CLOSURE PLAN
MONTOUR ASH BASIN NO. 1

MONTOUR STEAM ELECTRIC STATION
DERRY TOWNSHIP
MONTOUR COUNTY, PENNSYLVANIA

Prepared for:

MONTOUR, LLC
WASHINGTONVILLE, PENNSYLVANIA

Prepared by:

CIVIL & ENVIRONMENTAL CONSULTANTS, INC.
333 BALDWIN ROAD
PITTSBURGH, PA 15205

CEC Project 132-065.0114

October 2016

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APPENDICES

1.0 OBJECTIVE

On behalf of Montour, LLC, Civil & Environmental Consultants, Inc. (CEC) has prepared this Closure Plan for the Montour Steam Electric Station (MSES) Ash Basin No. 1 (Basin 1) to meet the closure requirements defined in Code of Federal Rules, Title 40, Part 257.102 (§257.102) and Part 257.103 (§257.103) for existing Coal Combustion Residuals (CCR) surface impoundments. Basin 1 is classified as an existing CCR surface impoundment by definition in Part 257.53 (§257.53).

2.0 SITE DESCRIPTION

Montour, LLC (Montour) owns and operates the Montour Steam Electric Station (MSES), which is located in Derry Township, Montour County, Pennsylvania. Basin No. 1 was constructed to dispose of coal combustion residuals (CCR) and to treat wastewater from the MSES. The location of Basin No. 1 is shown on Figure 1 – Site Location Map in Appendix A.

Basin 1 is permitted by Pennsylvania Department of Environmental Protection (PADEP) as a Class II Residual Waste Disposal Impoundment under Permit No. 301315, which expires in April 2018. Basin 1 is also regulated by the PADEP Bureau of Waterways Engineering Division of Dam Safety under Permit No. 47-009 and under National Pollutant Discharge Elimination System (NPDES) Permit No. PA0008443.

Basin No. 1 is an unlined, earthen dike disposal impoundment. The permitted disposal area is approximately 155 acres. Basin 1 went into service in 1971 and was developed by excavating site soils to construct an embankment dike around the excavation. The perimeter of Basin 1 is approximately 11,000 feet in length and up to approximately 40-feet high. The dike ties into a bedrock ridge along the eastern side of the basin. A slurry wall was subsequently installed in the perimeter dike except in the bedrock ridge area. Basin 1 is divided into Subbasins A, B, and C by internal dikes referred to as the Median Dike and the Splitter Dike, respectively. Refer to Figure 2 – Site Plan in Appendix A for the site features.

The CCR disposed in Basin 1 have historically included coal fly ash (ceased in 1982), coal bottom ash (presently managed elsewhere), Stabil-Fil (lime-amended fly ash), and mill rejects (presently managed elsewhere). A small quantity of bottom ash fines are currently sluiced into Subbasin B which functions as a settling basin. The water is decanted by culverts through the splitter dike into Subbasin C. Water is discharged from Subbasin C through a spillway to the on-site detention basin before discharging to Chillisquaque Creek where it is monitored under an NPDES Permit.

In preparing for eventual basin closure, Montour submitted a Major Permit Modification (MPM) Application to PADEP in November 2014 which PADEP approved by a permit modification dated June 18, 2015. The MPM Application proposed the following:

- Placement of Conditioned Fly Ash (fly ash conditioned with moisture) as a beneficial use to increase final waste grades to promote surface water run-off and decrease the potential for long-term ponding of water on the final cover.
- Installation of a surface water management system designed in accordance with PADEP regulations.
- Placement of an alternative final cover system consisting of a geomembrane, geotextile cushion/drainage layer, and final cover soil.

The MPM Application increased the permitted capacity of the facility to 9,642,000 cubic yards. In accordance with the MPM, Montour has been placing Conditioned Fly Ash (CFA) in Basin 1 as structural fill to increase the final grades in preparation for basin closure. The placement of fly ash is considered beneficial use of coal ash as structural fill per Pennsylvania Residual Waste Regulations Article IX, Chapter 290.102 of the Pennsylvania Code.

The MPM Application included a PADEP Form 16R – Liner System, which describes the cap system over Basin 1, and Form 18R – Closure/Post-Closure Land Use Plan, which describes the closure and post-closure activities to be performed at Basin 1. Applicable sections of the approved Form 16R and 18R are provided in Appendices B and C, respectively, for reference.

3.0 §257.102 CRITERIA FOR CONDUCTING THE CLOSURE OR RETROFIT OF CCR UNITS

The applicable sections of §257.102 are presented below in bold, italic font. The responses follow each section of the rule and are provided in normal font.

§257.102 states:

(b) Written closure plan - (1) Content of the plan. The owner or operator of a CCR unit must prepare a written closure plan that describes the steps necessary to close the CCR unit at any point during the active life of the CCR unit consistent with recognized and generally accepted good engineering practices. The written closure plan must include, at a minimum, the information specified in paragraphs (b)(1)(i) through (vi) of this section.

(b)(1)(i) A narrative description of how the CCR unit will be closed in accordance with this section.

(b)(1)(ii) If closure of the CCR unit will be accomplished through removal of CCR from the CCR unit, a description of the procedures to remove the CCR and decontaminate the CCR unit in accordance with paragraph (c) of this section.

(b)(1)(iii) If closure of the CCR unit will be accomplished by leaving CCR in place, a description of the final cover system, designed in accordance with paragraph (d) of this section, and the methods and procedures to be used to install the final cover. The closure plan must also discuss how the final cover system will achieve the performance standards specified in paragraph (d) of this section.

Closure of the CCR unit will be accomplished by leaving CCR in place and placing a final cover system over the entire limits of the disposal area. The MPM Application proposes to remove CCR from a portion of Subbasin C which will be repurposed as a sedimentation pond for Basin 1. The CCR in a portion of Subbasin C will be relocated to an area that will have a final cover system installed. The permitted cap system and closure plan are detailed in Form 16R and 18R of the MPM Application provided in Appendices B and C, respectively.

(b)(1)(iv) An estimate of the maximum inventory of CCR ever on-site over the active life of the CCR unit.

The estimated maximum inventory of CCR ever on-site over the active life of the CCR unit based on the permitted capacity for Basin No. 1 is approximately 9,642,000 cubic yards. The actual inventory of CCR may be less depending on the volume of CFA placed during MSES operations.

(b)(1)(v) An estimate of the largest area of the CCR unit ever requiring a final cover as required by paragraph (d) of this section at any time during the CCR unit's active life.

The current disposal area in Basin No. 1 is approximately 155 acres. As part of the MPM Application, CCR will be removed from a portion of Subbasin C which will be repurposed as a sedimentation pond. After relocation of the CCR in Subbasin C, a maximum of 143 acres of Basin No. 1 will require a final cover system over CCR.

(b)(1)(vi) A schedule for completing all activities necessary to satisfy the closure criteria in this section, including an estimate of the year in which all closure activities for the CCR unit will be completed. The schedule should provide sufficient information to describe the sequential steps that will be taken to close the CCR unit, including identification of major milestones such as coordinating with and obtaining necessary approvals and permits from other agencies, the dewatering and stabilization phases of CCR surface impoundment closure, or installation of the final cover system, and the estimated timeframes to complete each step or phase of CCR unit closure. When preparing the written closure plan, if the owner or operator of a CCR unit estimates that the time required to complete closure will exceed the timeframes specified in paragraph (f)(1) of this section, the written closure plan must include the site-specific information, factors and considerations that would support any time extension sought under paragraph (f)(2) of this section.

Basin 1 will continue to operate as a CCR disposal unit as long as MSES is generating power by burning coal. Consistent with the MPM Application, the facility could continue to accept CFA through 2025. The life expectancy is an estimate and is subject to change based on the availability of CFA and other factors. Montour has the necessary permits and approvals to complete the closure of Basin 1.

During placement of CFA and installation of the final cover system, saturated, in place CCR will drain. Additional dewatering and stabilization of the CCR is not required.

A final cover system will be installed after CFA placement is completed. The final cover will be installed over areas with CCR in place. In accordance with the MPM Application, the final cover system will be installed in phases over 5 years with an estimated completion date of 2031. MPM Application Drawing E377134, Sheet 9 provided in Appendix A shows the proposed sequence and schedule for final cover system installation.

(b)(3) Amendment of a written closure plan. (i) The owner or operator may amend the initial or any subsequent written closure plan developed pursuant to paragraph (b)(1) of this section at any time. (ii) The owner or operator must amend the written closure plan whenever (A) There is a change in the operation of the CCR unit that would substantially affect the written closure plan in effect; or (B) Before or after closure activities have commenced, unanticipated events necessitate a revision of the written closure plan. (iii) The owner or operation must amend the closure plan at least 60 days prior to a planned change in the operation of the facility or CCR unit, or no later than 60 days after an unanticipated event requires the need to revise an existing written closure plan. If a written closure plan is revised after closure activities have commenced for a CCR unit, the owner or operator must amend the current closure plan no later than 30 days following the triggering event.

Amendments to the Closure Plan will be completed as necessary based on closure activities.

(4) The owner or operator of the CCR unit must obtain a written certification from a qualified professional engineer that the initial and any amendment of the written closure plan meets the requirements of this section.

A written certification from a qualified professional engineer for the initial written closure plan is provided. Certifications will also be provided for any amendments to the plan.

(d) Closure performance standard when leaving CCR in place—(1) The owner or operator of a CCR unit must ensure that, at a minimum, the CCR unit is closed in a manner that will:

(d)(1)(i) Control, minimize or eliminate, to the maximum extent feasible, post-closure infiltration of liquids into the waste and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere;

The installation of the geomembrane final cover system over Basin No. 1 will minimize the potential for infiltration of liquids into the CCR and releases of CCR, leachate, or contaminated run-off to the ground or surface waters or to the atmosphere.

(d)(1)(ii) Preclude the probability of future impoundment of water, sediment, or slurry;

The permitted final grades have a maximum 3 percent slope and a minimum 1 percent slope. A settlement analysis that was performed as part of the MPM Application shows that post-settlement grades provide positive drainage with no ponding of surface water at the final grades.

The conveyance of surface water run-off to the sedimentation basin will reduce the probability of future impoundment of surface water on the basin final cover. The installation of the final cover system will reduce the probability of future impoundment of water in the existing CCRs within the impoundment.

(d)(1)(iii) Include measures that provide for major slope stability to prevent the sloughing or movement of the final cover system during the closure and post-closure care period;

Final CCR grades and the specified interface shear strength between the final cover system components provides for slope stability to prevent the sloughing or movement of the final cover system during the closure and post-closure care period. Stability of the final cover system components were evaluated in the MPM Application, Form 16R which is provided in Appendix B.

(d)(1)(iv) Minimize the need for further maintenance of the CCR unit; and

The design of the final cover system minimizes the need for further maintenance of the CCR unit. The post-closure land use is open space (meadow) which requires minimal maintenance activities.

(d)(1)(v) Be completed in the shortest amount of time consistent with recognized and generally accepted good engineering practices.

Consistent with the MPM Application, the final cover system will be installed in phases over 5 years. This schedule is consistent with the requirements included in §257.102(f)(1)(ii) requiring existing surface impoundments to complete closure activities within 5 years of commencing closure.

(d)(2) Drainage and stabilization of CCR surface impoundments. The owner or operator of a CCR surface impoundment or any lateral expansion of a CCR surface impoundment must meet the requirements of paragraphs (d)(2)(i) and (ii) of this section prior to installing the final cover system required under paragraph (d)(3) of this section.

(d)(2)(i) Free liquids must be eliminated by removing liquid wastes or solidifying the remaining wastes and waste residues.

Standing water in Basin 1 will be eliminated during placement of CFA.

(d)(2)(ii) Remaining wastes must be stabilized sufficient to support the final cover system.

The CFA is able to support the weight of the final cover system and the construction equipment used to place the final cover.

(d)(3) 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 (d)(3)(i) of this section, or the requirements of the alternative final cover system specified in paragraph (d)(3)(ii) of this section.

(d)(3)(i) 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.

(d)(3)(i)(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.

(d)(3)(i)(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.

(d)(3)(i)(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)(3)(i)(D) The disruption of the integrity of the final cover system must be minimized through a design that accommodates settling and subsidence.

The permitted final cover system in the MPM consists of the following components from bottom to top:

- 40-mil geomembrane,
- 6 oz/sy cushion/drainage geotextile, and
- 1-foot thick cover soil layer.

The final cover system will minimize infiltration and erosion and will accommodate settling and subsidence.

(d)(3)(ii) 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 (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.

The proposed final cover system is an alternative to what is proposed in paragraphs (d)(3)(ii)(A) through (D). The proposed final cover system meets the design criteria of the regulation. There is not a bottom liner system in the impoundment and the permeability of the natural subsoils is estimated to be greater than 1.0×10^{-4} cm/sec (Basin-Wide Hydrogeologic and Risk Assessment Report, prepared by CEC, December 2015). The geomembrane in the final cover system has an estimated permeability on the order of 1.0×10^{-12} cm/sec that is much less than the maximum final cover permeability of 1.0×10^{-5} cm/sec or the permeability of the subsoils. The final cover system includes a 1-foot thick soil erosion layer which is thicker than specified in the regulation and is capable of sustaining native plant growth to minimize erosion. The final cover system will accommodate the anticipated settling of the CCR as presented in Attachment 3.3 of Form 16R in the MPM Application provided in Appendix B.

