Closure Plan, Rev. 4

Tanners Creek Fly Ash Pond

Facility Name: Tanners Creek Plant
Fly Ash Pond Complex

Facility Location: 800 AEP Drive, Lawrenceburg, IN

Facility County: Dearborn

Facility Solid Waste Permit No: N/A

Owner:
Tanners Creek Development, LLC.
1515 Des Peres Rd., Suite 300
St. Louis, MO 63131
p. 314-835-2878

Prepared by:
S&ME, Inc.
6190 Enterprise Court
Dublin, OH 43016

October 18, 2017
Revised June 26, 2018
Revised October 12, 2018
Revised March 14, 2019

March 14, 2019

Tanners Creek Development, LLC.
1515 Des Peres Rd., Suite 300
St. Louis, MO 63131

Attention: Mr. Daniel Dunn

Reference: **Closure Plan, Rev. 4**
Tanners Creek Plant Fly Ash Pond
Lawrenceburg, Indiana
S&ME Project No. 7217-17-007A

Dear Mr. Dunn:

In accordance with our change order request dated January 22, 2019, which was authorized on February 4, 2019, S&ME has revised the Closure Plan for the Tanners Creek Plant Fly Ash Pond located near Lawrenceburg, Indiana. The Closure Plan includes several documents in addition to this narrative. Specifically, the following are included as appendices to the Closure Plan: Drawings, a Ground Water Monitoring Plan, a QA/QC Plan, a Post Closure Care Plan, Engineering Calculations, Geotechnical Data, and a Dust Control Plan.

In addition to the narrative, Revision 4 of the Closure Plan replaces the following prior submitted documents:

- Ground Water Monitoring Plan, Closure Plan Attachment II (Revision 6)
- Subsurface Data Report, Closure Plan Attachment VI (formerly Geotechnical Data Report)
- Comment Log, Closure Plan Attachment VII

Additionally, we have provided an updated cover page for the overall Closure Plan. All other prior submitted attachments to the Closure Plan remain unchanged from the Revision 3 submittal.

The revised documents were updated based on the Request for Additional Information (RAI) received from the Indiana Department of Environmental Management dated December 3, 2018 and fully supersede the previous versions dated October 12, 2018.

We appreciate having been given the opportunity to be of service on this project. If during the review of this submittal you have any questions, please do not hesitate to contact our office.

Sincerely,

S&ME, Inc.

Michael T. Romanello, P.E.
Project Engineer
Indiana PE Registration No. 11600160

Michael G. Rowland, P.E.
Senior Engineer

Engineer Certification

I hereby certify that these documents were prepared or approved by me, and that I am a duly licensed professional engineer under the laws of the State of Indiana.

MICHAEL T ROMANELLO
REGISTERED
PE11600160
STATE OF
INDIANA
PROFESSIONAL ENGINEER

Signature: ______________________ Date: 3-14-19

Name: Michael T. Romanello

Address: 6190 Enterprise Court

Dublin, OH 43016

Telephone Number: 614-793-2226

Professional Engineer Registration No. PE-11600160

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1.0 Introduction

1.1 Site Overview

The Tanners Creek Power Plant is located adjacent to the Ohio River on State Route 50 approximately one mile southwest of Lawrenceburg, Indiana. The first of four coal fired steam electric generating units at the facility came on-line in 1951 and power generation ceased in May of 2015. The plant, while active, was operated by the Indiana Michigan Power Company (a subsidiary of American Electric Power). Tanners Creek Development, LLC purchased Tanners Creek Plant in October of 2016 and intends to redevelop portions of the property. The general facilities currently present at the Tanners Creek Power Plant include the following:

- Power plant and support structures (conveyors, buildings, transmission, etc.);
- remnants of the former coal pile;
- the "Old" ash disposal area;
- the Main Ash Pond;
- the Fly Ash Pond complex; and,
- an IDEM permitted Ash Landfill constructed over a former ash pond (aka overfill).

Figure 1 shows the location of the ash ponds in relation to the plant. This document presents a Closure Plan for the fly ash pond complex only. American Electric Power previously prepared and submitted to the Indiana Department of Environmental Management (IDEM) a Closure Plan for the Tanners Creek ash ponds on March 23, 2015. The AEP Closure Plan addressed the closure of the Fly Ash Pond, the Main Ash Pond, and the "Old" Ash Area. Tanners Creek Development, LLC intends to submit a closure plan for the Main Ash Pond and "Old' Ash Area under separate cover in the future.

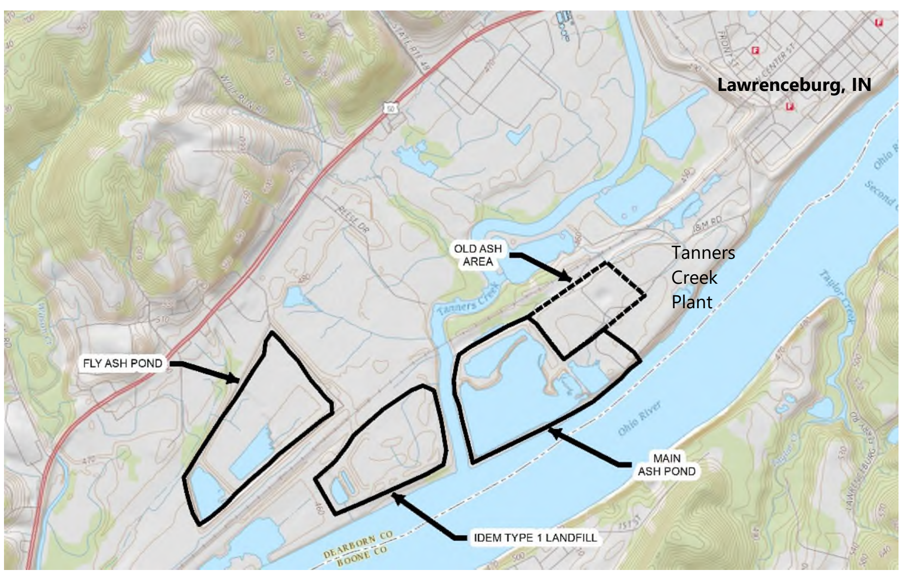

Figure 1-1: Vicinity Map

1.2 Plan Revision History

American Electric Power, in March of 2015, submitted a Closure Plan which addressed not only the Fly Ash Pond but also the Main Ash Pond at Tanners Creek. S&ME, in October of 2017, prepared on behalf of Tanners Creek Development, a Closure Plan limited to only the Fly Ash Pond. The October 2017 submittal is considered Revision 0 of this Closure Plan as it was the first version limited to only the Fly Ash Pond Complex. The following revisions of this Closure Plan were prepared by S&ME on behalf of Tanners Creek Development:

- Rev 1 – March 2018, prepared in response to IDEM RAI, fully superseded Rev 0
- Rev 2 – June 2018, prepared in response to IDEM RAI, fully superseded Rev 1
- Rev 3 – October 2018, prepared in response to IDEM RAI. Following portions of Plan revised:
  - Closure Plan Text, and
  - Attachments II, IV, and VII.
- Rev 4 (current version) – March 2019, prepared in response to IDEM RAI. Following portions of Plan revised:
  - Closure Plan Text, and
  - Attachments II, VI, and VII.

