ -	Ac	100	\$ 200.00	\$ 20,000.00
4. ClosureTurf Sand Replacement Slopes	Ac	0	\$ 500.00	\$ -	Ac	0	\$ 500.00	\$ -	Ac	20	\$ 500.00	\$ 10,000.00
SUBTOTAL			\$	180,441.60			\$	180,441.60			\$	30,000.00
Present Worth Annual Maintenance												
60 years at 9.15%			\$	1,960,317.54			\$	1,960,317.54			\$	325,920.00
			\$	20,341,135.06			\$	34,111,813.06			\$	16,995,561.54

Alternative Cover System Demonstration 40 CFR § 257.102(d)(3)(ii)

Asbury Power Plant
2133 Uphill Road
Asbury, Missouri 64832

December 2021

Prepared For:
The Empire District Electric Company
602 S. Joplin Avenue
Joplin, Missouri 64801



Anika Careaga
12/21/21



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2.0 CERTIFICATE OF COMPLIANCE	1
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4.0 ALTERNATIVE FINAL COVER SYSTEM	3
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LIST OF APPENDICES

Appendix A – HELP Model (EPA Soil Cover)

Appendix B – HELP Model (ClosureTurf Cover)



1.0 INTRODUCTION

The EPA CCR Rule allows the closure of a CCR surface impoundment by leaving the CCR in place and requires the installation of a final cover system. If a CCR unit is closed by leaving CCR in place, the owner or operator must install a final cover system that is designed to minimize infiltration and erosion, and at a minimum, meets the requirements of paragraph 40 CFR 257.102(d)(3)(i) or the requirements of the alternative final cover system specified in paragraph 40 CFR 257.102(d)(3)(ii) of the rule. The owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer that the design of the final cover system meets the requirements of this section (40 CFR 257.102(d)(3)(iii)).

2.0 CERTIFICATE OF COMPLIANCE

Alternative Final Cover System Demonstration
EPA CCR Rule Section 40 CFR 257.102(d)(3)
Empire District Electric Company – Asbury Power Plant
Asbury, Missouri

CERTIFICATION 40 CFR 257.102(d)(3)(iii)

The undersigned Professional Engineer (P.E.) is familiar with the requirements of 40 CFR Part 257. The above summarizes the status of the Alternative Final Cover System Demonstration for the closure of the Empire District Electric Company’s CCR Impoundment at the Asbury Power Plant. I hereby certify that the facility is in compliance with 40 CFR 257.102(d)(3)(iii) and all information has been placed in the Operating Record. Notification of availability of this document should be provided to the State Director as required in section 257.107(h).

Name: Anika Careaga, P.E.

Seal:

Signature: Anika Careaga
Date: 12/21/2021

Registration Number: 2005022085

State: Missouri



3.0 REGULATORY REQUIREMENTS

The following Alternative Final Cover System Demonstration is being presented for the Empire District Electric Company's CCR Impoundment at the Asbury Power Plant. This serves as certification that the facility has completed an Alternative Final Cover System Demonstration in compliance with 40 CFR 257.102(d)(3)(ii) of the EPA CCR Rule.

The final cover system for the CCR impoundment must comply with 40 CFR 257.102(d)(3)(i). This regulation states:

The final cover system must be designed and constructed to meet the criteria in paragraphs (d)(3)(i)(A) through (D) of this section. The design of the final cover system must be included in the written closure plan required by paragraph (b) of this section.

(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.

(C) The erosion of the final cover system must be minimized by the use of an erosion layer that contains a minimum of six inches of earthen material that is capable of sustaining native plant growth.

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

40 CFR 257.102(d)(3)(ii) outlines the requirements should the facility chose to utilize an alternative final cover system. This regulation states:

The owner or operator may select an alternative final cover system design, provided the alternative final cover system is designed and constructed to meet the criteria in paragraphs (d)(3)(ii)(A) through (C) of this section. The design of the final cover system must be included in the written closure plan required by paragraph (b) of this section.

(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 (d)(3)(i)(A) and (B) of this section.

(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 (d)(3)(i)(C) of this section.

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

40 CFR 257.102(d)(3)(iii) requires an alternative cover system design to be certified by a professional engineer. This regulation states:

The owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer that the design of the final cover system meets the requirements of this section.

4.0 ALTERNATIVE FINAL COVER SYSTEM

The chosen final cover system to be evaluated is the ClosureTurf system. ClosureTurf is a patented, three component system that is EPA Subtitle D compliant landfill that is specifically designed to address and solve soil erosion, slope integrity, installation and maintenance cost control, EPA regulation compliance, and longevity of structure and appearance. The anticipated design life of ClosureTurf is 100 years. ClosureTurf consists of the following components, top to bottom.

- Specialized sand infill
- Engineered artificial turf
- Flexible geomembrane liner (FML)
- Prepared CCR subgrade

The owner or operator may select an alternative final cover system provided the system is designed and constructed to meet the criteria discussed later in this report. These criteria include:

- Infiltration
- Erosion
- Integrity

5.0 INFILTRATION

The U.S. EPA Hydrologic Evaluation of Landfill Performance (HELP) Model was utilized to complete a comparison of the reduction of infiltration through the final cover system. The assumptions listed below were used as input parameters used for running the HELP model:

- The HELP model was run for a one acre (43,560 square feet) area over a twenty year period.
- The monthly precipitation and temperature data for Asbury, Missouri as tabulated per EPA guidance in the HELP Model.
- In order to determine membrane leakage for the proposed ClosureTurf flexible membrane liner (FML) cap, the following parameters were specified: a pinhole density of 2 holes per acre, an installation defect of 2 holes per acre, and a placement quality of "good." This is believed to be representative of a 40-mil linear low-density polyethylene (LLDPE) liner installed with typical quality assurance/quality control (QA/QC) methods.

The HELP Model runs were performed for the following two conditions: (1) EPA Soil Cover and (2) ClosureTurf Cover. The HELP Model results are included in **Appendix A** for the EPA Soil Cover, **Appendix B** for the ClosureTurf Cover.

Operating Condition	Average Annual Percolation Through Cap
EPA Soil Cover	10.83"
ClosureTurf Cover	0.91"

The ClosureTurf final cover system reduces the average annual percolation through the final cover by 91.6% when compared to the EPA Soil Cover.