(d)(3)(iii) 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.

A written certification from a qualified professional engineer that the design of the final cover system meets the requirements of this section is provided.

(e) Initiation of closure activities. Except as provided for in paragraph (e)(4) of this section, the owner or operator of a CCR unit must commence closure of the CCR unit no later than the applicable timeframes specified in either paragraph (e)(1) or (2) of this section.

(e)(1) The owner or operator must commence closure of the CCR unit no later than 30 days after the date on which the CCR unit either:

(e)(1)(i) Receives the known final receipt of waste, either CCR or any non-CCR waste stream; or

(e)(1)(ii) Removes the known final volume of CCR from the CCR unit for the purpose of beneficial use of CCR.

The initiation of closure activities for Basin No. 1 will begin no later than 30 days after the final receipt of waste. Depending on the time of year, initiation of closure activities may include installing surface water controls, intermediate cover, or final cover.

(e)(2)(i) Except as provide by paragraph (e)(2)(ii) of this section, the owner or operator must commence closure of a CCR unit that has not received CCR or any non-CCR waste stream or is no longer removing CCR for the purpose of beneficial use within two years of the last receipt of waste or within two years of the last removal of CCR material for the purpose of beneficial use.

If Basin No. 1 does not receive waste for two years, closure activities will be initiated unless the provisions of (e)(2)(ii) are met.

(f) Completion of closure activities.

(f)(1) Except as provided for in paragraph (f)(2) of this section, the owner or operator must complete closure of the CCR unit:

(f)(1)(i) For existing and new CCR landfills and any lateral expansion of a CCR landfill, within six months of commencing closure activities.

(f)(1)(ii) For existing and new CCR surface impoundments and any lateral expansion of a CCR surface impoundment, within five years of commencing closure activities.

Closure of Basin No. 1 will be completed within five years of initiating closure activities. This schedule is consistent with the closure construction sequencing proposed in the MPM Application and provided on Sheet 9 in Appendix A.

(f)(2)(i) Extensions of closure timeframes. The timeframes for completing closure of a CCR unit specified under paragraphs (f)(1) of this section may be extended if the owner or operator can demonstrate that it was not feasible to complete closure of the CCR unit within the required timeframes due to factors beyond the facility's control. If the owner or operator is seeking a time extension beyond the time specified in the written closure plan as required by paragraph (b)(1) of this section, the demonstration must include a narrative discussion providing the basis for additional time beyond that specified in the closure plan. The owner or operator must place each completed demonstration, if more than one time extension is sought, in the facility's operating record as required by §257.105(i)(6) prior to the end of any two-year period. Factors that may support such a demonstration include:

(f)(2)(i)(A) Complications stemming from the climate and weather, such as unusual amounts of precipitation or a significantly shortened construction season;

(f)(2)(i)(B) Time required to dewater a surface impoundment due to the volume of CCR contained in the CCR unit or the characteristics of the CCR in the unit;

(f)(2)(i)(C) The geology and terrain surrounding the CCR unit will affect the amount of material needed to close the CCR unit; or

(f)(2)(i)(D) Time required or delays caused by the need to coordinate with and obtain necessary approvals and permits from a state or other agency.

If the proposed closure construction schedule cannot be met, Montour will submit a demonstration in accordance with paragraph (f)(2)(i) providing the basis for the additional time to complete closure.

(f)(3) Upon completion, the owner or operator of the CCR unit must obtain a certification from a qualified professional engineer verifying that closure has been completed in accordance with the closure plan specified in paragraph (b) of this section and the requirements of this section.

Upon completion of closure of the CCR unit, a written certification from a qualified professional engineer will be prepared stating that closure has been completed in accordance with the Closure Plan.

(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 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).

Upon initiation of closure, Montour will prepare a notification of intent to close the CCR unit. The notification will include the certification by a qualified professional engineer for the design of the final cover system as required by §257.102(d)(3)(iii). The notification will be placed in the operating record in accordance with §257.105(i)(7).

(h) Within 30 days of completion of closure of the CCR unit, the owner or operator must prepare a notification of closure of a CCR unit. The notification must include the certification by a qualified professional engineer as required by §257.102(f)(3). 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)(8).

Within 30 days of completion of closure, Montour will prepare a notification of closure of the CCR unit. The notification will include certification by a qualified professional engineer as required by §257.102(f)(3). The notification will be placed in the operating record in accordance with §257.105(i)(8).

(i) Deed notations. (1) Except as provided by paragraph (i)(4) of this section, following closure of a CCR unit, the owner or operator must record a notation on the deed to the property, or some other instrument that is normally examined during title search.

Following closure of the CCR unit, Montour will record a notation on the deed to the property, or other some instrument that is normally examined during a title search. The notification on the deed will in perpetuity notify any potential purchasers of the property that the land has been used as a CCR unit and that its use is restricted under the post-closure care requirements.

Within 30 days of recording the notation on the deed to the property, Montour will prepare a notification stating that the notation has been recorded. The notification will be placed in the operating record in accordance with §257.105(i)(9).

(j) The owner or operator of the CCR unit must comply with the closure recordkeeping requirements specified in §257.105(i), the closure notification requirements specified in §257.106(i), and the closure Internet requirements specified in §257.107(i).

Montour will comply with the closure recordkeeping requirements specified in §257.105(i), the closure notification requirements specified in §257.106(i), and the closure Internet requirements specified in §257.107(i).

(k) Criteria to retrofit an existing CCR surface impoundment.

Montour is not planning to retrofit Basin No. 1.

4.0 §257.103 ALTERNATE CLOSURE REQUIREMENTS

The applicable sections of §257.103 are presented below in bold, italic font. The responses follow each section of the rule and are provided in normal font.

§257.103 states:

§257.103 Alternative closure requirements

The owner or operator of a CCR landfill, CCR surface impoundment, or any lateral expansion of a CCR unit that is subject to closure pursuant to §257.101(a), (b)(1), or (d) may continue to receive CCR in the unit provided the owner or operator meets the requirements of either paragraph (a) or (b) of this section.

Montour is not currently proposing alternative closure requirements for Basin No. 1. If an alternative closure is proposed in the future, Montour will document that the conditions required in paragraph (a) or (b) of this section are met.

5.0 PROFESSIONAL ENGINEER CERTIFICATION

This Closure Plan fulfills the CCR Rule Closure requirements for a Written Closure Plan (§257.102(b)) and Final Cover System (§257.102(d)(3)). This Closure Plan will be placed in the operating record by October 17, 2016.

I, Rick J. Buffalini, P.E., a registered professional engineer in the state of Pennsylvania certify that Montour Ash Basin No. 1 fulfils the Closure Plan requirements of §257.102(b) and that the final cover system design fulfils the requirements for §257.102(d)(3). This certification is based on my review of the Montour Ash Basin No. 1 Closure Plan.

Rick J. Buffalini, P.E.

Printed Name of Professional Engineer

Signature

041196-E	Pennsylvania	10-12-16
Registration No.	Registration State	Date

Stamp/Seal:

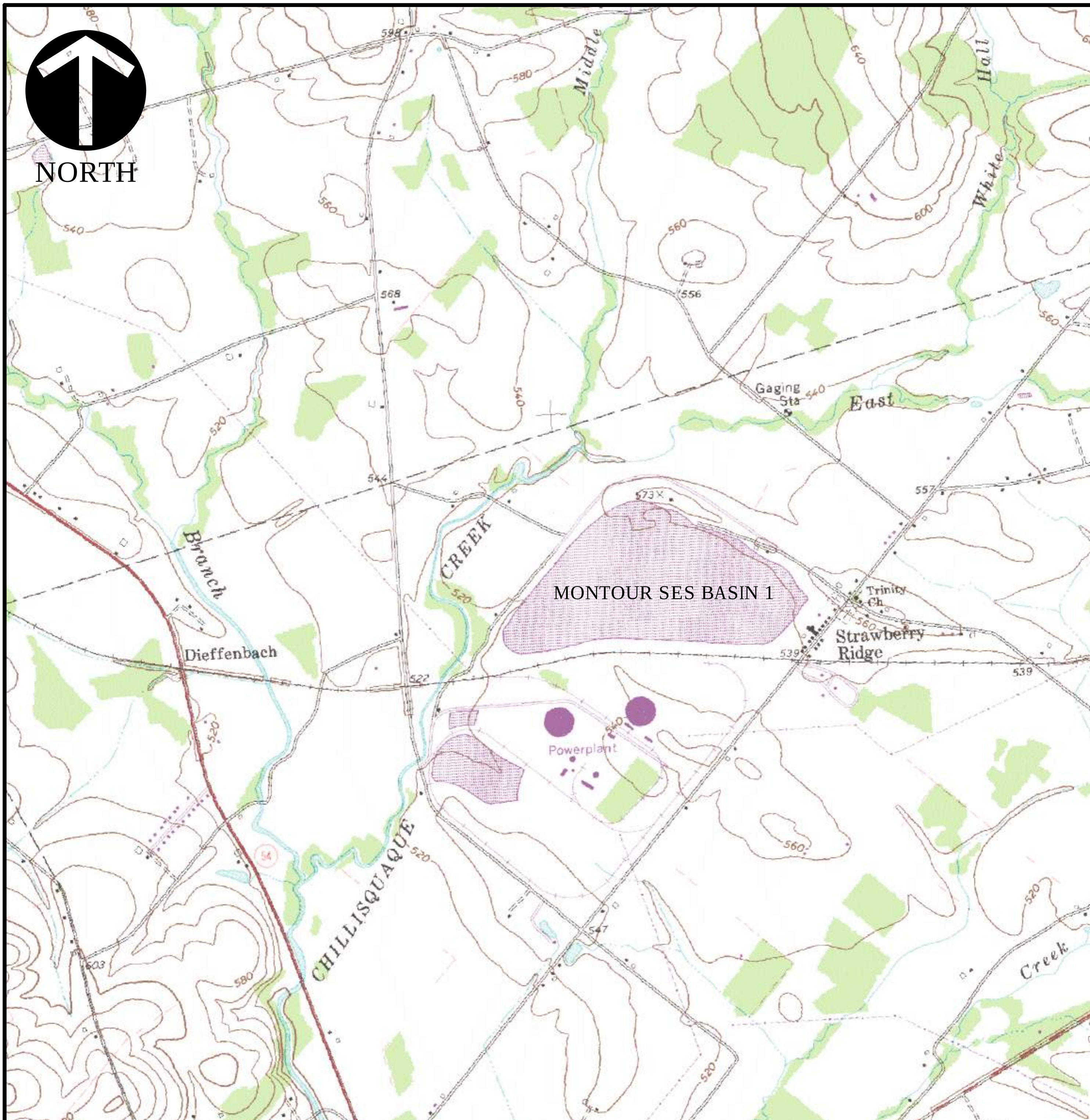
6.0 REFERENCES

1. Major Permit Modification Application for Design Changes, November 2014, Civil & Environmental Consultants, Inc.

2. Basin-Wide Hydrogeologic and Risk Assessment Report, December 2015, Civil & Environmental Consultants, Inc.

APPENDIX A

FIGURES



REFERENCE

1. U.S.G.S. 7.5' TOPOGRAPHIC MAP, WASHINGTONVILLE QUADRANGLE, PA DATED: 1969, PHOTOREVISED: 1977. PHOTOINSPECTED: 1983.

SCALE IN FEET

0 2000 4000

*HAND SIGNATURE ON FILE

CEC

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MONTOUR, LLC.
CLOSURE AND POST-CLOSURE PLAN
MONTOUR STEAM ELECTRIC STATION
WASHINGTONVILLE, PENNSYLVANIA

SITE LOCATION MAP

DRAWN BY: DWD	CHECKED BY: AMR	APPROVED BY: *RJB	FIGURE NO.: 1
DATE: 8/22/2016	DWG SCALE: 1" = 2000'	PROJECT NO: 132.065.0114	