2.0 Facility Description

2.1 General Configuration

The fly ash pond complex, when originally constructed in 1977 and 1978, consisted of a single impoundment contained by a fully encompassing perimeter earthen dike. The bottom of the pond was extended below the surrounding ground surface and the interior of the pond was lined with a 20 mil PVC geomembrane. Fly ash was sluiced into the pond from the northern end and a clear water area was maintained on the southern end.

The impoundment was physically split into the southern clear water pond and the upper (northern) basin between 2003 and 2007. The reconfiguration was accomplished by constructing an interior dike consisting of bottom ash over the in-place sluiced fly ash. At this time, spillways were installed in the upper basin on the east and west sides near the south end to convey the flow to the clear water pond. In 2010, the upper basin was split into an eastern basin and a western basin with the installation of a splitter dike also constructed of bottom ash over the in-place sluiced fly ash. The upper basin and clear water pond areas are collectively referred to as the fly ash pond (FAP) in this Plan.

Key elevations (nominal) for the FAP are as follows:

- El 465 - 470 – outboard toe of earthen dike.
- EL 458 – bottom of pond.
- El 495 – top of original earthen dike (clear water pond dike on west, south, and east sides).
- El 518 – top of bottom ash dike on west, north, and east sides of the upper basin.

- El 511 – top of bottom ash dike between upper basin and clear water pond.
- El 508 – general surface of the fly ash within upper basin.
- El 488 – 100 year, 24 hour flood level of Ohio River adjacent to the FAP
- El 491 – emergency spillway invert.

2.2 General Operation

When the FAP complex was operational, fly ash sluiced from the Station discharged into the FAP complex at the northern end of the upper basin(s). The water level within the upper basin(s) was controlled by adding/removing stop logs in the spillways located at the southeast and southwest corners. Discharge from the spillway via 30" HDPE pipes was to open channels located at the toe of the bottom ash dikes (inboard side of the original earthen dike crest). The channels discharged into the clear water pond at the northeast and northwest corners.

The water level within the clear water pond was controlled by pumping; the former pump structure is located near the middle of the southern dike. Water was pumped from the clear water pond to the Main Ash Pond through an above ground pipeline. An emergency spillway is located at the southeast corner of clear water pond. The emergency spillway penetrates the top of the original earthen dike via a box culvert and then through a concrete chute down the outboard slope of the earthen dike to a toe ditch. The toe ditch drains westward along the toe of the southern dike before turning south at the southwest corner of the FAP where the ditch discharges into Wilson Creek prior to its confluence with the Ohio River.

2.3 Existing Conditions

Sluicing of fly ash to the FAP ceased in 2014 and AEP initiated preliminary closure activities at that time. The sluice pipes from the plant were removed. The splitter dike between the east and west upper basins was removed along with the upper 6 to 8 feet of the interior dike between the upper basin and clear water ponds. The bottom ash from the dike removal was placed in the clear water pond, leaving a smaller open water area. The outlets of both spillway pipes remain as do the ditches between the spillway pipe outlets and the clear water pond. The pumps in the clear water pond have been removed; water in the clear water pond is conveyed to the Main Ash Pond using a portable pump connected to the original pipeline. The emergency spillway remains intact.

A Conceptual Design Report was prepared and submitted to IDEM in April 2017, and a meeting followed to discuss the report. This Closure Plan generally follows the closure approach presented in the April 2017 Conceptual Design Report.

Preliminary ash excavation and grading are on-going and include the following activities:

- The splitter dike between the clear water pond and upper basin has been excavated to approximate Elevation 500 with the bottom ash pushed into the clear water pond area. This area was then re-constructed to Elevation 505 with fly ash.
- The upper basin has been graded to construct two drainage channels providing positive drainage toward the existing spillways.
- Excess ash cut has been placed into the clear water pond area.

- Both spillways in the upper basin have been exposed and are being used to convey surface (contact) water drainage.

The Closure Drawings prepared as part of this Plan are based on the conditions at the site from April 2017 when the base topographic survey was performed.

3.0 Supporting Information

3.1 Historic Investigations and Permits

The following documents provide a summary of the major investigations, design documents, and inspections related to the Fly Ash pond that are known to have been conducted:

- Investigations for Proposed Fly Ash Pond, Casagrande Consultants, 1976.
- Final Report of Geotechnical Consultation and Inspection Services, Woodward-Clyde Consultants 1979.
- Fly Ash Storage Pond Elevation 518' Raising Engineering Report, AEP, ProServ, and Bar Engineering, 2002.
- Design Drawings and Construction Specifications, Barr Engineering and AEP, 2002
- Fly Ash Pond 518' Raising Construction Drawings, AEP, March 3, 2003.
- Fly Ash Pond Bathymetric Survey, AEP, December 11, 2008.
- Deformation Review, AEP 2007 and 2009
- Fly Ash Pond Piezometric Static Water Levels, Indiana Michigan Power Company, 2009.
- Site Inspection and Observation Report, Geo/Environmental Associates, 2009.
- Fly Ash Pond Assessment Report, Lockheed Martin/Obrien & Gere, 2009 (for USEPA).
- Geotechnical Exploration Report, TRC, 2014.
- Closure Plan, TRC, February 2015.
- Phase 1 Environmental Site Assessment, Burns McDonnell, March 2016.
- Title V Operating Permit, IDEM, February 6, 2015.
- Title V Permit Retirement, IDEM, January 29, 2016.

The IDEM Solid Waste Permits division prepared a Request for Additional Information dated July 24, 2015 following receipt of the 2015 Closure Plan. A formal response was not prepared by AEP prior to the purchase the Plant. S&ME has provided responses to the IDEM review comments dated July 24, 2015, February 6, 2018, May 10, 2018, and December 3, 2018 as they pertain to this closure plan. A separate comment log has been prepared and has been included with this Plan as Attachment VII.