6.0 EROSION

The alternative cover system must provide protection from wind and water erosion. Since there is not a soil component of this system the ClosureTurf Cap system will have minimal impacts from wind and water erosion. The system may require replacement of the sand infill on a periodic basis.

7.0 INTEGRITY

The alternative cover system must accommodate settling and subsidence. The ClosureTurf final cover system will have minimal disruption of the integrity of the system due to settling and subsidence.

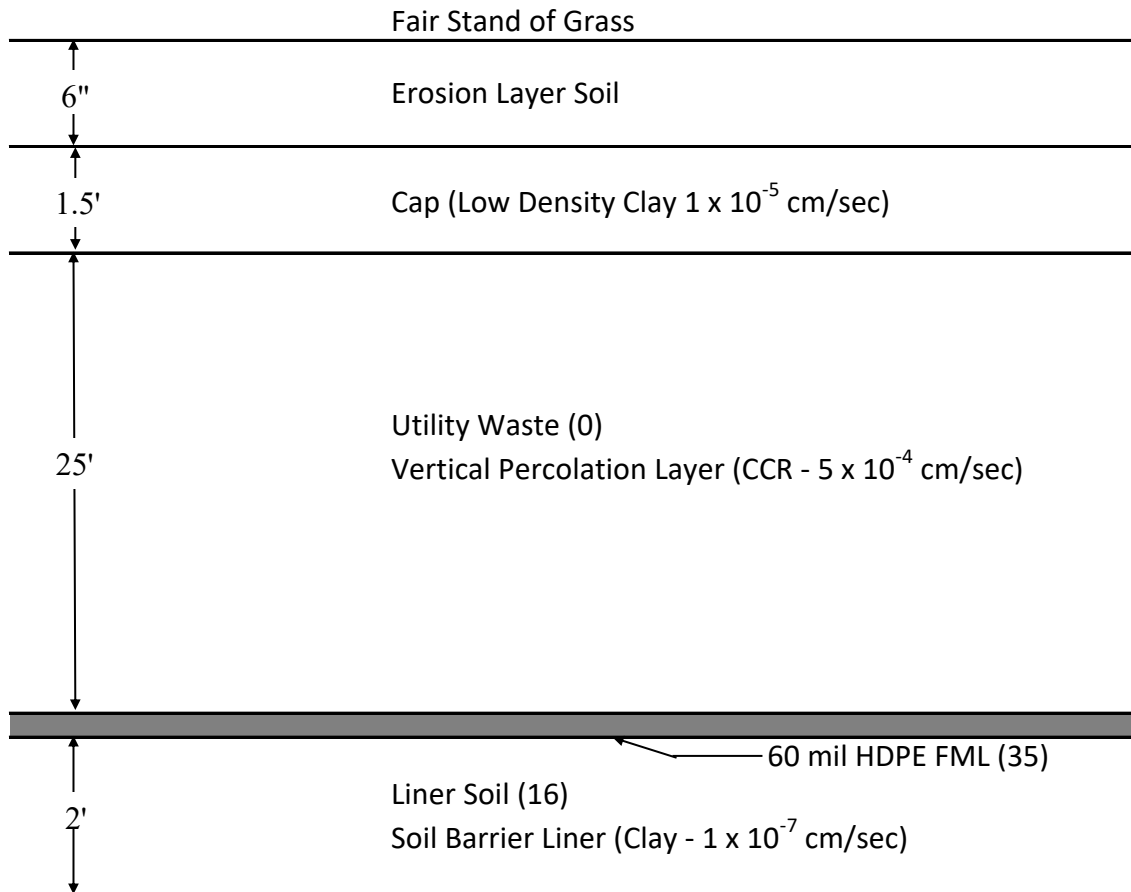
8.0 CONCLUSIONS

The use of the ClosureTurf final cover system meets or exceeds the performance of the EPA Soil Cap when factors associated with infiltration, erosion and integrity are considered.

APPENDIX A

HELP Model (EPA Soil Cover)

Asbury Impoundments
EPA Soil Cover HELP Model
(Not to Scale)



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HELP Model

Hydrologic Evaluation of Landfill Performance Model

General Information

Title

Address

Coordinates (degrees) Lat Long

Years of Simulation Units

LF Area (acres) Specify Initial Moisture?

% Subject to Runoff Water/snow storage (in)

Soil & Design

Temporarily suspend layer rule checking

1	SiL - Silty Loam	
2	Soil Cap	
3	CCR Waste	
4	HDPE Membrane	
5	Liner Soil (High)	

Weather

Data Method	Parameter	Years of Data	✓	✎
[Precipitation	20	✓	✎
	Temperature	20	✓	✎
	Solar Radiation	20	✓	✎
▶	Wind Speed/Rel Humidity		✓	✎
▶	Other Parameters <small>(growing season, LAI & evap zone)</small>		✓	✎

Runoff Curve Number

User-specified curve number (1)

HELP will use the curve number:

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: ASBURY IMPOUNDMENT CLOSURE **Simulated On:** 10/26/2021 17:36

Layer 1

Type 2 - Lateral Drainage Layer

SiL - Silty Loam

Material Texture Number 9

Thickness	=	6 inches
Porosity	=	0.501 vol/vol
Field Capacity	=	0.284 vol/vol
Wilting Point	=	0.135 vol/vol
Initial Soil Water Content	=	0.1967 vol/vol
Effective Sat. Hyd. Conductivity	=	1.90E-04 cm/sec
Slope	=	2.25 %
Drainage Length	=	200 ft

Layer 2

Type 3 - Barrier Soil Liner

Soil Cap

Material Texture Number 43

Thickness	=	18 inches
Porosity	=	0.475 vol/vol
Field Capacity	=	0.378 vol/vol
Wilting Point	=	0.265 vol/vol
Initial Soil Water Content	=	0.475 vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-05 cm/sec

Layer 3

Type 1 - Vertical Percolation Layer (Waste)

CCR Waste

Material Texture Number 83

Thickness	=	300 inches
Porosity	=	0.541 vol/vol
Field Capacity	=	0.187 vol/vol
Wilting Point	=	0.047 vol/vol
Initial Soil Water Content	=	0.2294 vol/vol
Effective Sat. Hyd. Conductivity	=	5.00E-04 cm/sec