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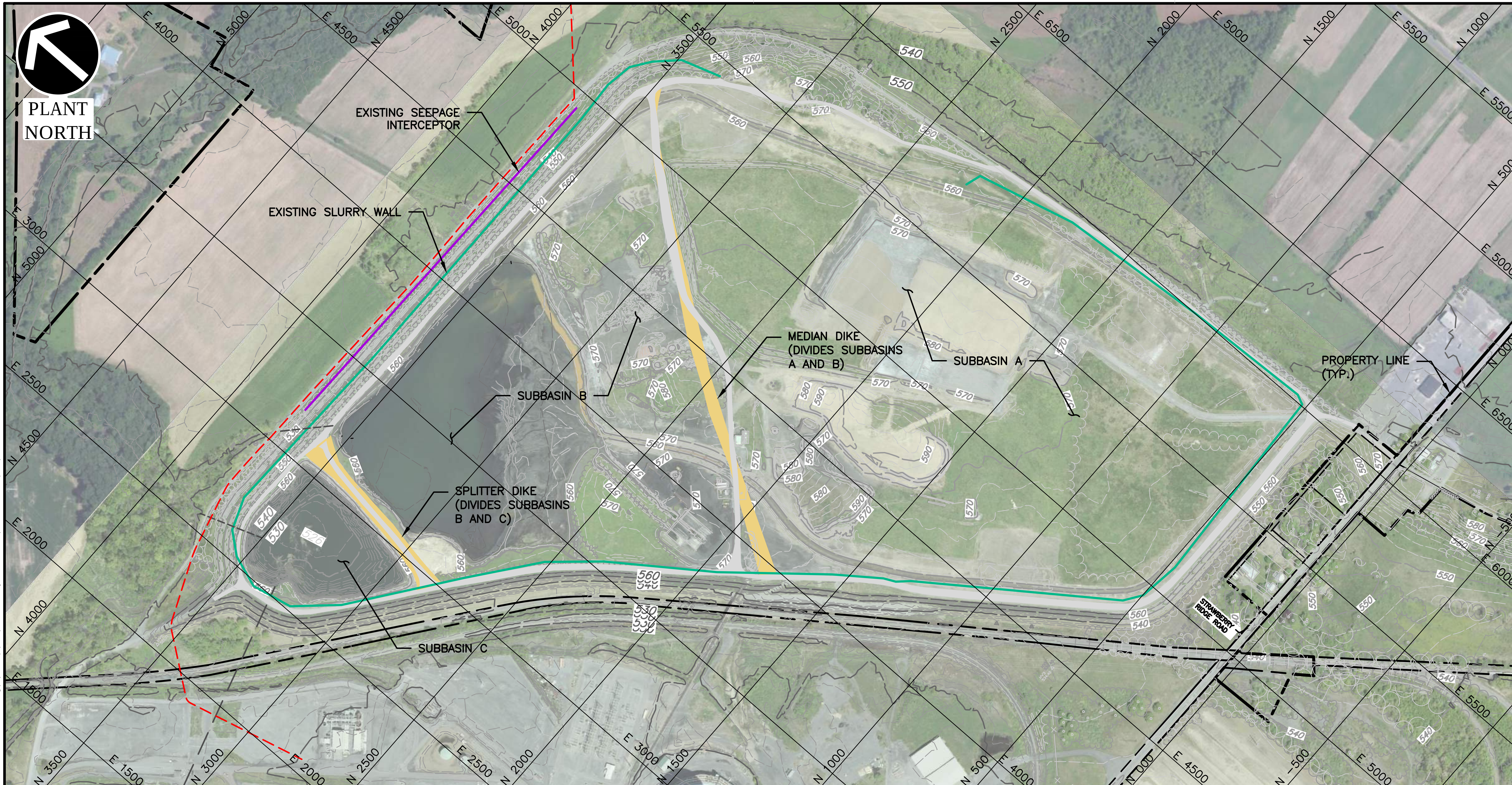

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REFERENCES

1. BACKGROUND IMAGERY PROVIDED TO CEC BY TALEN IN JUNE 2016.
2. EXISTING TOPOGRAPHY BASED ON 2016 TOPOGRAPHIC MAPPING FOR 2015 OPERATION REPORT, DRAWING NO. E376172 BY CDI L.R. KIMBALL.
3. A SITE SPECIFIC COORDINATE SYSTEM IS SHOWN. MONTOUR S.E.S. USES A NGVD 1929 VERTICAL DATUM INSIDE BASIN 1.
4. EXISTING CONTOURS TO SOUTH OF BASIN 1 WERE DERIVED FROM THE PAMAP PROGRAM 3.2 FT DIGITAL ELEVATION MODEL OF PENNSYLVANIA; DEVELOPED BY PAMAP PROGRAM, PA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES, BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY; DATED 2008.
5. PROPERTY BOUNDARIES AND OWNERS HAVE BEEN PROVIDED BY PPL THROUGH A GIS DATA RELEASE AGREEMENT, DATED SEPTEMBER 4, 2014. COPYRIGHT 2011, ALL RIGHTS RESERVED. THE INFORMATION CONTAINED HEREIN IS THE PROPRIETARY PROPERTY OF THE CONTRIBUTOR SUPPLIED UNDER LICENSE AND MAY NOT BE REPRODUCED EXCEPT AS LICENSED BY DIGITAL MAP PRODUCTS.

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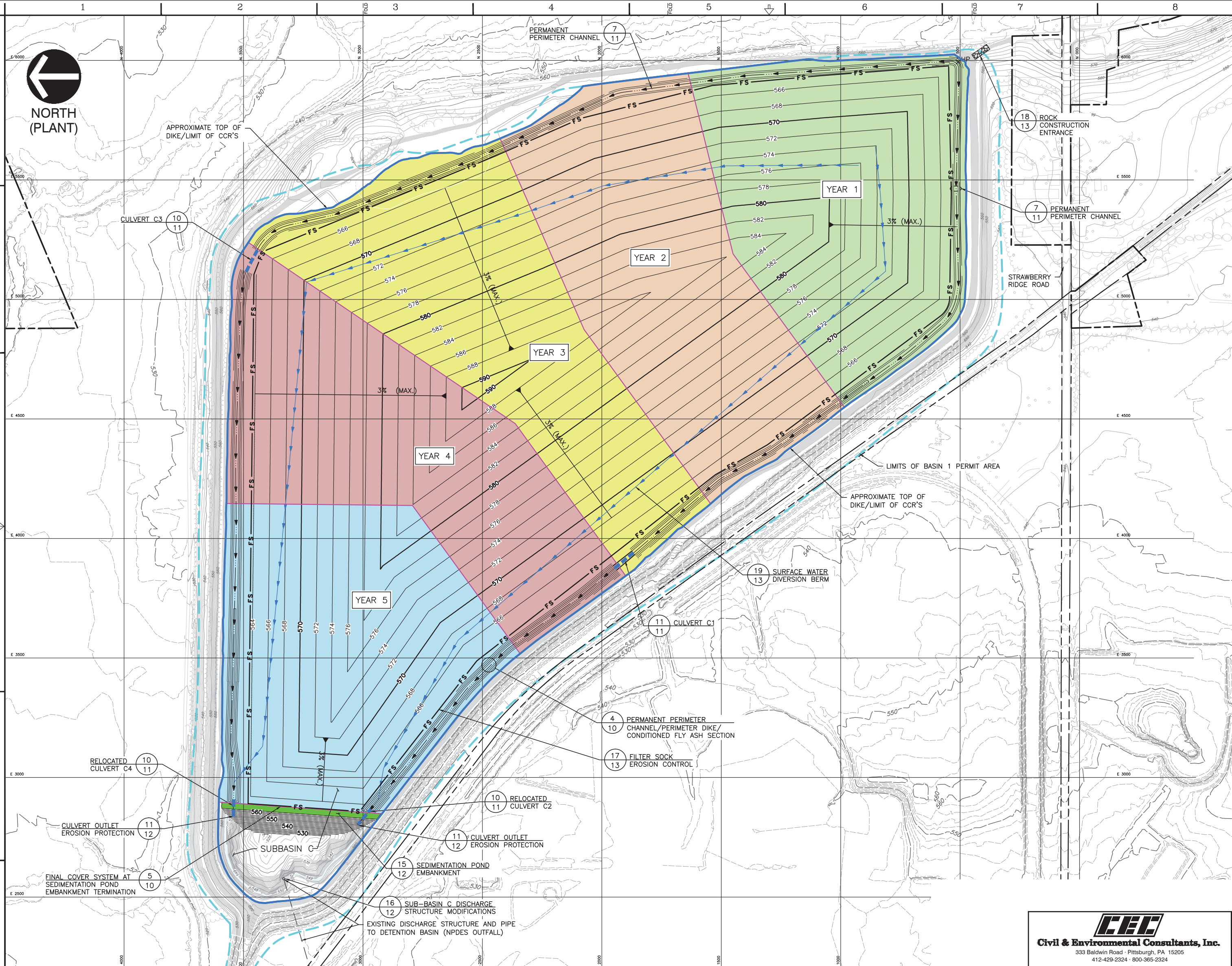
MONTOUR, LLC.
CLOSURE AND POST-CLOSURE PLAN
MONTOUR STEAM ELECTRIC STATION
WASHINGTONVILLE, PENNSYLVANIA

SITE PLAN

DRAWN BY:	DWD	CHECKED BY:	AMR	APPROVED BY:	*RJB	FIGURE NO.:	2
DATE:	8/22/2016	DWG SCALE:	1"=400'	PROJECT NO:	132-065.0114		

P:\2013\132-065\-CADD\Dwg\SW01\132065-SW01-FIGURE 2.dwg{2} LS:(8/25/2016 - jhendrickson) - LP: 10/12/2016 12:58 PM



LEGEND

- PROPERTY LINE
- LIMITS OF BASIN 1 PERMIT AREA
- APPROXIMATE TOP OF DIKE/LIMIT OF CCR'S
- 570 EXISTING CONTOUR
- 570 PROPOSED CONTOUR (TOP OF FINAL COVER)
- ACCESS ROAD
- PROPOSED CULVERT
- SEDIMENTATION POND EMBANKMENT
- PERIMETER CHANNEL
- SURFACE WATER DIVERSION BERM
- YEAR 1 — PHASE LIMIT AND YEAR OF FINAL COVER INSTALLATION (TYP.)
- XX/XX — DETAIL NO. / DRAWING NO. ON WHICH DETAIL IS CALLED OUT
- FS — FILTER SOCK EROSION CONTROL

NOTES

1. THE FINAL COVER SYSTEM WILL BE INSTALLED IN PHASES OVER APPROXIMATELY 5 YEARS. THE APPROXIMATE LIMIT OF THE PHASES ARE SHOWN. THE ACTUAL LIMITS OF THE FINAL COVER SYSTEM INSTALLED DURING EACH PHASE MAY VARY FROM THOSE SHOWN.
2. THE FINAL COVER GRADES SHOWN REPRESENT THE MAXIMUM PROPOSED LIMITS AND GRADES. THE FINAL COVER GRADES MAY RANGE FROM 3% (MAX) TO 1% (MIN). THE ACTUAL CONDITIONED FLY ASH GRADES MAY BE LOWER THAN THOSE PRESENTED.
3. EROSION AND SEDIMENTATION CONTROLS WILL BE INSTALLED UPSTREAM OF THE PERIMETER CHANNEL AND FUNCTIONAL PRIOR TO DISTURBANCE OF AN AREA. THE LOCATION OF E&S CONTROLS ARE NOT SHOWN AND WILL BE INSTALLED BASED ON THE SITE CONDITIONS.
4. THE SURFACE WATER DIVERSION BERM WILL BE CONSTRUCTED AS EACH PHASE IS COMPLETED. A TEMPORARY DOWNCHUTE WILL BE INSTALLED TO DIRECT SURFACE WATER TO THE PERIMETER CHANNEL.

REFERENCE

1. THE EXISTING TOPOGRAPHY, DATED MAY 1, 2013 WAS GENERATED USING AERIAL PHOTOGRAPHY BY L. ROBERT KIMBALL AND ASSOCIATES, INC. THE 2013 TOPOGRAPHY IN SUBBASIN B WAS REFERENCED FROM PPL DRAWING NO. E376172 REV 3, DATED 6/2013.
2. THE 2014 ANNUAL BATHYMETRIC SURVEY IN SUBBASINS B AND C IS FROM DRAWING 750188GPS.DWG, DATED MAY 8, 2014, WHICH WAS GENERATED BY PPL.
3. A SITE SPECIFIC COORDINATE SYSTEM IS SHOWN. MONTOUR S.E.S. USES A NAVD 1929 VERTICAL DATUM INSIDE BASIN 1.
4. THE LIMITS OF THE PERMIT AREA IS FROM PPL DRAWING E244381, DATED 9/2007.
5. EXISTING CONTOURS TO SOUTH OF BASIN 1 WERE DERIVED FROM THE PAMAP PROGRAM 3.2 FT DIGITAL ELEVATION MODEL OF PENNSYLVANIA; DEVELOPED BY PAMAP PROGRAM, PA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES, BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY; DATED 2008.
6. PIPE BRIDGE AND SLUICE PIPE LOCATIONS WERE TAKEN FROM PPL MONTOUR, LLC DWG. NO. D324541 SHEET 1 OF 3, DATED 9/19/08.
7. THE APPROXIMATE TOP OF DIKE/LIMIT OF CCR'S SHOWN IS AN ESTIMATED LOCATION BASED ON REFERENCES FROM PPL DRAWINGS.
8. PROPERTY BOUNDARIES AND OWNERS HAVE BEEN PROVIDED BY PPL THROUGH A GIS DATA RELEASE AGREEMENT, DATED SEPTEMBER 4, 2014.

COMMONWEALTH OF PENNSYLVANIA — REGISTERED PROFESSIONAL ENGINEER — ANGELA M. RAMIREZ — PE082317

Angela M. Ramirez

SCALE IN FEET 0 200 400

Civil & Environmental Consultants, Inc.
333 Baldwin Road · Pittsburgh, PA 15205
412-429-2324 · 800-365-2324
www.cecinc.com

ACCT– 103650	MONTOUR S.E.S. ASH BASIN #1 MAJOR PERMIT MODIFICATION CLOSURE PHASING PLAN
SCALE– AS SHOWN	
BY– MJI	
REVIEWED RJB	
APPROVED ANGELA M. RAMIREZ — DATE 10/29/14	PPL MONTOUR, LLC
PPL DRAWING NO. D377134	SHEET NO. 9 — REV. 0

132–065XR–CV10–007 – CLOSURE PHASING PLAN.dwg

PPL CORP. FORM 4163D (4/00) Nov. 3, 2014 – 6:04 PM

PC CAD

APPENDIX B

PADEP FORM 16R – LINER SYSTEM

FORM 16R
LINER SYSTEM – PHASE II

Revised October 2014

Form 16R – Table of Contents

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WASTE MANAGEMENT

Date Prepared/Revised October 2014
DEP USE ONLY
Date Received

FORM 16R
LINER SYSTEM - PHASE II

This form must be fully and accurately completed. All required information must be typed or legibly printed in the spaces provided. If additional space is necessary, identify each attached sheet as Form 16R, reference the item number and identify the date prepared. The "date prepared/revised" on any attached sheets needs to match the "date prepared/revised" on this page.