3.2 Other Permits

Closure of the FAP will require improving the existing drainage ditches at the toe of the embankment around the eastern and southern portion of the FAP to sufficiently carry runoff from the 100-year storm. The improved ditches will discharge into an unnamed tributary of Wilson Creek near the southeast corner of the FAP. The removal of a culvert in the channel downstream of the FAP is also planned to improve drainage capacity. The FAP drainage ditch improvements will result in minor impacts to the tributary stream and an adjacent wetland.

S&ME coordinated with the regulatory agencies to obtain Indiana Regional General Permit (RGP) No. 1 authorization for the proposed jurisdictional waters impacts. On March 9, 2018, the United States Army Corps of Engineers (USACE) issued RGP No. 1 authorization for the project. The USACE permit reference number is LRL-2017-1143-mdh. On March 29, 2018, Indiana Department of Environmental Management, Office of Water Quality approved the RGP Section 401 Water Quality Certification for the project. The IDEM permit reference number is 2018-188-15-ADF-X.

4.0 New Field Work

4.1 Topographic Survey

S&ME retained GeoPro Consultants to prepare topographic mapping of the fly ash pond complex. Field work for the survey was performed in March 2017. GeoPro utilized a combination of ground survey, existing LiDAR data, and drone imagery to develop topographic contours of the fly ash pond facility. The topographic mapping has been incorporated into the design drawings. The survey was limited to development of topographic contours; services did not included a boundary survey, an ALTA survey, or a utility survey.

Bathymetric topographic contours were generated for the portion of the clear water pond which was below water at the time of the GeoPro survey. The topographic contours were digitized from a bathymetric survey performed by AEP in 2008, with elevations converted from the NAVD29 datum to the NAVD88 datum. The bathymetric topographic contours were utilized for cut/fill volume calculations and are considered approximate.

4.2 Subsurface Investigation

S&ME performed 23 Cone Penetration Test (CPT) soundings to supplement the available geotechnical data. The CPT soundings were performed within the pond to better define the consistency of the in-place sluiced fly ash materials and evaluate the current groundwater conditions. At select locations, pore pressure dissipation and shear wave velocity testing were performed. Additionally, 5 open standpipe piezometers were installed in the upper basin to permit water level readings within the ash. The CPT investigation data has been included within the Subsurface Information Report presented as Attachment VI of this Plan. The report summarizes the data collection procedures, identifies the CPT locations, and provides interpretation plots of the data.

The Subsurface Information Report also includes a discussion of the soil and groundwater conditions beneath and adjacent to the FAP. The report contains the currently available subsurface data which were collected by others and identifies the previous reports from which the data were obtained. The data collected by others, which is presented in the report, includes:

- Exploration Logs,
- Well completion diagrams,
- Soils laboratory test results,
- Measured groundwater elevations, and
- Potentiometric maps.

5.0 Closure Design

5.1 Overview

The closure of the FAP will be constructed using a phased approach. Following demolition of select structures, and installation of initial surface water controls, the first phase will focus on constructing the closure of the upper basin by re-grading the ash and constructing the cover system. Grading will be such that no water is impounded at completion. Surface water will be routed through breaches in the bottom ash dike. During the closure of the upper basin, the clear water pond will be used to manage both contact water and construction runoff directed from the breach channels. Once the cover system on the upper basin is in place and vegetation established, surface water drainage will be diverted away from the clear water pond. This will be accomplished by breaching the original earthen dike and constructing surface water downdrain channels upstream of the clear water pond. Closure of the clear water pond will then take place. During closure of the clear water pond, contact water and construction runoff will be managed within progressively smaller portions of the clear water pond via pumping. Once the final cover system grading is complete, surface water runoff from the clear water pond will be conveyed through the existing emergency spillway. The emergency spillway will be used to permanently carry the runoff from the former clear water pond area to the toe of the slope where it will enter the improved perimeter drainage channel and outlet into the Wilsons Creek tributary stream.

Grading plans have been developed for the limited grading work for the 'Initial' and 'Final' surface water control phases, as well as the mass grading for the closure work in the upper basin and clear water pond. Earthwork associated with the closure of the upper basin is designated as Phase 1, and work associated with the closure of the clear water pond is designated as Phase 2. Separate plan sheets for the 'Top of Ash' and 'Final Grade' have been prepared for both the Phase 1 and Phase 2 grading activities. Quantities for the major tasks associated with each drawing have been included in the Drawings. A complete schedule of values is included with the Engineer's Estimate of Probable Construction Costs presented in Section 7.1 of this Plan.

5.2 Closure Considerations

The following key considerations were used by S&ME based on the conceptual closure design and preliminary discussions with IDEM:

- Achieve positive drainage without the need for dramatic ash cut and fills and to the extent possible, balance the ash cut/fill volumes;

- Relatively flat slopes and channels are acceptable (to minimize ash cut/fill), however design should consider settlement so that channels continue to drain post-settlement;
- Overall closure, and specifically closure of clear water pond, needs to consider management of contact and storm water;
- Grading should be simple and easily constructible;
- Bottom ash dike toe drain pipes to be removed;
- IDEM engineering comments from the 2015 Closure Plan should be addressed.

5.3 Initial Surface Water Controls

The work to implement the initial surface water controls consists of improving the existing ditches between the earthen dike and bottom ash dike to promote positive drainage toward the clear water pond and manage the 100-year 24-hour storm event. With the exception of the final steps of the clear water pond closure where the open water area will be progressively decreased, interim construction storm storage within the clear water pond will be maintained to contain the 25-year 24-hour storm event. Implementation of the initial surface water controls is detailed on Sheet 5 of the Drawings.

5.4 Phase 1 Closure

The proposed grading within the upper basin will create two surface water collection channels that drain southward toward the east and west spillway locations. The bottom ash dike will be breached to allow the surface water collection channels to outlet to the improved ditches. The existing spillway structures and 24-inch drainage conduits will be removed as part of the bottom ash dike breach excavation.

At the time of the topographic survey, the ash surface in the upper basin generally ranged from Elevation 506 to Elevation 510. The invert of the surface water collection channels start near Elevation 508, but the upper basin requires fill ranging up to 8 feet on the north end to create positive drainage into the channels. The collection channels slope at a nominal gradient of 0.5% to Elevation 498 before entering the breach channels. The slope of the ash grades and final grades depicted for the upper basin closure are typically 50H:1V (2%). The intent is to create positive drainage from all areas with minimal cut depths into the fly ash.