Layer 4

Type 4 - Flexible Membrane Liner**HDPE Membrane****Material Texture Number 35**

Thickness	=	0.06 inches
Effective Sat. Hyd. Conductivity	=	2.00E-13 cm/sec
FML Pinhole Density	=	1 Holes/Acre
FML Installation Defects	=	2 Holes/Acre
FML Placement Quality	=	3 Good

Layer 5**Type 3 - Barrier Soil Liner****Liner Soil (High)****Material Texture Number 16**

Thickness	=	24 inches
Porosity	=	0.427 vol/vol
Field Capacity	=	0.418 vol/vol
Wilting Point	=	0.367 vol/vol
Initial Soil Water Content	=	0.427 vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07 cm/sec

Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	91
Fraction of Area Allowing Runoff	=	100 %
Area projected on a horizontal plane	=	1 acres
Evaporative Zone Depth	=	6 inches
Initial Water in Evaporative Zone	=	1.18 inches
Upper Limit of Evaporative Storage	=	3.006 inches
Lower Limit of Evaporative Storage	=	0.81 inches
Initial Snow Water	=	0 inches
Initial Water in Layer Materials	=	88.792 inches
Total Initial Water	=	88.792 inches
Total Subsurface Inflow	=	0 inches/year

Note: SCS Runoff Curve Number was User-Specified.

Evapotranspiration and Weather Data

Station Latitude	=	37.34 Degrees
Maximum Leaf Area Index	=	2
Start of Growing Season (Julian Date)	=	101 days

End of Growing Season (Julian Date)	=	298 days
Average Wind Speed	=	10 mph
Average 1st Quarter Relative Humidity	=	70 %
Average 2nd Quarter Relative Humidity	=	73 %
Average 3rd Quarter Relative Humidity	=	65 %
Average 4th Quarter Relative Humidity	=	67 %

 Note: Evapotranspiration data was obtained for ASBURY, MISSOURI

Normal Mean Monthly Precipitation (inches)

<u>Jan/Jul</u>	<u>Feb/Aug</u>	<u>Mar/Sep</u>	<u>Apr/Oct</u>	<u>May/Nov</u>	<u>Jun/Dec</u>
1.889852	2.02005	3.921549	4.211902	6.485159	5.735078
3.560809	3.345081	5.309204	3.827304	4.61823	3.094609

 Note: Precipitation was simulated based on HELP V4 weather simulation for:
 Lat/Long: 37.34/-94.57

Normal Mean Monthly Temperature (Degrees Fahrenheit)

<u>Jan/Jul</u>	<u>Feb/Aug</u>	<u>Mar/Sep</u>	<u>Apr/Oct</u>	<u>May/Nov</u>	<u>Jun/Dec</u>
40.4	42	50.8	61.5	73.2	81.6
88.6	84.9	77.4	64.1	53.5	47.3

 Note: Temperature was simulated based on HELP V4 weather simulation for:
 Lat/Long: 37.34/-94.57
 Solar radiation was simulated based on HELP V4 weather simulation for:
 Lat/Long: 37.34/-94.57

Average Annual Totals Summary

Title: ASBURY IMPOUNDMENT CLOSURE
Simulated on: 10/26/2021 17:37

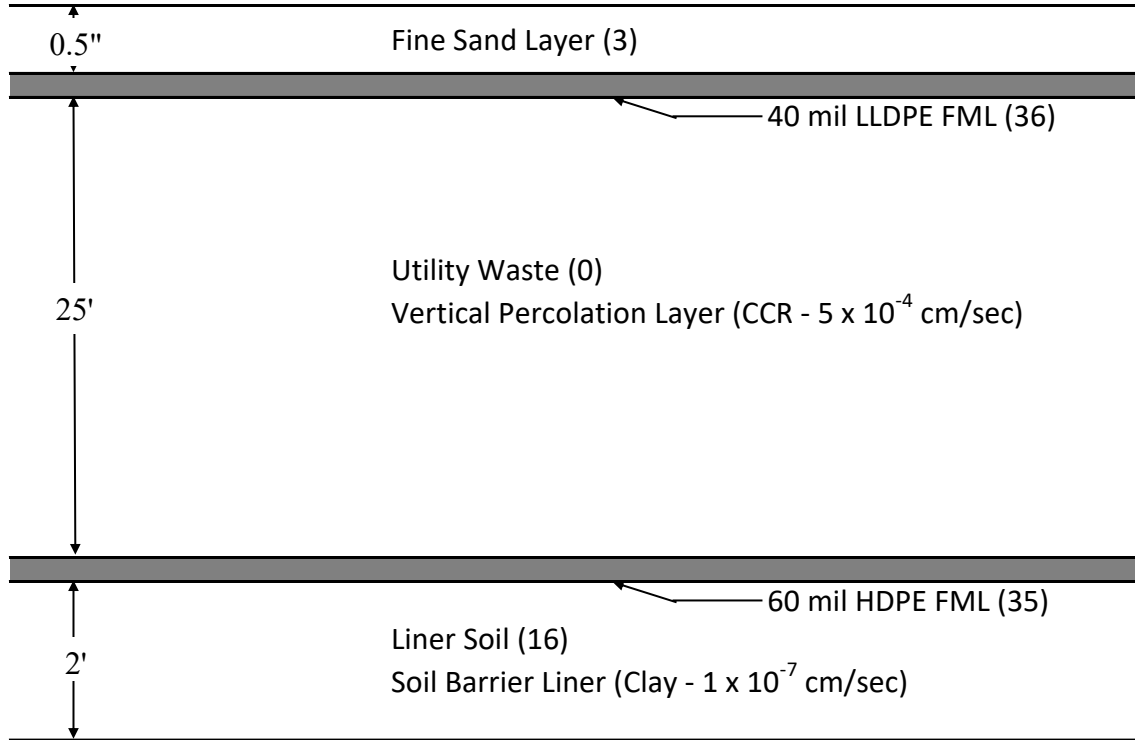
	Average Annual Totals for Years 1 - 20*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	48.02	[6.86]	174,308.3	100.00
Runoff	6.727	[2.246]	24,417.2	14.01
Evapotranspiration	30.444	[3.661]	110,512.7	63.40
Subprofile1				
Lateral drainage collected from Layer 1	0.0054	[0.0026]	19.7	0.01
Percolation/leakage through Layer 2	10.832031	[2.650459]	39,320.3	22.56
Average Head on Top of Layer 2	0.1068	[0.0433]	---	---
Subprofile2				
Percolation/leakage through Layer 5	0.144342	[0.057306]	524.0	0.30
Average Head on Top of Layer 4	243.1687	[86.4836]	---	---
Water storage				
Change in water storage	10.6983	[2.9634]	38,834.8	22.28

* Note: Average inches are converted to volume based on the user-specified area.