General References: 288.412, 288.431, 288.531, 289.412, 289.431, 289.531

SECTION A. SITE IDENTIFIER

Applicant/permittee: PPL Montour, LLC

Site Name: Montour Steam Electric Station - Basin 1

Facility ID (as issued by DEP): 301315

SECTION B. LINER SYSTEM

Liner System is for:

- ☐ Residual Waste Landfill
  - ☐ Class I
  - ☐ Class II
  - ☐ Class III
- ☒ Residual Waste Disposal Impoundment
  - ☐ Class I
  - ☒ Class II

SECTION C. LOCATION

County: Montour County   Municipality: Derry Township

Total Acreage of Site: 176.5   Acreage of Disposal Area: 154.5

SECTION D. LINER SYSTEM COMPONENTS

	Liner System Components are:	Area (ft^2)	Is Equivalency Review Being Requested (Y/N)
☐	1. Subbase.	N/A	N
☐	2. Secondary Liner.	N/A	N
☐	3. Leachate Detection Zone.	N/A	N
☐	4. Primary Liner.	N/A	N
☐	5. Protective Cover.	N/A	N
☐	6. Leachate Collection System (within Protective Cover).	N/A	N
☒	7. Cap	6,229,080	Y
☐	8. Natural Attenuation	N/A	N
☐	9. Composite Liner Primary or Secondary (circle one)	N/A	N

SECTION E. SUPPORTING DATA

Supporting Data:

The following information must be submitted along with this form. For information not appended to this form, indicate below where in the specifications or drawings the required information is located.

		(Drawing)	(Specification)
1.	Design of Liner System. (Refer to Part II.)	E377134-Sheet 10 (final cover system)	See Attachment 2
2.	Liner Installation Plan. (Refer to Part III)	See Attachment 2	See Attachment 2
3.	Compatibility of Liner to Leachate. (Refer to Part IV)	See Attachment 2	See Attachment 2
4.	Physical, Chemical, Mechanical, and Thermal Properties of Liners. (Refer to Part V)	See Attachment 2	See Attachment 2
5.	Quality Assurance Plan for Construction and Installation of Liners. (Refer to Part VI)	See Attachment 2	See Attachment 2
6.	Quality Control Plan for construction and installation of liners	See Attachment 2	See Attachment 2
7.	Slope Stability Analysis	See Attachment 2	See Attachment 2

PART II. DESIGN OF LINER SYSTEM

SECTION A. PROJECT SPECIFICATIONS – *See Attachment 2*

Project Specifications		Subbase	Secondary Liner	Leachate Detection Zone	Primary Liner	Leachate Collection Zone	Protective Cover	Cap
Thickness (inches or mils)		N/A	N/A	N/A	N/A	N/A	N/A	See Att. 2
Maximum Particle Size (inches)		N/A	N/A	N/A	N/A	N/A	N/A	See Att. 2
Standard Proctor Density (percent)	FIELD	N/A	N/A	N/A	N/A	N/A	N/A	See Att. 2
	LAB	N/A	N/A	N/A	N/A	N/A	N/A	See Att. 2
Bearing Capacity (minimum) (lb/ft^2)		N/A	N/A	N/A	N/A	N/A	N/A	See Att. 2
Total Applied Load (lb/ft^2)		N/A	N/A	N/A	N/A	N/A	N/A	See Att. 2
Permeability (cm/s)	FIELD	N/A	N/A	N/A	N/A	N/A	N/A	See Att. 2
	LAB	N/A	N/A	N/A	N/A	N/A	N/A	See Att. 2
Slope (percent)	MINIMUM	N/A	N/A	N/A	N/A	N/A	N/A	See Att. 2
	MAXIMUM	N/A	N/A	N/A	N/A	N/A	N/A	See Att. 2

Geosynthetics:	Where synthetic liners, geonets, geotextiles, or other geosynthetic materials are to be used, provided information as to the manufacturer, trade name, type, specifications and composition of each product.
Non-Synthetic Liners:	Where clay or other soils will be used as the liner, provide information on the Atterberg Limits, soil density, moisture relationship moisture content, and sieve analysis to be maintained at the time of installation.
Drainage System:	Where piping is installed as part of the leachate detection, Leachate collection or gas disposal system submit plans and profile drawings of each level, cell or zone which clearly illustrates the: slope, spacing, diameter and schedule of all piping to be installed.

SECTION B. DESIGN BASIS – *See Attachments 2,3*

For each major element of the liner system outlined above, provide the following information which supports the basis for the design. Include copies of the results of all tests conducted at the site, assumptions, and calculations used in the design. The stability of the landfill site and design is to be determined at critical sections. This is to include any below grade excavations/embankments or berms that may be critical. Consideration must be given to long and short term stresses, equipment loadings, filling sequence, and the possibility of earthquakes. Where geosynthetics are used, a veneer stability analysis should be performed on the interfaces of the material and the soil or aggregates. A puncture analysis is to be included where a geosynthetic is used to protect a geomembraine. Include test results of all liner interfaces for friction angles. Following information is to be attached to this form and referenced to the appropriate section.

1. Subbase: ***N/A***
   - i. Submit detailed information on how the subbase was sized and located, including the minimum and maximum depths to seasonal high water table and regional groundwater table. Be sure all elevations are tied to projects grid system and benchmarks. Explain this bases for the subbase size and materials selected.
   - ii. Describe how the subbase will bear the weight of the liners, leachate detection and collection systems, wastes, cover material, and operations equipment without causing or allowing any failure of the liner system. Explain what evaluations were conducted at the site and of the subgrade materials to ensure adequacy for the projected loads.
   - iii. Discuss the potential for subsidence and the liner systems ability to allow for settlement.
2. Secondary Liner: ***N/A***
   - i. Describe the physical, chemical, and thermal properties taken into consideration in selecting the secondary liner.
   - ii. Submit and discuss the results of any testing conducted on the liner material which ensures it will not be adversely affected, both chemically and structurally, by the chemical characteristics of the waste or leachate.

SECTION B. DESIGN BASIS (con't)

3. Leachate Detection Zone: ***N/A***
   - i. Describe the physical, chemical, and thermal properties taken into consideration in selecting materials.
   - ii. Submit and discuss the results of any testing conducted on the detection zone materials which ensures they will not be adversely affected, both chemically and structurally, by the chemical characteristics of the waste or its leachate.
   - iii. Describe the methods for cleaning and maintaining pipes, including methods for testing installed pipes for leakage.
   - iv. Describe how the leachate detection zone will support the primary liner without causing punctures in the event of subsidence.
4. Primary Liner: ***N/A***
   - i. Describe the physical, chemical and thermal properties taken into consideration in selecting the primary liner.
   - ii. Submit and discuss the results of any testing conducted on the liner material which ensures it will not be adversely affected, both chemically and structurally, the by chemical characteristics of the waste or its leachate.
5. Protective Cover: ***N/A***
   - i. Provide a detailed description of the physical and structural aspects of the protective cover. Include information on the size, types, dimensions and depths of all materials used, slopes, calculations on anticipated stresses and loads from wastes and operating equipment. Describe how the cover material will protect the primary liner from physical damage from stresses and disturbances from overlying wastes, cover materials, and equipment operations.
   - ii. Describe how the protective cover will allow the continuous and free flow of leachate. Describe the possibility and effects of subsidence should it occur.
6. Leachate Collection System within Protective Cover: ***N/A***
   - i. Provide a detailed description of the physical and structural aspects of the proposed leachate detection system. Include information on the size, types, dimensions and depths of all materials used, slopes, calculations on anticipated bearing loads (wastes and equipment), and leachate detection capabilities. Indicate which drawings and sections of the specifications contain the information on layout and material requirements.
   - ii. Provide a description of how the system will detect, collect, and transmit leachate. Briefly describe the leachate treatment facilities and approvals obtained.
   - iii. Describe the methods for cleaning and maintaining pipes, including methods for testing installed pipes for leakage.
   - iv. Provide an evaluation of geotextiles used as filters for filtration and clogging.
   - v. Provide an evaluation for the transmissivity of geonets.
7. Cap: ***See Attachments 2,3***
   - i. Provide a detailed description of the chemical and structural characteristics of the materials to be used for the final cover. Be sure to indicate the minimum and maximum size of materials allowed, sieve sizes, USDA Texture Class, and any other significant distinguishing characteristics.
   - ii. Provide a description of how the materials are to be placed and compacted, with details on maximum slopes, minimum depths, and acceptable bearing loads.

PART III. LINER INSTALLATION PLAN

SECTION A. SUBBASE – *N/A*

1. Information on the maximum depth of earth moving activities and the site preparation procedures to be followed prior to the installation of any subbase materials.
2. Information on the selection of subbase materials, their grading and tests to be conducted to ensure uniformity.
3. Information on how the subbase materials are placed, graded, compacted, and tested for proper installation.

SECTION B. LINERS – *See Attachments 2,4*

1. For synthetic liners, provide all information supplied by the manufacturer as to required handling and installation procedures.
2. For non-synthetic liners, information on the minimum acceptable characteristics (i.e. moisture content, etc.) are to be provided.
3. For synthetic and non-synthetic liners, information as to the equipment required, pre and post installation testing is to be provided.

SECTION C. LEACHATE DETECTION AND COLLECTION ZONES – *N/A*

1. Provide details on how the detection and collection zones will be installed with specific information as to what materials and construction techniques will be used to construct each zone.
2. Describe the sequence of construction and equipment used.
3. Describe the sequence for installing the sump and all monitoring or gas venting facilities.

SECTION D. PROTECTIVE COVER – *N/A*

1. Describe where the cover materials will come from, and how they are transported and placed at the site.
2. Provide details on how the cover materials will be routinely tested for conformance with design specifications.

SECTION E. FINAL COVER AND GRADING – *See Attachment 2*

1. Provide a detailed description of how the final cover material is to be placed, compacted, and graded.
2. Describe the proposed final layout for the area with specific reference to any drainage facilities which will remain.

SECTION F. ATTENUATING SOIL BASE (CLASS III RESIDUAL WASTE LANDFILLS) – *N/A*

1. Describe the Class of soils to be used as classified by the United State Department of Agriculture.
2. Indicate where in the specifications and quality control procedures the requirements for attenuating soil, as contained in Section 288.624(b) of the residual waste regulations, are contained.
3. Describe the proposed sequence for placement of waste and attenuating soils.

SECTION G. HIGHWALLS – *N/A*

1. Describe how the liner or barrier materials will be installed to prevent the migration of leachate from the disposal area. **- *N/A***
2. Provide information on each type of barrier material to be used and its minimum thickness. Include appropriate information on the physical and chemical characteristics of the material, and proof the material is not adversely affected by solid waste, leachate, or its constituents. ***N/A***
3. Provide detailed information on the different seams or outcrops at the proposed site and how they will be isolated from wastes. ***N/A***
4. Explain how groundwater and surface water drainage will be controlled and eliminated. ***N/A***
5. Submit a plan for controlling damage from subsidence or the collapse of highwalls. ***N/A***

SECTION H. LIMITATIONS – *N/A*

1. Provide appropriate information on any land use restrictions or limitations that should be followed during and after closure of the facility.

PART IV. COMPATIBILITY OF LINER TO LEACHATE – Refer to Attachment 2

A sampling plan for each component of the liner system, including sample size, methods for determining sample locations, sampling frequency, acceptance and rejection criteria, and methods for ensuring that corrective measures are implemented is to be included with this form.

SECTION A.

Information must be submitted which demonstrates that leachate will not adversely affect the physical or chemical characteristics of the liner system, or inhibit the liner's ability to restrict the flow of solid waste, solid waste constituents, or leachate, based on EPA or ASTM guidelines approved by the Department.

SECTION B.

Attach a copy of the chemical analysis of the leachate used in determining the above results.

SECTION C.

Where appropriate, attach an analysis of the current leachate emanating from this landfill.

PART V. PROPERTIES OF SYNTHETIC LINERS – *See Attachments 2,4*

Supply the following physical, chemical, mechanical, and thermal properties for liners, based on ASTM methods where appropriate. Additional information may be submitted.