Overall, a net cut volume is required in the upper basin area to create enough ash fill for the closure of the clear water pond. During Phase 1 activities, all of the 'cut' material for the clear water pond closure will be placed in northern two-thirds of the clear water pond. The leading edge of the fill has been designed as a 6H to 1V slope. This slope is temporary and will be primarily constructed of dry ash materials placed above the pool elevation of the clear water pond. A slope stability analysis was performed to assess the temporary fill slope configuration. The analysis is discussed in Section 6.3. Additional key design components for the Phase 1 closure task are summarized in Table 5-1.

Table 5-1: Phase 1 Closure Key Design Components

Typical Top Gradient	2%
Perimeter Side Slopes	3H:1V
Collection Channel Gradient	0.5%
Bottom Ash Breach Gradient	East: 16.7 % West: 21.4 %
Breach Side Slopes	4H:1V
Area of Cover System	59.2 AC
Ash Excavation & Fill Volume	206,385 CY
Cover System Protective Soil Layer Fill Volume	238,680 CY
Cover System Vegetative Layer Fill Volume	47,735 CY

5.5 Final Surface Water Controls

In preparation for the Phase 2 grading work, final surface water controls will be implemented by diverting flow from the upper basin to the lower perimeter channels along the toe of the original earthen dike. This will be accomplished by extending both ash breach channels down through the earthen dike. The portion of the improved drainage channel between the bottom ash dike and clear water pond will be filled and redirected to the breach channels. The breach channel are designed at slopes of 4H to 1V. The ash breaches will be armored with a fabric-formed concrete lining and the earth dike breach will be armored with riprap. Discussion of the anticipated flow velocities and selected armoring are included with H&H analysis in Section 6.1. Contact water and construction runoff from within the clear water pond will continue to be controlled via pumping from the small open water area in the southeast corner of the clear water pond.

5.6 Phase 2 Closure

The ash fill placed in the clear water pond during the Phase I closure work will reach a maximum Elevation of 505 feet. The approximate top 10 feet of this ash fill will be used to fill the remaining area of the clear water pond during the Phase 2 closure. A surface water collection channel will extend from the emergency spillway outlet then branch to the north and west. The collection channels slope at a nominal gradient of 0.5%. The typical slopes of the ash surface and final cover system are 125H to 1V. The low gradient results from the need to maintain the ash below the elevation of the earthen dike crest for contact water control, the overall cut/fill balance, and the desire to outlet the surface water collection channels to the existing emergency spillway. The analysis is further discussed in Section 6.3. Additional key design components for the Phase 1 closure task are summarized in Table 5-2.

Table 5-2: Phase 1 Closure Key Design Components

Typical Closure Slope	125H:1V
Collection Channel Gradient	0.5%
Emergency Spillway Inlet Invert Elevation	491.2
Breach Side Slopes	4H:1V
Area of Cover System	11.5
Ash Excavation & Fill Volume	66,255 CY
Cover System Protective Soil Layer Fill Volume	46,450 CY
Cover System Vegetative Layer Fill Volume	9,290 CY

5.7 Cover System

5.7.1 Description

A cover system will be installed above all areas where ash is exposed, as well as down the outboard slopes of the upper basin bottom ash dikes. The cover system will include, from top to bottom:

- 6-inch vegetative layer;
- 30-inches of protective soil layer;
- Geocomposite drainage layer; and
- 40-mil LLDPE or 60 mil HDPE geomembrane.

The primary purpose of the cover soil is to protect the long-term integrity of the geomembrane. As the final cover system will be located above the 100-year flood level, the principal issues that could impact the geomembrane are: 1) erosion and subsequent exposure, 2) vehicle loading, 3) support of vegetation, 4) freeze thaw damage, and 4) burrowing animals.

The majority of soil material for the cover system will be obtained from the adjacent open field area to the southwest of the FAP, designated as Borrow Area 4. The viability of several local borrow areas was documented in a 2008 Borrow Study Report by FMSM Engineers. The report characterized the soils in Borrow Area 4, which has an area of approximately 19 acres, as low plasticity clays and silts (USCS Class CL-ML) based on observation of test pits and a limited number of index tests. Additional index tests in accordance with the QA/QC Plan (Attachment III) will be required during construction. Section 5.10 discusses the Borrow Area Construction Plan in more detail. A small portion of the cover soil will consist of on-site material generated as part of the earthen dike excavation required to establish the surface water controls.

Where the upper basin cover system is installed on the outboard slopes of the bottom ash dike, the geomembrane will extend beneath the drainage channel and terminate in a runout trench on the opposite side. The geomembrane on the south end of the upper basin will be anchored into the east-west bottom ash splitter dike located south of the upper basin. The geomembrane installed for the clear water pond closure will terminate in a runout trench on the crest of the earthen dike on west, south, and east sides. The geomembrane will be welded to geomembrane installed for upper basin closure along the anchor trench across the splitter dike on the north side of the clear water pond.

In addition to providing subsurface drainage capacity, the geocomposite drainage layer also serves as a cushion layer over the geomembrane. The geonet drainage core will outlet in 3 ways: 1) via drainage tubing running beneath the final grade of the collection channels; 2) via drainage tubing at the toe of the inboard slope on the north and south ends of the upper basin; and 3) daylight on the outboard slopes of the bottom ash dike 6" above the perimeter drainage channels. A non-woven geotextile will be used as the cushion layer for the approximate 2 acres where the geomembrane extends beyond the outlet of the geocomposite drainage layer below the perimeter channels. Specifications for all geosynthetics are provided in the QA/QC plan included as Attachment III.

5.8 PVC Liner Penetration

The interior of the original pond is lined with a 20 mil PVC geomembrane. The geomembrane extends up the inboard slopes of the earthen embankment, then presumably terminates in a runout or anchor trench within the crest. Over the upper basin, the proposed cover system liner and geocomposite drainage layer will be extended down the outboard side of the raised embankment and into an anchor trench on the inboard side of the earthen embankment. This termination detail will require the upper portion of the PVC geomembrane to be removed. In bottom lining applications, anchor trenches are initially a critical component of installation needed to prevent liners from creeping down slopes under its own weight, or due to forces such as wind lifting or cyclic expansion/contraction[(1)]. However, once a pond or landfill has been filled, the liner is fully buttressed which prevents such movement, but should be evaluated for global sliding stability. With the construction of the interior dike, the PVC liner is completely buttressed and high factors of safety for global sliding stability would be expected for an inward failure.