APPENDIX B

HELP Model (ClosureTurf Cover)

**Asbury Impoundments
ClosureTurf HELP Model**
(Not to Scale)



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HELP Model

Hydrologic Evaluation of Landfill Performance Model

General Information

Title: ASBURY IMPOUNDMENT CLOSURE

Address: 21133 UPHILL LANE
ASBURY MO 64832

Coordinates (degrees) Lat: 37.34 Long: -94.57

Years of Simulation: 20 Units: U.S. Standard

LF Area (acres): 1.00 Specify Initial Moisture? No

% Subject to Runoff: 100 Water/snow storage (in):

Soil & Design

Temporarily suspend layer rule checking

1	FS - Fine Sand			
2	LDPE Membrane			
3	CCR Waste			
4	HDPE Membrane			
5	Liner Soil (High)			

Weather

Data Method	Parameter	Years of Data		
[Precipitation	20		
	Temperature	20		
	Solar Radiation	20		
▶	Wind Speed/Rel Humidity			
▶	Other Parameters (growing season, LAI & evap zone)			

Runoff Curve Number

User-specified curve number (1):

HELP will use the curve number: 91

HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE
HELP MODEL VERSION 4.0 BETA (2018)
DEVELOPED BY USEPA NATIONAL RISK MANAGEMENT RESEARCH LABORATORY

Title: ASBURY IMPOUNDMENT CLOSURE **Simulated On:** 10/26/2021 18:02

Layer 1

Type 2 - Lateral Drainage Layer

FS - Fine Sand

Material Texture Number 3

Thickness	=	6 inches
Porosity	=	0.457 vol/vol
Field Capacity	=	0.083 vol/vol
Wilting Point	=	0.033 vol/vol
Initial Soil Water Content	=	0.4199 vol/vol
Effective Sat. Hyd. Conductivity	=	3.10E-03 cm/sec
Slope	=	1 %
Drainage Length	=	200 ft

Layer 2

Type 4 - Flexible Membrane Liner

LDPE Membrane

Material Texture Number 36

Thickness	=	0.04 inches
Effective Sat. Hyd. Conductivity	=	4.00E-13 cm/sec
FML Pinhole Density	=	2 Holes/Acre
FML Installation Defects	=	2 Holes/Acre
FML Placement Quality	=	3 Good

Layer 3

Type 1 - Vertical Percolation Layer (Waste)

CCR Waste

Material Texture Number 83

Thickness	=	300 inches
Porosity	=	0.541 vol/vol
Field Capacity	=	0.187 vol/vol
Wilting Point	=	0.047 vol/vol
Initial Soil Water Content	=	0.1898 vol/vol
Effective Sat. Hyd. Conductivity	=	5.00E-04 cm/sec

Layer 4

Type 4 - Flexible Membrane Liner

HDPE Membrane**Material Texture Number 35**

Thickness	=	0.06 inches
Effective Sat. Hyd. Conductivity	=	2.00E-13 cm/sec
FML Pinhole Density	=	2 Holes/Acre
FML Installation Defects	=	2 Holes/Acre
FML Placement Quality	=	3 Good

Layer 5**Type 3 - Barrier Soil Liner****Liner Soil (High)****Material Texture Number 16**

Thickness	=	24 inches
Porosity	=	0.427 vol/vol
Field Capacity	=	0.418 vol/vol
Wilting Point	=	0.367 vol/vol
Initial Soil Water Content	=	0.427 vol/vol
Effective Sat. Hyd. Conductivity	=	1.00E-07 cm/sec

 Note: Initial moisture content of the layers and snow water were computed as nearly steady-state values by HELP.

General Design and Evaporative Zone Data

SCS Runoff Curve Number	=	91
Fraction of Area Allowing Runoff	=	100 %
Area projected on a horizontal plane	=	1 acres
Evaporative Zone Depth	=	0.5 inches
Initial Water in Evaporative Zone	=	0.018 inches
Upper Limit of Evaporative Storage	=	0.228 inches
Lower Limit of Evaporative Storage	=	0.016 inches
Initial Snow Water	=	0 inches
Initial Water in Layer Materials	=	69.706 inches
Total Initial Water	=	69.706 inches
Total Subsurface Inflow	=	0 inches/year

 Note: SCS Runoff Curve Number was User-Specified.

Evapotranspiration and Weather Data

Station Latitude	=	37.34 Degrees
Maximum Leaf Area Index	=	2
Start of Growing Season (Julian Date)	=	101 days
End of Growing Season (Julian Date)	=	298 days

Average Wind Speed	=	10 mph
Average 1st Quarter Relative Humidity	=	70 %
Average 2nd Quarter Relative Humidity	=	73 %
Average 3rd Quarter Relative Humidity	=	65 %
Average 4th Quarter Relative Humidity	=	67 %

 Note: Evapotranspiration data was obtained for ASBURY, MISSOURI

Normal Mean Monthly Precipitation (inches)

<u>Jan/Jul</u>	<u>Feb/Aug</u>	<u>Mar/Sep</u>	<u>Apr/Oct</u>	<u>May/Nov</u>	<u>Jun/Dec</u>
1.889852	2.02005	3.921549	4.211902	6.485159	5.735078
3.560809	3.345081	5.309204	3.827304	4.61823	3.094609

 Note: Precipitation was simulated based on HELP V4 weather simulation for:
 Lat/Long: 37.34/-94.57

Normal Mean Monthly Temperature (Degrees Fahrenheit)