	Property	Results with Units of Measurement	ASTM Method
1.	Thickness		
2.	Tensile Strength at Yield		
3.	Elongation at Yield		
4.	Elongation at Break		
5.	Density		
6.	Tear Resistance		
7.	Carbon Black Content		
8.	Puncture Resistance		
9.	Seam Strength (% of Liner Strength)		
10.	Ultraviolet Light Resistance		
11.	Carbon Black Dispersion		
12.	Permeability		
13.	Liner Friction Angle in Degrees		
14.	Stress Crack Resistance		
15.	Oxidative Induction Time		
16.	Chemical Compatibility		
17.	Percent Recycled Materials		

PART VI. QUALITY ASSURANCE PLAN FOR CONSTRUCTION AND FOR INSTALLATION OF LINERS *– See Attachment 2*

The following information shall be submitted on separate pages and referenced to the appropriate section. For each Section A summary table is to be provided which explains the procedures, the frequency for each test, and the pass/fail criteria which must be met.

SECTION A.

Qualifications of independent QA personnel (describe experience and training).

SECTION B. SUBBASE – *N/A*

1. Provide design summary of procedures used to assure objectives are met:
   a. Outline tests and observations to ensure quality of compacted fill.
   b. Explain observations to ensure removal of objects or undesirable materials.
   c. Discuss observations and tests that ensure that the surface is compacted, smooth, uniform, and consistent with design grades.
   d. Summarize surveying to ensure that facility dimensions, side slopes, and bottom slopes are as specified in design.
   e. Summarize review of Quality Control information.

SECTION C. NON-SYNTHETIC LINERS – *N/A*

1. Discuss inspection procedures of liner materials and test fill compaction. Properties to be tested should include: permeability, soil density/moisture content relationships, maximum clod size, particle size distribution, natural water content, Atterberg limits.
2. Outline procedures and methods for observing and testing liner materials before and after placement to ensure:
   a. Removal of roots, rocks, etc.
   b. Identification of changes in soil characteristics causing a change in construction specifications.
   c. Adequate spreading and incorporation of water to obtain full penetration through clods ad uniform distribution of the specified water content.
   d. Maintaining optimum water content throughout wet and dry periods and during construction.

SECTION D. SYNTHETIC AND GEOSYNTHETIC LINERS – *See Attachments 2,4*

Outline Procedures For:

1. Inspection of product quality, the review of manufacturers control procedures and any other observations related to transporting, storing, and handling.
2. Inspection of foundation preparation and equipment.
3. Observations of liner placement.
4. Need and availability of manufacturers representative.
5. Observations of weather conditions.
6. Observations and measurements of anchor trench to ensure that it is as specified in design drawings.
7. Observations and tests to confirm that all designed liner penetrations and liner connections are installed as specified.
8. Visual inspection for tears, punctures, or thin spots during placement.
9. Inspections during and after liner seaming.
10. Observations and tests to assure that seals around liner penetrations are of sufficient strength and are impermeable to leachate.

SECTION E. PROTECTIVE COVER – *N/A*

Outline Procedures For:

1. Tests to ensure that the cover material meets design specifications, including permeability and clogging potential.
2. Observations that the cover material is free from objects that could damage the liner.
3. Observations to ensure that equipment used to place cover does not damage liner.
4. Measurements to ensure that entire liner is covered with specified thickness of cover material.

SECTION F. LEACHATE DETECTION AND COLLECTION SYSTEM – *N/A*

Discuss how the following activities will be conducted:

1. Observations and measurements to ensure that materials are of specified size and strength, and that pipe perforations are sized and spaced as specified.
2. Observations and tests to ensure that soils to be used are of proper size and gradation.
3. Method of placing bedding and inspection to ensure the pipes are bedded correctly and not susceptible to movement.
4. Observations and measurements to ensure that pipes are placed at specified locations, at specified grades, and are joined together as specified.
5. Observations and tests to ensure that backfilling is completed as specified in design, in all areas, including areas where a liner connects to a structure.
6. Testing of pipe joints and testing of solid wall pipes to ensure that there is no leakage.
7. Observations and tests of the granular drainage layer to ensure that the material meets the specifications of design (including permeability and clogging potential to geosynthetics).
8. Synthetic drainage layers: Observations to ensure proper placement, correct seaming, and allowable weather conditions.
9. Geotextiles: Observations of placement to ensure that specifications are followed, adequate overlap or seaming, and that there is no damage.
10. Sumps: Observations to ensure that structures are of specified dimensions, material, and capacity.
11. Mechanical and electrical equipment installation: Observations to ensure that equipment is in accordance with design specifications and manufacturer's recommendations.

SECTION G. FINAL COVER SYSTEM – *See Attachment 2*

Discuss who and how following activities will be conducted:

1. Observations and tests to evaluate stability of cover system foundation.
2. Observations and testing as necessary to confirm that soil materials meet specified design.
3. Non-synthetic component: Monitor soil type, moisture content, density, compaction, lift thickness, clod size, uniformity of compaction, completeness of coverage, and permeability.
4. Tests for seals around penetrations such as gas vent pipes to ensure that they do not leak.
5. Inspections for perimeter of cover, where the soil component joins or overlies the liner system, to ensure that it is installed according to specifications.
6. Liners used in the capping system shall follow guidelines for synthetic liners.
7. Observations for a protective layer, such as a geotextile, which is placed above the liner as protection from drainage layer, to ensure proper placement to avoid damage to the liner.
8. Drainage and gas venting layer placement: The gas discharge layer is placed below the synthetic liner and the water drainage layer is placed above the synthetic liner. Guidelines for the leachate collection and detection zone will be followed. Inspections of the installation of the drainage layers around the perimeter of the cover system is important, for it is here that the system connects to the surface drainage facilities. Ensure that design specifications, particularly dimensions and slopes, are achieved. Controlled gas discharge or collection systems are checked for proper installation and function.
9. Filter layer used above or below drainage layer to stop migration or piping of fine materials should be tested for any clogging potential. During construction of filter layer, inspection will include monitoring of particle size (for soil materials) or geotextile type and certification, seaming or overlap for geotextiles, slope of surface, and coverage.
10. Topsoil layer placement: Monitor uniformity of application process, observations to ensure that soil is not overly compacted, and measurements of thickness and slope of topsoil layer.
11. Topsoil seeding: Inspection of seeding process, measurement of tilling depth, application rate of additives should be monitored for consistency with design specifications. Application equipment will be appropriate. Verify that all vents and standpipes or other penetrations through cover are not damaged by tilling and application process. Weather conditions are to be appropriate. Post-construction: Slopes will be surveyed and any unusual depressions noted and corrected.
12. Review of Quality Control information.

ATTACHMENT 2

Form 16R Narrative for Major Permit Modification

ATTACHMENT 2

FORM 16R NARRATIVE FOR MAJOR PERMIT MODIFICATION

PART I

SECTION D: LINER SYSTEM COMPONENTS

A final cover system (cap) will be installed over the entire limits of coal combustion residuals (CCRs) at Montour Steam Electric Station Basin No. 1.

D7. Cap

A Request for Equivalency Review (Form Q) is being submitted for an alternative final cover system, which will consist of 1-foot of cover soil, geotextile, and geomembrane.

SECTION E: SUPPORTING DATA

These items are addressed in later sections of the form.

PART II – DESIGN OF LINER SYSTEM

SECTION A: PROJECT SPECIFICATIONS

Project specifications are being presented for the final cover system. The other items, including subbase, secondary liner, leachate detection zone, primary liner, protective cover, and leachate collection system within protective cover are not applicable to this facility.

Cap:

Thickness: The final cover system will be placed directly on conditioned fly ash or intermediate cover. The final cover system will include the following from bottom to top:

- 40-mil geomembrane;
- 6 oz/sy non-woven geotextile; and
- 1-foot of cover soil.

Maximum Particle Size (Inches): The maximum particle size for the final cover soil is 6-inches.

Standard Proctor: Not Applicable. The final cover soil will be placed in accordance requirements provided with Form J. No compactive effort is required for the placement of the final cover soil.

ATTACHMENT 16R-1
(Continued)

Bearing Capacity: Not Applicable

Total Applied Load: The total long-term applied load, based on the weight of the final cover materials above the geomembrane, will be approximately 115 psf. During construction and placement of final cover soils, additional loads will be applied by construction equipment. It is estimated that approximately 755 psf will be applied to the geomembrane by a low ground pressure dozer.

Permeability: The cover system includes a geomembrane with an estimated permeability of $1x10^{-12}$ cm/s.

Slope: The proposed maximum final design grades are 3 percent. The proposed grades are the maximum anticipated based on conditioned fly ash generation. The final grades may vary depending on actual generation rates and duration of conditioned fly ash placement. The minimum final design grade is the current permitted slope of 1 percent.

SECTION B: DESIGN BASIS

A design basis is being presented for the final cover system. The other items, including subbase, secondary liner, leachate detection zone, primary liner, protective cover, and leachate collection system within protective cover are not applicable to this facility.

7. Cap

(i) Provide a detailed description of the chemical and structural characteristics of the materials to be used for the final cover. Be sure to indicate the minimum and maximum size of materials allowed, sieve sizes, USDA Texture Class, and any other significant distinguishing characteristics.

The final cover system will consist of 1-foot of soil, geotextile, and geomembrane. The final cover system will be placed over CCRs including conditioned fly ash, which is approximately 143 acres after modifying Sub-Basin C to be a sedimentation pond and relocating any CCRs from the sedimentation pond area. The final cover soil will be constructed using a blend of 50 percent (maximum) bottom ash fines and 50 percent soil. The maximum particle size of the soil is 6-inches. 40% of the soil must pass the No. 10 (2 mm) sieve. The requirements for the final cover soil are provided with Form J.

A 40-mil PVC, HDPE, or LLDPE geomembrane will be used as the barrier layer. A 6-oz/sy nonwoven geotextile will be used as a cushion and drainage layer above the geomembrane.

Several geotechnical investigations were performed as part of the design of the increased grading plan. A summary of the geotechnical investigations is provided in Attachment 3.1.

The stability analysis for the final cover system is presented in Attachment 3.2. The minimum factors of safety calculated were 6.3 and 1.9 for the static and dynamic (seismic) conditions, respectively. This exceeds the minimum required factors of safety of 1.5 static conditions and 1.2 dynamic (seismic) conditions. Based on these results, the final cover system constructed with the proposed components at 3 percent slopes meets the stability requirements in 25 Pa. Code § 289.271 which is related to the dike of an impoundment but also relevant here.

The in-situ CCRs are predicted to settle as the water levels in the basin drop during and following closure which will result in a decrease in the slope of the final grades. The proposed final grades have a maximum slope of 3 percent and a minimum slope of 1 percent, which is the currently permitted slope. The post settlement grades indicate positive drainage and no ponding at either 3 percent or 1 percent final grades. The settlement analyses are provided in Attachment 3.3.

The geomembrane component of the final cover system will be installed to reduce the infiltration of surface water through conditioned fly ash and underlying CCRs. A HELP Model analysis was performed to model infiltration through the final cover system and is provided in Attachment 3.4. The HELP Model shows an infiltration rate of 0.13-inches per acre per year through the geomembrane.

(ii) Provide a description of how the materials are to be placed and compacted, with details on maximum slopes, minimum depths, and acceptable bearing loads.

No compactive effort is required for placement of the final cover soil. The soil will be placed with low ground pressure equipment. The final cover soil will be placed to a minimum depth of 1-foot. The maximum slope is 3 percent. Additional requirements for the final cover soil are provided in the Form J.

PART III – LINER INSTALLATION PLAN

This section provides installation plans for the final cover system geotextile, geomembrane liner, and final cover soil. The other items, including subbase, leachate detection and collection zones, protective cover, attenuating soil base, and highwalls are not applicable to this facility.

ATTACHMENT 16R-1
(Continued)

SECTION B: LINERS

1. For synthetic liners, provide all information supplied by the manufacturer as to required handling and installation procedures.

The geotextile will be installed in accordance with Manufacturer's guidelines.

The geomembrane liner will be installed in accordance with the International Association of Geosynthetics Installers (IAGI) Guidelines or Manufacturer's Guidelines, whichever are more restrictive. The IAGI Guidelines for PVC are presented in Attachment 4.1 and the IAGI Guidelines for HDPE and LLDPE are presented in Attachment 4.2. Manufacturer's Data Sheets for various suppliers of PVC are presented in Attachment 4.3, for HDPE are presented in Attachment 4.4, and for LLDPE are presented in Attachment 4.5.

2. For non-synthetic liners, information on the minimum acceptable characteristics (i.e. moisture content, etc.) are to be provided.

Not applicable.

3. For synthetic and non-synthetic liners, information as to the equipment required, pre and post installation testing is to be provided.

The geomembrane liners will be installed in accordance with the IAGI Guidelines or Manufacturer's Guidelines.

SECTION E: FINAL COVER AND GRADING

1. Provide a detailed description of how the final cover material is to be placed, compacted, and graded.

No compactive effort is required for placement of the final cover soil. The final cover soil will be placed to a minimum depth of 1-foot using low ground pressure equipment. The requirements for the final cover soil are provided with Form J.

2. Describe the proposed final layout for the area with specific reference to any drainage facilities which will remain.

The proposed maximum design grades are 3 percent and minimum design grades are 1 percent. A perimeter channel and sedimentation pond will be constructed within Basin No. 1. As the site is capped, the final cover system will be placed over all areas of Basin No. 1 containing CCRs, including the perimeter channels. The permanent perimeter channels will be lined with the final cover system. A diversion berm will be constructed on the final cover system.