An analysis was performed to determine whether the existing bench on the inboard slope of the earthen embankment is wide enough to act as a horizontal runout trench for the existing PVC liner following removal of the liner anchor trench to accommodate the installation of the proposed final cover. Results show the existing 10 foot bench is wider than the minimum necessary to fully engage the tensile strength of the PVC. Therefore, the removal of the upper portion of the PVC geomembrane and anchor trench should not impact the integrity of the liner system. Around the clear water pond, a runout trench on top of the crest or within 18 inches of the top will be used for the proposed liner in the cover system, limiting the impact to the PVC geomembrane. The minimum required runout length calculation is included in the Slope Stability Analysis presented in Attachment V.

5.9 Dewatering Procedures

5.9.1 Pre-Construction

Once sluicing ash into the fly ash pond ceased in 2014, no additional liquids were pumped in. In its dormant state, the impounded surface water in the upper basin dissipated through the outlet structures and via subsurface flow into the clear water pond. Beginning in 2017, the rate of removal of water (pumping) from the clear water pond was increased so as to attempt to maintain the clear water pond in a dry condition. Concurrently regrading of the ash in the upper basin began. The regrading focused on creating positive drainage to better facilitate dewatering of the upper basin. At the time of the subsurface investigation in June 2017, the upper basin was stable for vehicular traffic.

5.9.2 Phase 1

The collection channels incorporated into the Phase 1 Ash Subgrade, which have been partially constructed as part of preliminary grading activities, provide further positive drainage to the clear water pond and lessen the potential for impounding water following large storm events prior to construction of the cover system. No additional surface water control, such as pumping from sumps or well points has been planned as part of the Phase 1 closure.

5.9.3 Phase 2

As part of Phase 2, surface water from the upper basin will be diverted away from the clear water pond by extending the breach channels through the earthen dike. Contact water and construction runoff from the clear water pond area will be diverted to an open water area in the southeast corner. The open water will be pumped to the main ash pond following the current operational procedures. The area of open water will be reduced as ash fill placement progresses. After installation of the cover system, surface water runoff from the Phase 2 area will discharge through the existing emergency spillway.

5.10 Borrow Area Plan

A Construction Plan / Storm Water Pollution Prevention Plan (SWPPP) was developed for Borrow Area 4 by Stantec. The SWPPP, dated September 12, 2017, includes an ALTA Survey, Wetland Delineation, Erosion and Sediment Control Plan and Details, and supporting calculations. The limits of Borrow Area 4 begin approximately 110 feet from the toe of the Fly Ash Pond southern embankments, juts beyond the gravel access drive. The total disturbed area is 20.6 acres. Approximately 400,000 CY of borrow material is available from this source, exceeding the requirements for the FAP closure. The proposed excavation grades are 4H:1V with a maximum depth reaching Elevation 455. The distance from the FAP embankments and proposed excavation grades do not adversely impact the stability of the Fly Ash Pond.

Excavation of borrow soils from Borrow Area 4 will be by the Contactor’s means and methods. There is no plan to backfill the borrow area. After excavation is complete, water may pond in the excavation area until it overflows through an emergency spillway, which outlets into an unnamed ditch leading to Wilson Creek

6.0 Engineering Analyses

The following sections document the engineering analyses, which were completed in support of the FAP Closure Plan. Analysis results are summarized below with a full narrative and supporting calculations presented in Attachment V of this Plan. The calculations and analyses were performed in general accordance with the requirements of 329 IAC 10-15-8 associated with Municipal Solid Waste Landfills as similar calculation and analysis requirements are not well defined for Restricted Waste Sites.

6.1 Hydrologic & Hydraulic Analysis

A hydrologic and hydraulic (H&H) analysis was performed to demonstrate that proposed surface water controls for the Tanners Creek Fly Ash Pond (FAP) Closure are properly sized in accordance with Indiana

Annotated Code Title 329, Article 10, Solid Waste Land Disposal Facilities. Specifically, all permanent drainage controls are to be sized for the 25-year 24-hour design storm event; S&ME used the 100-year 24-hour event for the design of all surface water controls. For computational purposes, we have assumed that the Ohio River is at a normal pool because the 100 year flood elevation reaches partway up the lower perimeter embankment. Results of the H&H study, including an extended narrative, have been detailed in Appendix A of Attachment V.

6.1.1 *Hydrologic Study*

The permanent drainage controls generally consist of open channels that convey storm water from the northern portion of the basin to two soil breaches. The existing emergency spillway, consisting of a concrete box culvert and concrete chute will convey storm water runoff from the clear water pond area. These drainage controls are discussed in more detail in Appendix A of Attachment V. S&ME used the SCS method to estimate the peak discharge during the design storm event. Hydrologic and hydraulic analyses were conducted using HydroCAD v.10 to model each drainage area using TR-20 methodology.

6.1.2 *Hydraulic Study*

Permanent drainage controls in this study include culverts and open channels that convey storm water flow to the clear water pond during Phase I or offsite during the final grade configuration. S&ME routed each drainage area through the permanent drainage features using HydroCAD to demonstrate that these features meet the calculation objectives. Characteristics of each drainage control feature are included in Tables 6-1 and 6-2 below and the H&H Appendix.

Table 6-1: Culvert Pipe Characteristics

Description	Material	Rise (in)	Width (in)	Length (ft)	Slope (ft/ft)	Roughness
Box Culvert	Concrete	36	48	89	0.0003	0.011

Table 6-2: Open Channel Characteristics

Channel	Bottom Width (ft)	Side Slopes (XH:1V)	Design Depth (ft)	Bed Slope (ft/ft)	Proposed Lining	Manning's Roughness n
West Drainage Channel	10	50	1.0	0.005	Temp ECB	0.052
West Ash Breach	10	4.2	2.0	0.082	Fabriform	0.025
West Perimeter Channel	10	3.0	2.0	0.002	Temp ECB	0.050
West Soil Breach	10	4.0	2.0	0.21	Riprap	0.054
East Drainage Channel	10	50	1.0	0.005	Temp ECB	0.052
East Ash Breach	10	4.2	2.0	0.069	Fabriform	0.025
East Perimeter Channel	10	3.0	2.0	0.002	Temp ECB	0.050
East Soil Breach	10	3.5	2.0	0.17	Riprap	0.051

6.1.3 Results

The proposed permanent drainage features were found to be adequately sized for the 100-year design storm event. The results of the open channel flow analysis are summarized in Tables 6-3 and 6-4 below.