<u>Jan/Jul</u>	<u>Feb/Aug</u>	<u>Mar/Sep</u>	<u>Apr/Oct</u>	<u>May/Nov</u>	<u>Jun/Dec</u>
40.4	42	50.8	61.5	73.2	81.6
88.6	84.9	77.4	64.1	53.5	47.3

 Note: Temperature was simulated based on HELP V4 weather simulation for:
 Lat/Long: 37.34/-94.57
 Solar radiation was simulated based on HELP V4 weather simulation for:
 Lat/Long: 37.34/-94.57

Average Annual Totals Summary**Title:** ASBURY IMPOUNDMENT CLOSURE**Simulated on:** 10/26/2021 18:02

	Average Annual Totals for Years 1 - 20*			
	(inches)	[std dev]	(cubic feet)	(percent)
Precipitation	48.02	[6.86]	174,308.3	100.00
Runoff	30.783	[5.429]	111,740.5	64.11
Evapotranspiration	14.505	[1.908]	52,651.6	30.21
Subprofile1				
Lateral drainage collected from Layer 1	1.8262	[0.0137]	6,629.1	3.80
Percolation/leakage through Layer 2	0.907643	[0.004009]	3,294.7	1.89
Average Head on Top of Layer 2	5.5846	[0.0302]	---	---
Subprofile2				
Percolation/leakage through Layer 5	0.015768	[0.008321]	57.2	0.03
Average Head on Top of Layer 4	27.6952	[14.9027]	---	---
Water storage				
Change in water storage	0.8898	[0.1835]	3,229.9	1.85

* Note: Average inches are converted to volume based on the user-specified area.



Quotation

Customer: Liberty Utilities
 Shaen Rooney
 shaen.rooney@libertyutilities.com
 (855) 216-6305
 602 S Joplin Ave., Joplin, MO 64802

Project: Asbury CCR Impoundment Closure

Location: 21133 Uphill Rd, Asbury, Missouri 64832

Date: February 8, 2022
Quotation No: 2022-Q-00267
Revision No: 1
Quote Prepared By: Steve Mayes
Email Address: smayes@watershedgeo.com

Payment Terms: Net 30
Quote Good For: 31 Days
Tariffs and Fees: **Not Included**

Quotation Material Schedule

Description	Quantity	Unit	Unit Price (USD\$)	Total Price (USD\$)
ClosureTurf Final Cover System Engineered Synthetic Turf (ClosureTurf CT) - MC270-306 Color: 100% Green (Olive 06) Square Feet: 5,229,000 Roll Size: 15' x 300' Number of Rolls: 1162 Waste and Overlap: 0.00 % MicroSpike DS - MS-LL-40 mil - 750' Thickness: 40-mil Polyethylene Type: LLDPE Square Feet: 5,226,750 Roll Size: 23' x 750' Number of Rolls: 303 Waste and Overlap: 0.00 % Welding Rod # of Units: 120 Pressure Relief Vents # of Units: 60	5,226,750	Sq. Ft.	\$1.84	\$9,617,220.00
MATERIAL SUBTOTAL				\$9,617,220.00
Engineered Turf Freight Type of Truck: Enclosed Box Truck Rolls per Truck: 27	44	Truck	\$5,500.00	\$242,000.00
Geomembrane Freight Type of Truck: Flatbed Rolls per Truck: 12	26	Truck	\$4,000.00	\$104,000.00
FREIGHT SUBTOTAL				\$346,000.00
Sales Tax (Estimate) Sales Tax will not be Charged if Provided a Tax Exemption Form (Please Provide Tax Exemption Form with Purchase Order)	Percent		5.45 %	\$524,138.49
TOTAL w/ SALES TAX				\$10,487,358.49

SEE NOTES ON FOLLOWING PAGE

Notes:

NOTICE TO CUSTOMERS: IN RECENT MONTHS, THE VOLATILITY OF THE RESIN MARKET HAS INCREASED AS SUPPLIERS ARE EXPERIENCING A HIGHER DEMAND THAN THEIR SUPPLY CAN ACCOMMODATE. THIS VOLATILITY, COUPLED WITH THE RECENT EXTREME WINTER WEATHER ALONG THE GULF COAST, HAS CREATED A FORCE MAJEURE EVENT THAT IMPACTS THE PRICING AND AVAILABILITY OF RESIN. IN THE EVENT OF VERIFIABLE RESIN PRICE INCREASES PRIOR TO THE EXPIRATION OF THIS QUOTATION, WATERSHED GEO SHALL REVISE AND REISSUE THIS QUOTATION. CUSTOMER SHALL ACKNOWLEDGE ACCEPTANCE OF THE PRICE ADJUSTMENT BEFORE WATERSHED GEO WILL COMPLETE THE ORDER PROCESSING.

1. Quantities provided by Customer. Customer shall confirm material quantities prior to ordering.
2. This quote shall be revised if the material quantities are changed.
3. Sales Tax will not be charge if Customer provides a Tax Exemption Form.
4. Freight pricing includes a one-hour off-loading window. Beyond this grace period a fee of \$100.00 per hour will be charged to the customer.
5. Watershed Geo standard Terms and Conditions of Sale will apply.
6. Watershed Geo reserves the right to pass along any verifiable raw material (i.e., resin) increases from our supplier's supplier up to the time of purchase order receipt assuming material delivery occurs on or before June 30, 2022.
7. Any costs associated with third party testing will be the responsibility of the customer.
8. Ten (10) year manufacturer's material warranty on the geomembrane component and a five (5) year manufacturer's material warranty on the turf component for material defects upon the completion of project. Manufacturer's warranty starts on the day that the materials are delivered to the site.
9. Current product lead time for the ClosureTurf® system components of geomembrane and engineered turf are 10 to 12 weeks from receipt of Purchase Order excluding time for MQC approval and conformance testing. Lead times are subject to change.

Technical Clarifications and Exceptions:

1. Watershed Geo will provide ClosureTurf Final Cover System geomembrane and turf components meeting the property values listed in the attached product data sheet.