PART IV – COMPATIBILITY OF LINER TO LEACHATE

A 40-mil PVC, HDPE, or LLDPE geomembrane will be used as a barrier directly over the conditioned fly ash and CCRs. The geomembrane material is not susceptible to chemical attack based on USEPA 9090 testing where testing was performed with much more potent leachate than will contact the final cover geomembrane. Consequently, these materials were selected based on performance in similar applications, and are expected to perform well in this application. Since the material's performance is well documented, USEPA 9090 testing is not included in this submission.

PART V – PROPERTIES OF SYNTHETIC LINERS

Manufacturer's Data Sheets provide information regarding physical, chemical, mechanical, and thermal properties for liners and ASTM Methods for testing. Manufacturer's Data Sheets for various suppliers of PVC are presented in Attachment 4.3, for HDPE are presented in Attachment 4.4, and for LLDPE are presented in Attachment 4.5.

PART VI – QUALITY ASSURANCE PLAN FOR CONSTRUCTION AND FOR INSTALLATION OF LINERS

Quality assurance will be provided during construction of the final cover system, which includes 1-foot of soil, geotextile, and geomembrane. The quality assurance requirements for the geomembrane are included in Section D and the quality assurance requirements for the final cover soil are included in Section G.

SECTION D: SYNTHETIC AND GEOSYNTHETIC LINERS

The geotextile will be installed in accordance with Manufacturer's guidelines. Requirements for geotextiles are provided in Table 1. Information relating to quality assurance for geomembrane construction is provided in the IAGI Guidelines and in Manufacturer's Guidelines. The IAGI Guidelines for PVC are presented in Attachment 4.1 and the IAGI Guidelines for HDPE and LLDPE are presented in Attachment 4.2. Requirements for PVC geomembrane are provided in Table 2, HDPE geomembrane are provided in Table 3, and LLDPE geomembrane are provided in Table 4. Shear strength requirements based on the stability analyses are provided in Table 5.

ATTACHMENT 16R-1
(Continued)

SECTION G: FINAL COVER SYSTEM

The final cover soil will be constructed using a blend of 50 percent bottom ash fines (maximum) and 50 percent soil. The maximum particle size of the soil is 6-inches. 40% of the soil must pass the No. 10 (2 mm) sieve. No compactive effort is required for placement of the final cover soil. The final cover soil will be placed to a minimum depth of 1-foot. The requirements for the final cover soil are provided with Form J.

The geomembrane shall be installed in accordance with the IAGI Guidelines. The IAGI Guidelines for PVC are presented in Attachment 4.1 and the IAGI Guidelines for HDPE and LLDPE are presented in Attachment 4.2.

ATTACHMENT 3.1

Geotechnical Investigations

PURPOSE

The purpose of this attachment is to provide a summary of the geotechnical investigations performed by CEC and the data obtained from these investigations. The data summarized in this attachment are utilized in the settlement/strain and stability analyses provided in Attachments 16R-3.2 and 16R-3.3, respectively.

BACKGROUND

Coal Combustion Residuals (CCRs) have been sluiced into Basin 1 since commencement of generating operations in 1972. The sluiced residuals from the coal combustion process generally contained 75% flyash and 25% bottom ash. Mill rejects have also been previously disposed of in Basin 1. Prior to 1982, all of the aforementioned CCR constituents were disposed of in Basin 1. However, in 1982 PPL began diverting flyash for beneficial use purposes pursuant to Chapter 290 of the Pennsylvania Code. Since 1982, bottom ash has been the primary constituent of the CCR placed into Basin 1.

GEOTECHNICAL SUBSURFACE INVESTIGATIONS

Test Boring Investigation: In February 2014, CEC performed a geotechnical and hydrogeologic investigation within the basin. The investigation included the drilling of 12 test borings for the collection of geotechnical soil samples. Eight of the test boring (MB-17 through MB-22, MB-25, and MB-26) were advanced and samples of the CCR were collected using direct push methods. Standard penetration tests (SPTs) were performed and Shelby tube samples were collected within the CCRs at Test Borings MB-23/MPZ-7S, MB-28/MPZ-12S, MB-27/MPZ-11S, MB-39. SPT and splitspoon samples were collected on 2 or 5-feet centers using a 2-feet long split-spoon sampler. Details of the SPT are described in the American Society for Testing and Materials (ASTM) Standard D1586. Where possible, relatively undisturbed Shelby tube samples were obtained in conjunction with performing SPTs within the CCRs for laboratory testing. Details of Shelby tube sampling procedures are described in ASTM D1587. Split-spoon samples were collected in approximately the uppermost 10 to 25 feet, and Shelby tube samples were collected in approximately the upper-most 5 to 20 feet. Below these depths, only direct push samples were obtained because the CCRs were too wet to recover split spoon and Shelby tube samples. CEC's project representative described the material color, texture, apparent origin, and apparent moisture content of the split-spoon samples obtained. Test boring logs with soil descriptions and sampling data are appended to this attachment. The test boring locations are shown on Figure 16R-3.1.

Up to approximately 1 foot of soil fill was encountered at the ground surface overlying the CCRs. The fill encountered generally was described as moist and consisted of various soil types (clay, silt, sand, and gravel). CCRs were encountered directly beneath the soil fill and ranged in thickness at the geotechnical test borings from approximately 30 to 45 feet. The CCRs encountered consisted primarily of silt or medium to coarse-grained sand with varying amounts of silt and gravel. Based on the results of the SPTs, the fine-grained CCRs (silt) that were sampled had a consistency ranging from very soft to stiff. The relative density of the coarse-grained CCRs (sand) encountered ranged from very loose to very dense, but was mostly loose to very loose.

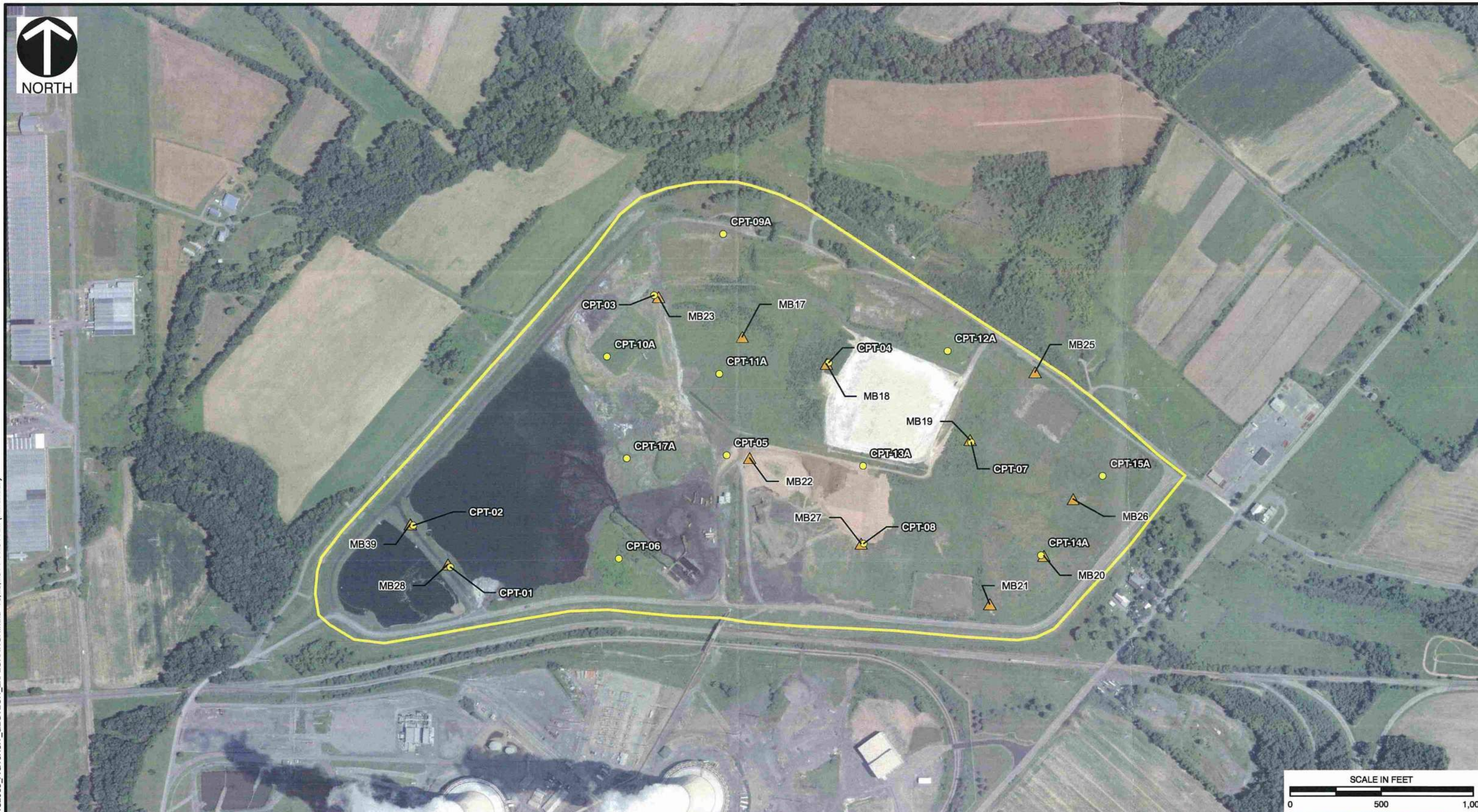
CPT Investigation: In September 2014, a subsurface exploration program was performed utilizing piezocone penetration testing (CPTu) methods. The CPTu rig performed sixteen soundings across the basin generally in accordance with ASTM D5778. These soundings were performed mostly at locations of previously drilled test borings. Each CPTu sounding consisted of pushing an electronic piezocone through the soil and CCRs at a constant rate. The piezocone measures cone tip resistance, sleeve friction, and pore water pressures. Piezocone measurements were obtained and recorded at an interval of two inches. Similar to the results of the SPTs, the CPT data indicated stiffer CCRs in approximately the uppermost 10 to 20 feet and softer CCRs below. The piezocone measurements can be correlated to a variety of engineering parameters; however, no samples are able to be obtained during the performance of these soundings.

SUMMARY OF LABORATORY RESULTS

Laboratory testing was performed on select samples obtained during drilling to determine engineering characteristics of the in-situ CCRs. The laboratory testing included grain size analysis, water content, Atterberg limits, specific gravity, proctor compaction, hydraulic conductivity, CU triaxial, and consolidation testing. Testing was performed on splitspoon, direct push, Shelby tube, and remolded samples of the CCR. Testing was also performed on bulk samples of the conditioned flyash proposed for use in the basin closure. The shear strength and compressibility of the CCRs were determined based on the results of the CU Triaxial and consolidation tests. The Shelby tube samples for these tests were selected based on the field description of the materials sampled and the recovery of each sample.

Unified Soil Classification System (USCS) designations were determined from the results of the grain size and Atterberg limits testing. The USCS classifications were determined for select Shelby tube samples as well as for bulk samples obtained from other test borings throughout the site. This was done so that the strength and consolidation testing results can be correlated and applied to similar materials that were encountered at other locations. According to the USCS, the samples were classified as SM (silty sand), SW-SM (well graded sand with silt and gravel), ML (silt and sandy silt), and CL-ML (silty clay with sand). Laboratory test results are appended to this attachment. Interpretations of compressibility and shear strength data are discussed in Attachments 16R-3.2 and 16R-3.3, respectively.

TEST BORING AND CPT SOUNDING LOCATION PLAN



LEGEND

- ○ CPT Sounding
- △ Test Boring (MBXX)
- —— Approximate Extent of Basin 1

REFERENCE

ESRI WORLD IMAGERY / ARCGIS MAP SERVICE:
HTTP://GOTO.ARCGISONLINE.COM/MAPS/WORLD_IMAGERY,
ACCESSED 10/29/2014, IMAGERY DATE: 2011.

CEC

Civil & Environmental Consultants, Inc.

333 Baldwin Road - Pittsburgh, PA 15205-9072
412-429-2324 · 800-365-2324
www.cecinc.com

MONTOUR S.E.S.
ASH BASIN #1
MAJOR PERMIT MODIFICATION

GEOTECHNICAL EXPLORATION LOCATIONS

DRAWN BY: NBW	CHECKED BY: JMN	APPROVED BY: DMC*	FIGURE NO: * Hand signature on file	**16 R-3.1**	
DATE: 10/24/2014	SCALE: 1 " = 500 '	PROJECT NO: 132-065			

P:\2013\132-065\-GIS\Maps\Geotech\132065_FIG16R3.1_GEOTECH_EXPLORATION.mxd 10/29/2014 11:34 AM (nwiencek)

ATTACHMENT 3.2

Final Cover Stability Analysis

OBJECTIVE

This analysis was performed to determine the minimum factor of safety (FS) and required interface shear strength for the final cover system considering the proposed grades and final cover system components. The minimum FS requirements of 1.5 for static conditions and 1.2 for dynamic (seismic) conditions according to 25 Pa. Code § 289.271 were used in for this analysis. 25 PA. Code § 289.271 is related to the dike of an impoundment but also relevant here.

MATERIAL PARAMETERS

The final cover system was analyzed for shallow translational failure surfaces under static and seismic conditions using a spreadsheet developed by the Geosynthetic Research Institute (GRI) as part of the GRI Reports #18 and #19. This spreadsheet was modified slightly to model our specific scenarios. The proposed final cover system consists of the following from top to bottom:

- 1-foot thick Soil/Bottom Ash Fines Layer;
- 6 oz/sy Non-Woven geotextile; and
- 40-mil LLDPE, HDPE, or PVC Geomembrane.