Table 6-3: Culvert Pipe Results

Calculation Method	Estimated Peak Flow (cfs)	HW Elevation	Roadway/ Embankment Elevation	Overtopping?
HydroCAD	38.8	492.15	494.0	NO
HY-8	38.8	493.02	494.0	NO

Table 6-4: Open Channel Results

Channel	Calculation Method(1)	Design Depth (ft)	Calculated 100-Year Flow Depth (ft)
West Drainage Channel	HydroCAD/MathCAD	1.0	0.95
West Ash Breach	HydroCAD/MathCAD	2.0	0.63
West Perimeter Channel	HydroCAD/MathCAD	2.0	1.10
West Soil Breach	HydroCAD	2.0	0.73
East Drainage Channel	HydroCAD/MathCAD	1.0	0.95
East Ash Breach	HydroCAD/MathCAD	2.0	0.66
East Perimeter Channel	HydroCAD/MathCAD	2.0	1.04
East Soil Breach	HydroCAD	2.0	0.77

6.2 Slope Stability

A two-dimensional slope stability analysis was performed to evaluate the global stability of the FAP embankments in an interim condition and final closure configuration. Stability calculations were performed in general accordance with the US Army Corps of Engineers (USACE) *Slope Stability* Manual (EM-1110-2-1902) and 329 IAC 10. S&ME selected three cross-sections for the slope stability analysis: 1) the splitter dike between the clear water pond and the upper basin at the completion of Phase I; 2) a section through the upper basin's raised embankment and original earthen embankments; and, 3) the exterior embankment of the clear water pond. Targeted minimum safety factors corresponding to small uncertainty of strength parameters but with potential imminent danger to human life or the environment were used in accordance with 329 IAC 10-5-8 Table 6-1. Results of the slope stability analysis are summarized in Table 6-5. Full results of the assessment, including an extended narrative, have been detailed in Appendix B of Attachment V.

Table 6-5: Stability Analysis Results Summary

Design Cross-Section	Load Case	Failure Mode	Minimum FS	Computed Factor of Safety
A Splitter Dike	Static	Rotational	1.5	1.99
		Translational	1.5	1.82
B Upper Basin	Static	Rotational	1.5	1.94
	Seismic	Rotational	1.3	1.56
C Clear Water Pond	Static	Rotational	1.5	1.77
	Seismic	Rotational	1.3	1.44

6.3 Liquefaction Evaluation

The liquefaction triggering evaluation of the site was performed in general accordance with the requirements of 329 IAC 10-16-7 – Unstable Area Siting Restrictions. The evaluation was conducted in accordance with the Simplified Procedure method (Youd et al, 2001) using CPT liquefaction assessment software. The software program was used to evaluate the liquefaction potential for 9 CPT locations and a continuous plot of the factor of safety was generated. The seismic hazard used in the liquefaction analysis was a 2 percent probability of exceedance in a 50-year period event, resulting in an earthquake magnitude of 5.0 with a design PGA of 0.07g. Results of the analysis indicate that liquefaction of the sluiced fly ash is not predicted to occur. The minimum factor of safety for the CPT locations evaluated was above 2.0. Results of the assessment, including the development of the seismic design parameters, have been detailed in Appendix C of Attachment V.

6.4 Cover System Stability

A veneer stability analysis was performed for the final cover system configuration. The purpose of performing veneer stability analysis is twofold: 1) to determine the overall minimum interface friction angle needed for the various cover system interfaces; and, 2) determine the allowable transmissivity value of the geocomposite drainage layer. Targeted minimum safety factors corresponding to large uncertainty of strength parameters and no imminent danger to human life or the environment were used in accordance with 329 IAC 10-5-8 Table 1. Results of the veneer stability analysis are summarized below and a full narrative with supporting calculations is presented in Appendix D of Attachment V.

- Minimum cover system interface friction angle for 2.5% slopes in upper basin: <1°
- Minimum cover system interface friction angle for all other areas: 23.8°
- Minimum Allowable Transmissivity: 8.0 x 10^{-4} m^2/sec

A smooth geomembrane has been specified for the 2.5% grades within the upper basin area. A textured geomembrane has been specified for all other areas. The results reflect values that appear achievable based on similarly completed projects. In accordance with 329 IAC 10-22-6, the minimum allowable tested hydraulic transmissivity value of the geocomposite drainage layer provides an equivalent hydraulic transmissivity to the required value.

As noted in Section 5.9 – Dewatering Procedures, the surface of the Upper Basin currently exhibits a stable subgrade suitable for construction and support of the cover system. In the 6 weeks following the investigation, extended ground water measurements indicated the water level within the ash was between 11 and 18 feet below the surface. Furthermore, the minimum-required safety factors have been demonstrated for liquefaction, indicating the ash would remain stable under potential seismic events (see Section 6.3).

Additional fill placement is needed in some areas of the Fly Ash Pond to achieve final subgrade elevations. Fill is also necessary in the clear water pond area, where the majority of the initial fill placement will be from placing ash and other fill materials at the leading edge of and into any remaining open water. Open water will be removed simultaneously via pumping with this filling effort. This filling method is not suitable for controlled compaction effort. As fill placement nears final grade and is adequately above the water level within the ash, the upper 5 feet of subgrade below the cover system will be compacted in a controlled manner. The ash and other materials that are planned to be placed in an "uncompacted" manner are expected to settle relatively quickly under the influence of overlying surcharge loads. Similar to the upper basin, the ash fill placed within the clear water pond area is expected will exhibit a stable nature for compaction equipment when the subgrade is within 5 feet of the final grade. No areas of unstable subgrade will be permitted directly beneath the cover system.

6.5 Settlement Analysis

A settlement analysis was performed to estimate the settlement of the in-place sluiced fly ash and underlying foundation layers due to the loads created during regrading of the ash and construction of the cover system. Two prediction methods were used and compared to estimate the total settlement. One method used a constrained-modulus approach utilizing the site-specific CPT data. The second method was a traditional one-dimensional consolidation theory considering site-specific and typical consolidation parameters of fly ash. Results from a recent test fill placement on in-place sluiced coal combustion products (CCP) suggest the sluiced material exhibits an immediate settlement response compared to the consolidation behavior for clays(2). Therefore, the majority of the expected settlement in the sluiced fly ash is expected to occur prior to reaching the final grade, and the potential impacts of differential settlement impeding positive drainage in the cover system is very low.