Acceptance of Quotation and the attached Terms and Conditions:

Print Name: _____

Title: _____

Signature: _____

Purchase Order Number: _____

Date: _____

TERMS AND CONDITIONS OF SALE

1. **GENERAL:** These standard terms and conditions (“Terms and Conditions”) will apply to the sale of all product (“Product”) by Watershed Geosynthetics LLC, or any of its partners, distributors, affiliates, agents, and/or joint ventures (collectively and individually, “Seller”). These Terms and Conditions cannot be modified, amended or changed without Seller’s prior written consent. Seller hereby specifically and expressly objects to and rejects any terms and conditions or other provisions in customer’s purchase orders, printed forms, correspondence or any other writings which are different from, inconsistent with or in addition to these Terms and Conditions and the terms contained in the quotation to which these Terms and Conditions are attached (the “Quotation”).

2. **PRICE:** The Product will be sold and invoiced at the price stated in the Quotation. Unless otherwise expressly specified in the Quotation, the prices set forth therein will expire fifteen (15) days after the date thereof. If customer has not accepted the Quotation at the stated prices within such fifteen (15) day period, Seller reserves the right to thereafter adjust the prices for such Product. Unless otherwise expressly specified in the Quotation, prices do not include federal, state or local sales, excise, use or other taxes now in effect or hereafter levied by reason of this contract. All such taxes shall be paid by customer.

3. **DELIVERY, TRANSPORTATION AND RISK OF LOSS:** Unless otherwise agreed in writing by the parties, all Product sold will be transported and delivered “FOB Destination.” Seller will select the method, routing and agency of transportation but the cost therefor will be the responsibility of the customer. Seller will bear the risk of loss, damage or other incidents of ownership until delivery is made to customer’s destination.

Upon request, the customer will be given the right to select the method, routing and agency of transportation. If the Product is to be shipped pursuant to the customer’s shipping instructions and the customer fails to provide Seller with such instructions by the fourteenth (14th) day after Seller is ready to ship the Product, Seller will ship the Product as Seller deems appropriate and reasonable. The delivery date set forth the Quotation is an approximate date of delivery only unless the parties have mutually agreed in writing to a definitive date for delivery. Seller may deliver the Product within a reasonable time prior to or after the delivery date set forth in the Quotation. If the customer fails or refuses for any reason whatsoever to take delivery of Product at the designated time of delivery, then the customer shall be responsible for all reasonable storage fees resulting from such failure or refusal to accept timely delivery. Such storage fees shall be in addition to the price of the Product set forth in the Quotation. Unless otherwise agreed to in writing, any Product held by Seller in storage for more than thirty (30) days after the agreed date of delivery may be sold, scrapped or destroyed by Seller without relieving the customer of the obligation to pay for the Product and storage.

4. **INSPECTION:** The customer shall inspect the Product at the place of destination promptly upon delivery but in no event more than fifteen (15) days after the date thereof (the “Inspection Period”). The customer must accept any tender by Seller of the Product substantially in conformity with the terms set forth in the Quotation, subject to the customer’s remedies set forth in paragraph 8 below. The customer will be deemed to have accepted tender of the Product if the customer fails to submit a claim pursuant to paragraph 6(b) below before the expiration of the Inspection Period.

5. **PAYMENT:** Unless terms to the contrary are set forth in the Quotation, payment terms are net 15 days from the date of delivery. All payments shall be made in United States currency, and any payments not made within said payment terms may, at Seller’s election, accrue interest at the rate of one and one-half percent (1.5%) per month until paid in full. Whenever reasonable grounds for insecurity arise with respect to due performance by the customer, Seller may demand terms of payment different from those specified herein and may demand assurance of the customer’s due performance. Seller may, upon making such demand, suspend production, shipment and/or deliveries of the Product. If within the period stated in any such demand, the customer fails or refuses to agree to any such different terms of payment and/or fails or refuses to give adequate assurance of due performance, Seller may either:

(a) by notice to the customer, treat such failure or refusal as a repudiation by the customer of the portion of the contemplated transaction not then fully performed, whereupon Seller may cancel all further deliveries of the Product and all amounts unpaid for Product previously delivered will immediately become due and payable, or

(b) make shipments under reservation of a security interest and demand payment against tender of documents of title. If Seller retains a collection agency and/or attorney to collect overdue amounts, all collection costs, including attorney’s fees, incurred by Seller shall be paid by the customer.

6. **WARRANTY TERMS:**

(a) **Warranty.** Seller hereby warrants to customer only that, subject to the terms, conditions and limitations set forth herein, for a period of one (1) year from and after the date of delivery and acceptance thereof, the Product will be free of manufacturing defects, as of said date, and will materially comply with the specifications set forth in its Product Data Sheet in effect on the date of this quotation for the specific project for which customer will install or use the Product (the “Warranty”).

(b) **Notification of Claims.** Claims under the Warranty must be submitted to Seller in writing within thirty (30) days after discovery of any alleged breach of the Warranty via a nationally recognized overnight delivery service and addressed to:

Watershed Geosynthetics LLC
11400 Atlantis Place
Suite 200
Alpharetta, Georgia 30022
Attn: Michael R. Ayers, President

(c) Limitations on Coverage. The Warranty does not apply if the Product is (i) used for any application other than for which it was designed, (ii) Product is installed or repaired by anyone who has not been certified by Seller, or (iii) damaged by or as a result of:

- i. burns, cuts, accidents, vandalism, abuse, negligence or neglect;
- ii. improper design (i.e., noncompliance with the engineering standards of practice and/or Company's design guidance);
- iii. displacement of Product components due to gas uplift;
- iv. failure of adjacent structures such as storm water conveyance systems, roads, etc.;
- v. failure of the sub-base or subgrade;
- vi. the operation of non-rubber-tire or rubber-track equipment on the Product;
- vii. wind recorded on the site of the Product in excess of 120 mph;
- viii. storm events and/or seismic events exceeding the project's design parameters;
- ix. the surface being used for purposes other than for which it was designed and installed;
- x. exposure to chemicals or conditions which are not suitable for polyethylene, and polypropylene polymers;
- xi. post-fibrillation during or after installation of the Product for any purpose other than getting infill materials in place;
- xii. the operation of non-rubber-tire and/or non-rubber-track equipment on the Product;
- xiii. failure to properly limit vehicle traffic trips over the Product other than for maintenance and inspection;
- xiv. failure to limit the ground pressure of vehicle tires operating over the Product to less than 15 psi;
- xv. damages due to the misapplication, incorrect installation, installation defects and/or damages resulting from any kind of inadequate handling;
- xvi. settlement that causes loss of intimate contact with the subgrade or inverse grades causing non-positive drainage (i.e., ponding); and,
- xvii. global instability, waste mass instability and/or subgrade instability.