The final cover system will be constructed at the proposed maximum 3 percent grades.

Final Cover System Geosynthetics

The geosynthetic interfaces from top to bottom consists of:

(1) Final cover soils vs 6 oz/sy nonwoven geotextile;
(2) 6 oz/sy nonwoven geotextile vs geomembrane; and
(3) Geomembrane vs conditioned fly ash.

Table 1 (attached) from the Geosynthetics Research Institute (GRI) Report #30 was utilized to determine a reasonable shear strength envelope for the critical interface. An interface angle of friction of 10 degrees and 0 adhesion was selected representing the most conservative shear strength envelope of LLDPE smooth geomembrane vs nonwoven geotextile.

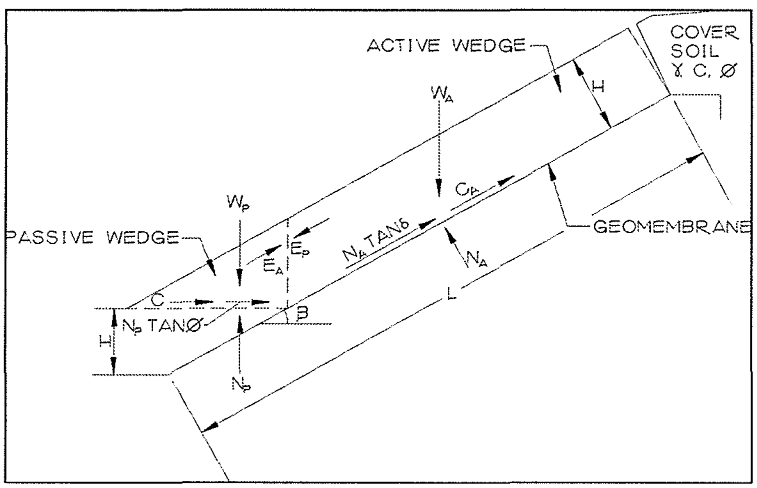
Final Cover Soil

Final cover soils will consist of 50 percent (maximum) bottom ash fines and 50 percent onsite soil. The material will be obtained from stripping the existing intermediate cover or from on-site stockpiles. The unit weight parameters used in this analysis were determined from the average of typical values for compacted bottom ash and clayey soils. The shear strength of the soil (friction angle) was conservatively estimated based on typical values and past experience.

Based on the testing results reported in the EPRI Coal Ash Disposal Manual: Third Edition, bottom ash produced from bituminous coal has an average optimum moisture content of 20% and an average maximum dry density of 94 pcf resulting in a compacted unit weight of 107 pcf compacted unit weight. The onsite native soils consist of SC and CL materials based on the laboratory testing results reported in the 2007 geotechnical investigation, which is appended to Attachment 24R-4. Based on Table 1 from the NAVFAC manual, the average total unit weight of compacted SC and CL material is approximately 123 pcf. Therefore, the total unit weight of the final cover soil is estimated to be the average of 107 pcf and 123 pcf, which is 115 pcf. The groundwater surface was assumed to be at the ground surface for the static condition. A buoyant unit weight of 115 pcf – 62.4 pcf = 52.6 pcf was used in the spreadsheet to model the affects of saturated final cover soils. The friction angle of the cover soil was assumed to be 27 degrees.

SPREADSHEET CALCULATIONS

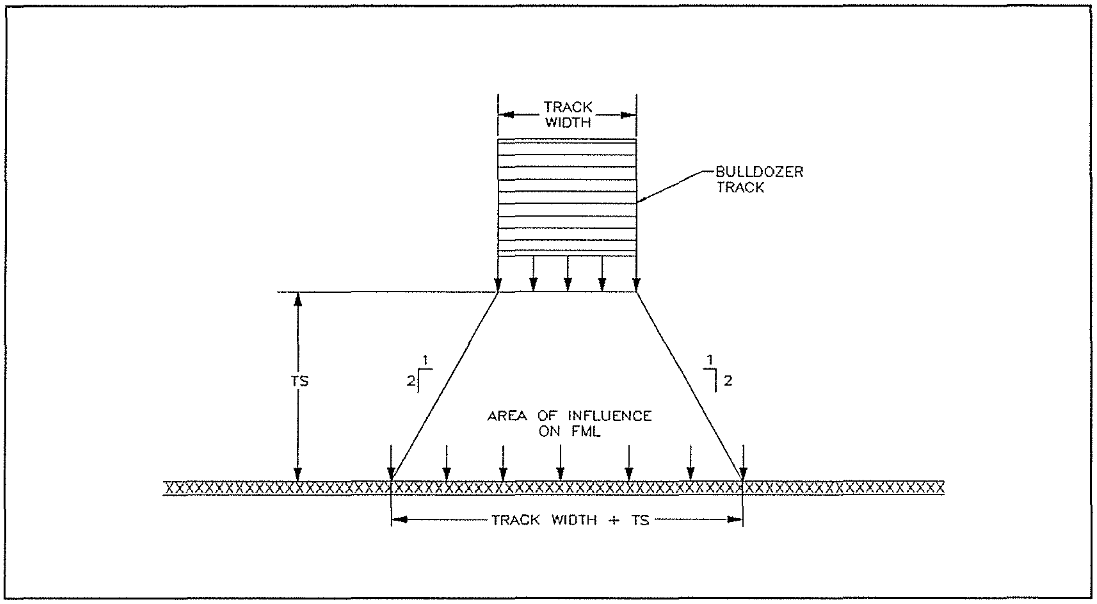
The following figure illustrates the free-body diagram used to perform the calculations.



The GRI Report #18 and #19 veneer slope stability calculations are prepared proposing the following assumptions:

- The presence of equipment along the cover slope is analyzed within GRI Report #18;
- The presence of equipment was only modeled in the static analysis;
- The shear strength component of adhesion developed between geosynthetic material layers is ignored;
- Tensile strength of the geosynthetic materials contributing to the veneer slope stability FS is ignored;
- The cover material provides a buttress at the toe of the slope (i.e. the passive soil wedge);
- Weights of the geosynthetic components are negligible compared to the weight of cover material and therefore are not considered in the calculations;
- The effect of seepage forces on the veneer stability of the final cover material layer, generated by a storm event is ignored;
- Cohesion within the final cover soil is ignored (conservative); and
- All calculations will utilize a 1-foot unit width of sideslope.

A Low Ground Pressure (LGP) bulldozer will likely be used to place the cover soil. The typical pressure distribution for a LGP dozer operating on top of a cover soil layer placed over underlying geosynthetic layers is modeled as illustrated in the following figure, where TS is the thickness of the soil layer over the geosynthetics.



The following typical LGP bulldozer equipment specifications are used within the GRI Report #18.

- 2 tracks
- Track length = 10.25 feet
- Track width = 2.75 feet
- Operating weight = 42,500 lbs
- One Track Contact area = 28.2 ft^2
- One Track Contact pressure = 21,250 lbs / 28.2 ft^2 = 753.5 psf

GRI Report # 18 utilizes an influence factor which is a function of the ratio of the bulldozer track width to the thickness of the cover soil to account for the dissipation of surface forces through the cover soil to the geosynthetic interface. An influence factor of 1.0 was used in this analysis for conservatism. Since the GRI Report # 18 calculation applies pressures over a smaller area of influence to the underlying geosynthetics than would be applied by using the typical stress distribution as shown in above figure, the GRI Report # 18 calculation represents a conservative approach for dissipation of forces through the cover soil to the underlying geomembrane.

The forces from the final cover system and LGP bulldozer are resolved to produce a veneer slope stability FS. The equations are shown on pages 13 and 14 of GRI Report #18, and for ease of calculations are incorporated into a spreadsheet to produce a FS corresponding to a given set of input parameters. A copy of the spreadsheet static and seismic calculations displaying the results is appended to this attachment.

SEISMIC COEFFICIENT

The horizontal shear wave acceleration caused by an earthquake is modeled within the stability analysis by inputting a seismic coefficient that is some fraction of gravity. The peak horizontal ground acceleration for the site is estimated to be 0.062g (6.2% of gravity) based on the U.S.G.S. website deaggregation with 2% Probability of Exceedance in 50 Years (a mean return time of approximately 2500 years). This is presented on the attached figure.

CONCLUSIONS

Using the GRI spreadsheet, the minimum FSs calculated were 6.3 and 2.0 for the static-saturated and seismic-unsaturated conditions, respectively. This exceeds the minimum required FSs in 25 Pa. Code § 289.271 of 1.5 static for conditions and 1.2 dynamic (seismic) for conditions. Based on these results, the final cover system constructed with the proposed components at 3 percent slopes meets the stability requirments in 25 Pa. Code § 289.271 which is related to the dike of an impoundment but also relevant here.

MINIMUM INTERFACE TESTING REQUIREMENTS

This analysis indicates that the soil/geosynthetics and geosynthetics/geosynthetics interfaces for the materials used to construct the final cover system over the 3 percent slopes results in acceptable factors of safety. The peak shear strength value was determined using the following equation:

$$\tau = c + \sigma_n \tan \phi = 0 \text{ psf} + 870 \text{ psf} \times \tan(10^{\circ}) = 153 \text{ psf}$$

Where: c = 0 psf

σ_n = final cover weight + equipment load = (115 pcf)(1 ft) + 753.5 psf $\simeq$ 870 psf

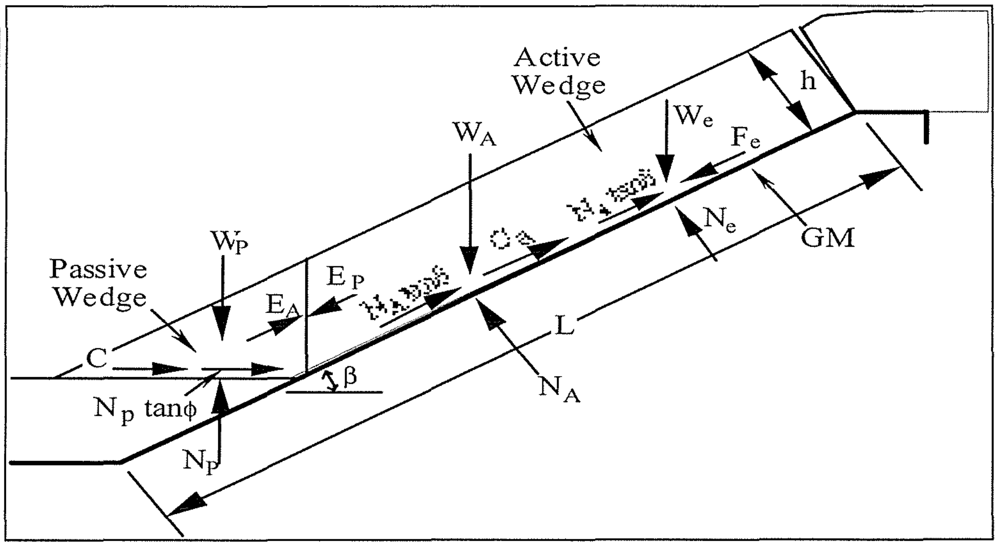
ϕ = 10 degrees

This shear strength value of 153 psf is specified in Form 16R, Table 5 as the requirement for the final cover system soil/geosynthetics and geosynthetics/geosynthetics interface peak shear strength under low normal loads. Any combination of c and ϕ yielding a $\tau \geq 153$ psf under a normal load of 870 psf will be considered acceptable.