Results from the two calculation methods predicted settlement of the in-place sluiced ash in the range of 4 to 12 inches for the upper basin, where the max fill height is 8 feet. In the clear water pond, the max fill height for Phase 2 is approximately 22 feet, but the thickness of the in-place ash is much less and the net stress increase from replacing the impounded water in the lined basin with ash fill is equivalent to approximately 8 feet of ash fill. This combination results in a predicted settlement range of 1 to 2 inches. In both cases, the primary consolidation settlement of the clay foundation layer ranges between 1 to 2 inches. Consolidation settlement in the foundation of this magnitude is not expected to appreciably affect the performance of the cover system. The settlement analysis calculation package is presented in Appendix E of Attachment V.

6.6 Universal Soil Loss

The annual erosion yield from the cover system was estimated using the Universal Soil Loss Equation (USLE). The USLE equation was developed for predicting average annual soil loss to determine the erodibility of a site based on several factors, such as rainfall intensity, slope length and steepness, and maintenance and vegetation. Results of the calculation predict an average annual yield of 2.5 tons per acre per year. This result is below the limiting value of 5 tons per acre per year, as required under 329 IAC 10-30-2. The Universal Soil Loss calculation package is presented in Appendix F of Attachment V.

7.0 Closure Plan Required Information

Rule 30, Section 8 of 329 IAC-10 lists the information required for Closure Plans for Restricted Waste Sites. This narrative meets the requirements of Section 4(a) for a written closure plan, with Section 5.0 presenting the steps necessary to close the facility. The additional required information is presented in the following sections.

7.1 Engineer's Opinion of Probable Construction Costs

An Engineer's Opinion of Probable Construction Cost, as well as the estimated cost per acre, has been incorporated into the IDEM Closure Form for RSWs I, II, III, C/D Site, and Non-MSWLF Facilities. This form is presented in Section 9.0 of this Plan.

7.2 Construction Schedule

Grading of ash within the upper basin (Phase 1 grading) began in the summer of 2017. The work in advance of approval of this plan is limited to ash grading, ash dewatering, and select demolition. No breaches of the dike will occur in advance of approval of this Closure Plan. It is anticipated that this Plan will be approved in 2018. Some construction may begin late in 2018 with full construction initiated in the spring of 2019. It is anticipated that the Phase 1 area will be closed by mid to late summer of 2019 and that Phase II will begin in late summer of 2019. It is desired to complete all closure construction by the end of 2019; however, the schedule includes a contingency for weather delays which provides for full closure construction completion early in 2020.

7.3 Closure Certification

The following will be submitted upon completion of the final closure of the fly ash pond facility in accordance with 329 IAC 10-30.

- A certification statement, signed by both the owner or operator and a registered professional engineer, that the facility has been closed in accordance with the approved closure plan.
- A Certification Report summarizing all aspects of the closure construction, including construction procedures, observations, and test results performed as required by the QA/QC Plan.
- A legal description of the solid waste boundary.
- Verification that the owner of the property on which the facility is located has recorded a notation on the deed to the facility property, or on some other instrument, normally examined during title search, which will, in perpetuity, notify any potential purchaser of the property that the land has been used as a solid waste land disposal facility. At a minimum, the recording must contain the following:

  A. The general types and location of waste.

B. The depth of fill.

C. A plot plan, with surface contours at intervals of two (2) feet, which must indicate:

1. final land surface water run-off direction;
2. surface water diversion structures after completion of the operation; and
3. final grading.

D. A statement that no construction, installation of wells, pipes, conduits, or septic systems, or any other excavation must be done on the property without approval by the commissioner.

7.4 Post Closure Requirements

Tanners Creek Development, LLC is attentive to the maintenance and post-closure requirements for post closure care as required by 329 IAC 10-31. Post-closure requirements must be followed for a period of 30 years following the date of final closure certification. A Post Closure Care Plan has been developed for the Fly Ash Pond Closure and is included with this Plan as Attachment IV.

8.0 Closure Plan Supporting Documents

The following documents have been prepared as part of the overall Closure Plan.

- Section 9.0, IDEM Closure Form Parts III through VIII
- Attachment I: Design Drawings
- Attachment II: Ground Water Monitoring Plan
- Attachment III: Construction Quality Assurance Plan
- Attachment IV: Post Closure Care Plan
- Attachment V: Calculations
- Attachment VI: New Geotechnical Data
- Attachment VII: Comment and Response Log
- Attachment VII: Dust Control Plan

9.0 IDEM Closure Form Parts III to VIII

III. LABOR, MATERIALS, & TESTING (Provide a listing of items necessary to close the facility. For items that will vary depending upon the number of acres to be closed, the quantities should be indicated on a per acre basis.)

A. Item	B. Quantity	C. Units
1. Mobilization & Demobilization	1	LS
2. Erosion and Sediment Control	1	LS
3. Demolition	1	LS
4. Phase 1 Soil Excavation	19,705	CY
5. Phase 2 Soil Excavation and Fill	5,075	CY
6. Phase 1 Ash Excavation and Fill	0	CY
7. Phase 2 Ash Excavation and Fill	66,255	CY
8. Protective Soil Cover	285,130	CY
9. Vegetative Layer	57,025	CY
10. Seeding and Mulching	70.69	AC
11. Liner Subgrade Preparation	7.85	AC
12. Smooth Geomembrane	49.66	AC
13. Textured Geomembrane	23.95	AC
14. Geocomposite Drainage Net	70.04	AC
15. Nonwoven Geotextile Cushion	5.05	AC
16. 6" Drainage Tubing, Perforated, IDOT Item 907.17(a)	6,229	LF
17. 6" Pipe, IDOT Item 907.17(b)	260	LF
18. Drainage Aggregate, IDOT Item 904.03, As Per Plan	650	CY
19. Pipe Bedding and Initial Backfill, As Per Plan	12	CY
20. Channel Lining Cover Material	9,679	CY
21. Fabric-formed Concrete Channel	17,100	SF
22. Rock Type 1	1,575	CY
23. Rock Type 2	820	CY
24. Rock Type 3	47	CY
25. Erosion Control Blanket	60,300	SY
26. INDOT Type 3 Filter Fabric	3,000	SY
27. CQA Testing and Reporting	1	LS

IV EXPECTED YEAR OF CLOSURE

A. Expected Year of Closure: 2019

B. Total Time Required to Close Facility (See instructions): 9 months

C. Time Required for Intermediate Steps in Closure (Provide a description of intermediate closure activities and the time required. See instructions.)

n/a

V. COST PER ACRE FOR FINAL COVER & VEGETATION

A. What Percent of Final Cover and Topsoil is Available from Areas That are Controlled, and Will be Controlled through Post-Closure, by the Permittee?