(d) Disclaimer of Warranties. Notwithstanding anything set forth herein to the contrary, SELLER MAKES NO WARRANTY THAT THE PRODUCT SHALL BE MERCHANTABLE OR FIT FOR ANY PARTICULAR PURPOSE, NOR DOES SELLER MAKE ANY OTHER WARRANTIES, EXPRESS OR IMPLIED, BY OPERATION OF LAW OR OTHERWISE, EXCEPT SUCH WARRANTIES AS ARE EXPRESSLY SET FORTH HEREIN.

(e) Limitation of Liability. In the event of a breach of the Warranty, under no circumstances shall Seller be liable to customer for any consequential, incidental, indirect, special, exemplary, punitive or any other damages regardless of whether the customer had notified Seller of the possibility thereof. The restrictions set forth in this provision include, but are not limited to, the recovery of lost profits, lost opportunity, loss of use, and downtime expenses.

7. **DEFAULT:** A party shall be in default hereunder if (a) it breaches any of its obligations set forth herein, or (b) a voluntary or involuntary petition in bankruptcy is filed by or against it, or (c) it is unable to pay its debts as they become due.

8. **CUSTOMER REMEDIES:** All claims for alleged defects in quality shall be deemed waived unless made in writing in accordance with paragraph 6(b) above. Seller's liability and customer's exclusive remedies hereunder are hereby limited to the repair or replacement of that portion of the Product that fails to comply with the Warranty, and customer shall not be entitled to any other remedies, whether in contract or tort, at law or in equity. Replacement of defective Product will be made only upon return of the defective Product after Seller has consented thereto and has delivered to the customer written shipping instructions. Seller shall be given a reasonable opportunity to investigate all claims and to inspect all Product that allegedly does not comply with the Warranty. Under no circumstances shall the customer be permitted to set off or credit any amounts due and owing to Seller unless Seller has agreed thereto in writing.

9. **FORCE MAJEURE DELAYS:** Seller's delay or failure in the performance of any of its obligations hereunder shall be excused if and to the extent such delay or failure is a result of Force Majeure. The term "Force Majeure" means any act or event that (i) delays the Seller's performance of its obligations in accordance with the terms of the Purchase Order, (ii) is beyond the reasonable

control of the Seller and is not due to its fault or negligence, (iii) is not reasonably foreseeable, and (iv) could not have been prevented or avoided by the Seller through the exercise of due diligence. Force Majeure includes, without limitation:

- (a) strikes or work stoppages;
- (b) fires, floods, inclement weather, or other acts of God;
- (c) riots, war, sabotage or other disturbances of the peace;
- (d) breakdowns, destruction, or failure of any kind of Seller's equipment or facilities necessary for performance hereunder or accidents at Seller's plants;
- (e) transportation delays, reductions, shortages, curtailment or cessation of supplies, materials, equipment, facilities, power, labor, transportation or other factors of production;
- (f) governmental legislation, regulations, rules or orders, or Seller's voluntary or involuntary participation in any plan of general public interest, either of which adversely affect manufacture or delivery hereunder;
- (g) delays of suppliers; or
- (h) any other cause beyond the reasonable control of Seller, whether or not similar to the causes or occurrences enumerated above.

In no event shall Seller, in the event of any of the aforesaid conditions, be liable to the customer or any third parties for any incidental, consequential, special, direct, indirect, punitive, contingent or reliance damages. In the event of any such delay or failure in performance, Seller shall have such additional time within which to perform its obligations hereunder as may reasonably be necessary under the circumstances. Further, Seller shall also have the right, to the extent necessary in Seller's reasonable judgment, to apportion fairly among its customers in such manner as Seller may consider equitable, the Product then available for delivery.

10. **TECHNICAL INFORMATION:** Unless otherwise agreed to by the parties in writing, all (i) drawings, data, specifications, designs, patterns, molds, tools, samples and other items prepared by Seller, and (ii) inventions made by Seller, including inventions based on information supplied by the customer, pursuant to a purchase of Product, shall be the sole and exclusive property of Seller.

11. **CANCELLATION:** The customer may not cancel this contract for the purchase of Product hereunder without prior written notice to, and the consent of, Seller. In addition, the customer shall, upon Seller's acceptance of any cancellation, pay Seller for all completed work for or Product ordered pursuant to the customer's order, all other costs incurred up to the date of cancellation, all lost profits due to the cancellation, and all other reasonable cancellation charges.

12. **INSTALLMENT DELIVERIES:** Seller shall be entitled to make delivery in installments unless otherwise stated in the Quotation. Seller may render a separate invoice for each installment, which invoice shall be paid when due, without regard to subsequent deliveries. Each installment shall be deemed a separate sale. Delay in delivery of any installment shall not relieve the customer of its obligations to accept delivery of remaining installments.

13. **INDEMNITY:** To the fullest extent permitted by law, the customer hereby releases, holds harmless, indemnifies and defends Seller, its officers, agents, employees, affiliates, joint ventures, insurers, successors and assigns, from and against any loss, liability, claims, suits, judgments, decrees, costs and damages ("Damages") resulting in personal injury or death, Damages to any real or personal property, and Damages relating to loss of use or loss of profit caused by, arising out of, or relating to the customer's acts or omissions. The sale of the Product shall not grant to the customer any right or license of any kind under any patent owned by Seller, but the foregoing shall not be understood to limit in any way the right of the customer to use the Product.

14. **MISCELLANEOUS:**

(a) This contract may be performed and/or assigned by Seller, and all rights hereunder against the customer may be enforced, wholly or in part, by Seller or by any one or more present or future partners, distributors, affiliates, joint ventures, transferees or assignees of Seller.

(b) The waiver by Seller of any terms, conditions, or provisions hereof shall not be construed to be a waiver of any other term, condition or provision, nor shall such waiver be deemed a waiver of a subsequent breach by the customer of the same term, condition or provision.

(c) Neither this contract nor the customer's substantive obligations hereunder may be assigned by the customer without the prior written approval of Seller, which approval may be granted or withheld in Seller's sole discretion.

(d) The entire understanding and agreement of the parties hereto with respect to the sale of the Product contemplated in the Quotation is contained therein and in these Terms and Conditions, and all prior understandings, agreements and representations, oral or written, are hereby deemed superseded and merged herein.

(e) This contract shall be deemed to be made in the State of Georgia and shall in all respects be construed and governed by the laws thereof other than its conflict of laws principles. Any disputes arising out of this contract shall be subject to the exclusive jurisdiction of any court of competent jurisdiction located in Fulton County, Georgia. The United Nations Convention of Contracts for the International Sale of Product shall not apply to this contract.

(f) Stenographic and clerical errors, whether in mathematical computations or otherwise, made by Seller in the Quotation or invoice issued pursuant thereto to customer shall be subject to correction.

(g) The remedies and rights reserved to Seller herein shall be cumulative with, and in addition to, all other rights and remedies provided at law or in equity.

ClosureTurf® w 40 mil MicroSpike® Liner

Product Data	Test Method	LLDPE Values	HDPE Values
Thickness (nominal), mil (mm)	ASTM D5994	40 (1.0)	40 (1.0)
Thickness (min. avg.), mil (mm)	ASTM D5994	38 (0.95)	38 (0.95)
Thickness (lowest indiv.), mil (mm)	ASTM D5994	34 (0.85)	34 (0.85)
Asperity Height (min. avg.), mil (mm)	ASTM D7466	20 (0.51)	20 (0.51)
Density, g/cc	ASTM D792, Method B	0.939 (max.)	0.94 (min.)
Tensile Properties (avg. both directions)	ASTM D6693, Type IV		
Strength @Yield (min. avg.), lb/in. width (N/mm)		N/A	88 (15.4)
Elongation @ Yield (min. avg.), % (GL=1.3 in.)		N/A	12
Strength@Break (min. avg.), lb./in. width (N/mm)		112 (19.6)	88 (15.4)
Elongation@Break (min. avg.), %(GL=2.0 in.)		400	350
Tear Resistance (min. avg.), lbs. (N)	ASTM D1004	25 (111)	30 (133)
Puncture Resistance (min. avg.) lbs. (N)	ASTM D4833	50 (222)	90 (400)
Carbon Black Content (range %)	ASTM D4218	2-3	2-3
Carbon Black Dispersion (Category)	ASTM D5596	Only near spherical agglomerates for 10 views in Cat. 1 or 2	
Stress Crack Resistance (Single Point NCTL), hours	ASTM D5397, Appendix	N/A	500
Oxidative Induction Time, minutes	ASTM D3895, 200°C, 1 atm O ₂	≥140	≥140

Agru America's geomembranes are certified to pass Low Temp. Brittleness via. ASTM D746 (-80°C), and Dimensional Stability via. ASTM D1204 (± 2% @ 100°C)

ENGINEERED TURF COMPONENT (CT)

Product Data	Test Method	Values
Yarn Type	N/A	Polyethylene, Fibrillated
Yarn Color	N/A	Olive Green, Play Green, Tan
Yarn Weight (Total Product Weight)	ASTM D5261 (sample size, 1 yd ²)	≥20 oz. / sq. yd. (≥ 32 oz. / sq. yd.)
Tensile Strength of Yarn	ASTM D2256	15 lbs. min.
CBR Puncture	ASTM D6241	1,500 lb. (MARV)
Tensile Product (MD/XD)	ASTM D4595	2,100 MD / 1,600 XD lb/ft (MARV)
Interface Friction between ClosureTurf CT and MicroSpike®	ASTM D5321	21°, min. Peak*
Engineered Turf Fiber UV Stability	ASTM G147	>60% retained tensile strength at 100 yrs. (projected)
Backing System UV Stability (Exposed)	ASTM G154 Modified Cycle 1., UVA340	110 lbs./ft. retained tensile strength at 6,500 hrs (projected)
Aerodynamic Evaluation	GTRI Wind Tunnel	120 mph with max. uplift of 0.12 lb/sf
Rainfall Induced Erosion	ASTM D6459	Infill Loss 0.1% at 6 in./hr. Rainfall
Steady State Hydraulic Overtopping (ClosureTurf® w/ HydroBinder®)	ASTM D7277/D7276	5 ft. overtopping resulting in 29 ft/s velocity and 8.8 psf shear stress for Manning's n value of 0.02
Full Scale Wave Overtopping Test Cumulative Volume (ClosureTurf® with HydroBinder®)	Colorado State University Wave Simulator	165,000 ft ³ /ft
Full Scale Wave Overtopping Test Discharge (ClosureTurf® with HydroBinder®)	Colorado State University Wave Simulator	4.0 ft ³ /s/ft
HydroBinder® Infill Mix	ASTM C387 / ASTM C109	3/4 in. infill 5,000 psi (min. at 28 days)

*Engineered turf/geomembrane interface. Geomembrane/subgrade interface is site specific and should be evaluated per Engineer of Record's requirements.

SUPPLY INFORMATION (Standard Roll Dimensions)

	Thickness		Width		Length		Area (approx.)		Weight (avg.)	
	mil	mm	ft.	m	ft.	m	ft ²	m ²	lbs	kg
MicroSpike®	40	1.0	23	7	750	229	17,250	1,603	~3,900	~1,770
Turf Component	N/A	N/A	15	4.6	300	91.44	4,500	418	~1,000	~454

ClosureTurf®, HydroTurf®, VersaCap®, TerraArmor® and PowerCap™ are U.S. registered trademarks which designate products from Watershed Geosynthetics LLC and/or its affiliated companies (collectively, "WG") that are the subject of issued and/or pending U.S. and foreign patents and patent applications. All information provided herein by WG concerning these products are based upon data derived from independent third-party testing. This information, however, should not be used or relied upon for any specific use without first consulting with an independent professional licensed in the geographic area in which a project is located. Since the actual site conditions, and the installation and use of these products are beyond our control, no guaranty or warranty of any kind, expressed or implied, is made by WG with respect to these products.