1. % of final cover: 100%

2. Describe location of sources: Soil from on-site borrow

3. % of topsoil: 100%

4. Describe location of sources: Soil obtained from off-site borrow

B. Cost Per Acre for Acquisition, Placement, & Compaction of 30-inches of Final Cover

1. Acquisition

   a. Quantity of clay needed per acre (cy/acre): 4,033 cy/ac

   b. Excavation unit cost ($/cy) (if obtained on-site): $1.50 $/cy

   c. Purchase unit cost ($/cy) (if obtained off-site): $0.00 $/cy

   d. Delivery unit cost ($/cy) (if obtained off-site): $0.00 $/cy

e. Acquisition cost ($/acre)
Line 1a * Line 1b (or)
Line 1a * (Line 1c + Line 1d) — $6,050 $/ac

2. Placement and Compaction

a. Placement/spreading unit cost — $0.50 $/cy

b. Compaction unit cost ($/cy) — $1.50 $/cy

c. Placement and compaction cost ($/acre)
Line 1a * (Line 2a + Line 2b) — $8,066 $/ac

3. Testing

a. Soil classification (if soil source)
is of variable quality)($/acre) — $400 $/ac

b. Survey control for cover thickness
and proper slopes ($/acres) — $500 $/ac

c. Density testing (if planned) ($/acre) — $5,500 $/ac (all field CQA Testing)

d. Testing cost ($/acre)
Line 3a + Line 3b + Line 3c — $6,400 $/ac

4. Clay Cover Cost ($/acre)
Line 1e + Line 2c + Line 3d — $20,516 $/ac

C. Cost Per Acre for Acquisition & Placement of Topsoil

1. Acquisition

a. Quantity of topsoil needed per acre
(cy/acre) — 807

b. Excavation unit cost ($/cy)
(if obtained off-site) — $0.00 $/cy

c. Purchase unit cost ($/cy)
(if obtained off-site) — $3.50 $/cy

	d. Delivery unit cost ($/cy) (if obtained off-site)	$0.50 $/cy
	e. Acquisition cost ($/cy) Line 1a * Line 1b (or) Line 1a * (Line 1c + Line 1d)	$3,228 $/ac
2.	Placement	
	a. Spreading unit cost ($/cy)	$0.50 $/cy
	b. Placement cost ($/acre) Line 1a * Line 2a	$404 $/cy
3.	Topsoil Cost ($/acre) Line 1e + Line 2b	$3,632 $/ac

D. <u>Cost Per Acre to Establish Vegetation</u>

1.	Vegetation	
	a. Seeding unit cost ($/acre)	$1,500 $/ac
	b. Fertilization unit cost ($/acre)	$1,000 $/ac
	c. Mulching unit cost ($/acre)	$500 $/ac
	d. Vegetation Establishment Cost ($/acre) Line 1a + Line 1b + Line 1c	$3,000 $/ac

E. <u>Cost Per Acre to Certify Closure</u>

1.	Registered Professional Engineer	
	a. Initial review of closure plan (hrs)	16 hrs
	b. Total number of inspections	10 visits
	c. Inspection time required (hrs/visit)	12 hrs/visit
	d. Total inspection time (hrs) Line 1b * Line 1c	120 hrs

e. Prepare final documentation (hrs) 120 hrs

f. Total engineer time (hrs)
Line 1a + Line 1d + Line 1e 256 hrs

g. Engineer unit labor cost ($/hr) $135 $/hr

h. Professional engineer cost ($)
Line 1f * Line 1g $34,560 $

i. Area of site permitted for filling (acres) 71.23 acres

j. Closure Certification Cost ($/acre)
Line 1h + Line 1i $485 $/ac

F. Other Costs Per Acre for Final Cover and Vegetation

1. Other Costs ($/acre) (Specify) $0 $/ac

G. Total of Items B through F (Must not be less than $5,000) $27,633 $/ac

VI OTHER CLOSURE COSTS (Give these on a total facility basis rather than per acre.)

A. Notation of Property Deed $500

B. Other Costs

Cost for items such as drainage features, installation of gas vents, etc., should be delineated in this section.

1. **Activity** / **Cost**

	Activity	Cost
1.	Mobilization & Demobilization	$150,000
2.	Erosion and Sediment Control	$100,000
3.	Demolition	$15,000
7.	Phase 1 Ash Excavation and Fill	$298,147
11.	Liner Subgrade Preparation	$68,424
12.	Smooth Geomembrane	$930,135
13.	Textured Geomembrane	$511,102
14.	Geocomposite Drainage Net	$1,952,582
15.	Nonwoven Geotextile Cushion	$52,764
16.	6" Drainage Tubing, Perforated, IDOT Item 907.17(a)	$24,916

Continued from Previous Page

VI OTHER CLOSURE COSTS (Give these on a total facility basis rather than per acre.)

B. Other Costs Continued

Cost for items such as drainage features, installation of gas vents, etc., should be delineated in this section.

1. Activity	Cost
17. 6" Pipe, IDOT Item 907.17(b)	$1,040
18. Drainage Aggregate, IDOT Item 904.03, As Per Plan	$12,995
19. Pipe Bedding and Initial Backfill, As Per Plan	$240
20. Channel Lining Cover Material	$62,915
21. Fabric-formed Concrete Channel	$111,150
22. Rock Type 1	$47,250
23. Rock Type 2	$24,600
24. Rock Type 3	$1,410
25. Erosion Control Blanket	$126,600
26. INDOT Type 3 Filter Fabric	$9,000
27. 10% Contingency	$646,257

C. **Total (Add costs from Sections A. and B.)** $5,141,027

VII CLOSURE COST ESTIMATE (Multiply item I.E. by Item V.G. and then add Item (VI.C.): $7,109,325

VIII ADDITIONAL INFORMATION REQUIRED FOR FACILITIES PROVIDING FINANCIAL ASSURANCE ON AN INCREMENTAL BASIS

A. **Will Closure Financial Assurance be Provided on an Incremental Basis? (If the answer to this question is no, skip to Item IX.)** no

B. **Map of Areas of Waste Deposition (Attach a copy of the facility's final contour map which shows the maximum areas of waste deposition on a yearly basis for the remaining life of the facility.)**

See Attachment 1

C. **Maximum Areas of Waste Deposition & Closure Costs (Fill in the following table for each remaining year of the facility's life.)**

Year	Max. Area of Waste Deposition (cumulative acres) (end of year)	Closure Cost w/o Partial Closure ($)	Area Partially Closed (cumulative acres) (start of year)	Increm. Closure ($)
2019	71.23 acres	$7,109,325	n/a	$0

Attachments