SPREADSHEET CALCULATIONS

COVER PLACEMENT WITH THE INCORPORATION OF EQUIPMENT LOADS

Placement of the Cover Material Layer
across the sideslopes with the incorporation of Equipment Loads



Calculation of FS

Active Wedge:

Wa=	*45566.2*	*lb*
Na=	*45546.1*	*lb*

Passive Wedge:

Wp=	*886.9*	*lb*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a=	*1580.2*
b=	*-9864*
c=	*142.0*

FS= 6.2

thiekness of cover soil = h =	1.00	ft
eov. mat. slope angle beneath the geomembrane = b =	1.70	degrees
finishcd cover material slope angle = w =	1.70	degrees
length of slope measured along the geomembrane = L =	900.0	ft
unit weight of the cover soil = g =	52.6	lb/ft^3
friction angle of the covcr soil = f =	27.0	degrecs
cohesion of thecover soil = e =	0.0	lb/ft^2
critical interfaee frietion anglc = d =	10.00	degrees
adhesion = ca =	0.0	lb/ft^2

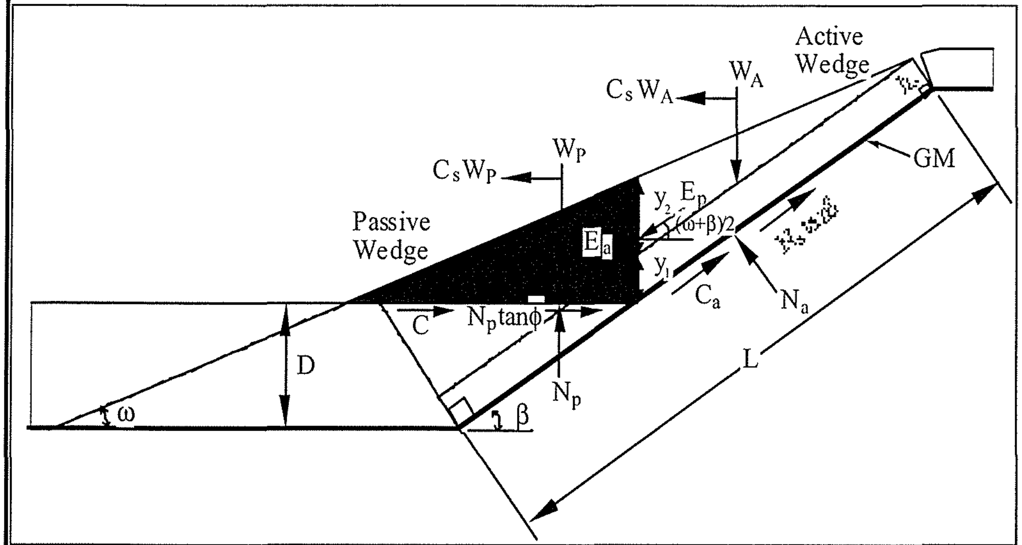
thickness of the eover soil = h =	1.00	ft
equipment ground pressure (= wt. of cquipment/(2wb)) = q =	753.5	lb/ft^2
length of cach equipment traek = w =	10.3	ft
width of cach equipment track = b =	2.8	ft
influenee factor* at gcomembrane interface = I =	1.00	
acccleration/deceleration of the bulldozer = a =	0.00	g

*Influence Factor Default Values

Cover Soil Thickness	Equipment Track Width		
	Very Wide	Wide	Standard
² 300 mm	1.00	0.97	0.94
300-1000 mm	0.97	0.92	0.70
³ 1000 mm	0.95	0.75	0.30

Note: ***Denotes an automatically calculated cell***
Denotes input values
numbers in Italics are calculated values

UNIFORMED AND/OR TAPERED COVER SOIL WITH CONSIDERATION OF SEISMIC FORCES



Calculation of FS

Active Wedge:

Wa=	*99621.8*	*lb*
Na=	*99578.0*	*lb*
Ca=	*0.0*	*lb*

Passive Wedge:

Wp=	*1939.1*	*lb*
C=	*0.0*	*lb*

$$FS = \frac{-b + \sqrt{b^2 - 4ac}}{2a}$$

a=	*9246.8*
b=	*-18668*
c=	*265.3*

FS= 2.0

(Note: for uniform cover soil thickness the input value of w = b)

thickness of cover soil at top (crest) of the slope = hc =	1.00	ft
thickness of cover soil along the bottom of the site = D =	1.00	ft
soil slope angle beneath the geomembrane = b =	1.70	degrees
finished cover soil slope angle = w =	1.70	degrees
length of slope measured along the geomembrane = L =	900.0	ft

unit weight of the cover soil = g =	115.0	lb/ft^3
friction angle of the cover soil = f =	27.0	degrees
cohesion of the cover soil = c =	0.0	lb/ft^2
critical interface friction angle = d =	10.0	degrees
adhesion between cover soil and geocomposite = ca =	0.0	lb/ft^2

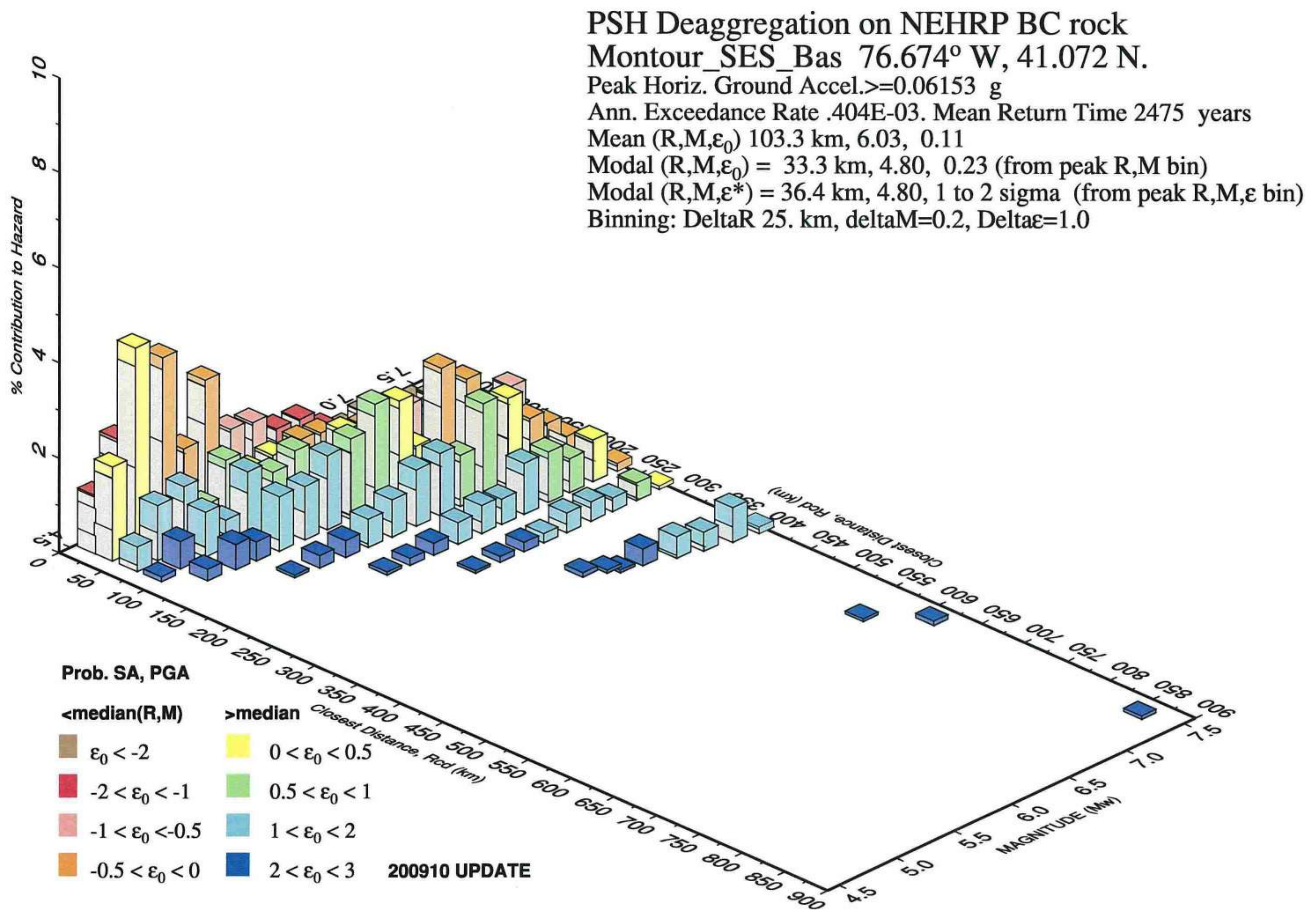
seismic coefficient = Cs =	0.06200	g

Note: ***Denotes an automatically calculated cell***

Denotes input values

numbers in Italics are calculated values

REFERENCES



GMT 2014 Oct 20 14:28:25 Distance (R), magnitude (M), epsilon (E0,E) deaggregation for a site on rock with average vs= 760. m/s top 30 m. USGS CGHT PSHA2008 UPDATE Bins with lt 0.05% contrib. omitted

Appendix Table 1. Summary of interface shear strengths.

Interface 1*	Interface 2*	Peak Strength					Residual Strength				
		Fig. No.	δ (deg)	Ca (kPa)	Points	R^2	Fig. No.	δ (deg)	Ca (kPa)	Points	R^2
HDPE-S	Granular Soil	1a	21	0	162	0.93	1b	17	0	128	0.92
HDPE-S	Cohesive Soil										
	Saturated	1c	11	7	79	0.94	1d	11	0	59	0.95
	Unsaturated	1c	22	0	44	0.93	1d	18	0	32	0.93
HDPE-S	NW-NP GT	1e	11	0	149	0.93	1f	9	0	82	0.96
HDPE-S	Geonet	1g	11	0	196	0.90	1h	9	0	118	0.93
HDPE-S	Geocomposite	1i	15	0	36	0.97	1j	12	0	30	0.93
HDPE-T	Granular Soil	2a	34	0	251	0.98	2b	31	0	239	0.96
HDPE-T	Cohesive Soil										
	Saturated	2c	18	10	167	0.93	2d	16	0	150	0.90
	Unsaturated	2c	19	23	62	0.91	2d	22	0	35	0.93
HDPE-T	NW-NP GT	2e	25	8	254	0.96	2f	17	0	217	0.95
HDPE-T	Geonet	2g	13	0	31	0.99	2h	10	0	27	0.99
HDPE-T	Geocomposite	2i	26	0	168	0.95	2j	15	0	164	0.94
LLDPE-S	Granular Soil	3a	27	0	6	1.00	3b	24	0	9	1.00
LLDPE-S	Cohesive Soil	3c	11	12.4	12	0.94	3d	12	3.7	9	0.93
LLDPE-S	NW-NP GT	3e	10	0	23	0.63	3f	9	0	23	0.49
LLDPE-S	Geonet	3g	11	0	9	0.99	3h	10	0	9	1.00
LLDPE-T	Granular Soil	4a	26	7.7	12	0.95	4b	25	5.2	12	0.95
LLDPE-T	Cohesive Soil	4c	21	5.8	12	1.00	4d	13	7.0	9	0.98
LLDPE-T	NW-NP GT	4e	26	8.1	9	1.00	4f	17	9.5	9	0.96
LLDPE-T	Geonet	4g	15	3.6	6	0.97	4h	11	0	6	0.98
PVC-S	Granular Soil	5a	26	0.4	6	0.99	5b	19	0	6	0.99
PVC-S	Cohesive Soil	5c	22	0.9	11	0.88	5d	15	0	9	0.95
PVC-S	NW-NP GT	5e	20	0	89	0.91	5f	16	0	83	0.74
PVC-S	NW-HB GT	5g	18	0	3	1.00	5h	12	0.1	3	1.00
PVC-S	Woven GT	5i	17	0	6	0.54	5j	7	0	6	0.93
PVC-S	Geonet	5k	18	0.1	3	1.00	5l	16	0.6	3	1.00

Appendix Table 1. (continued)

Interface 1*	Interface 2*	Peak Strength					Residual Strength				
		Fig. No.	δ (deg)	Ca (kPa)	Points	R^2	Fig. No.	δ (deg)	Ca (kPa)	Points	R^2
PVC-F	NW-NP GT	6a	27	0.2	26	0.95	6b	23	0	26	0.95
PVC-F	NW-HB GT	6c	30	0	8	0.97	6d	27	0	8	0.90
PVC-F	Woven GT	6e	15	0	6	0.78	6f	10	0	6	0.76
PVC-F	Geonet	6g	25	0	11	1.00	6h	19	0	11	0.99
PVC-F	Geocomposite	6i	27	1.1	5	1.00	6j	22	4.7	6	1.00
CSPE-R	Granular Soil	7a	36	0	3	1.00	7b	16	0	3	1.00
CSPE-R	Cohesive Soil	7c	31	5.7	6	0.71	7d	18	0	6	0.99
CSPE-R	NW-NP GT	7e	14	0	6	0.97	7f	10	0	6	0.98
CSPE-R	NW-HB GT	7g	21	0	3	1.00	7h	10	0	3	1.00
CSPE-R	Woven GT	7i	11	0	6	0.92	7j	11	0	3	1.00
CSPE-R	Geonet	7k	28	0	9	0.87	7l	16	0	9	0.80
NW-NP GT	Granular Soil	8a	33	0	290	0.97	8b	33	0	117	0.96
NW-HB GT	Granular Soil	8c	28	0	6	0.99	8d	16	0	6	0.91
Woven GT	Granular Soil	8e	32	0	81	0.99	8f	29	0	28	0.98
NW-NP GT	Cohesive Soil	9a	30	5	79	0.96	9b	21	0	28	0.79
NW-HB GT	Cohesive Soil	9c	29	0.9	15	0.71	9d	10	0	15	0.83
Woven GT	Cohesive Soil	9e	29	0	34	0.94	9f	19	0	16	0.86
GCL Reinforced (internal)	N/A	10a	16	38	406	0.85	10b	6	12	182	0.91
GCL (NW-NP GT)	HDPE-T	11a	23	8	180	0.95	11b	13	0	157	0.90
GCL (W-SF GT)	HDPE-T	11c	18	11	196	0.96	11d	12	0	153	0.92
Geonet	NW-NP GT	12a	23	0	52	0.97	12b	16	0	32	0.97
Geocomposite (NW-NP GT)	Granular Soil	13a	27	14	14	0.86	13b	21	8	10	0.92

TABLE 1
Typical Properties of Compacted Soils

Group Symbol	Soil Type	Range of Maximum Dry Unit Weight, pcf	Range of Optimum Moisture, Percent	Typical Value of Compression: At 1.4 tsf (20 psi)	Typical Value of Compression: At 3.6 tsf (50 psi)	Typical Strength Characteristics: Cohesion (as compacted) psf	Cohesion (saturated) psf	ϕ (Effective Stress Envelope Degrees)	Tan ϕ	Typical Coefficient of Permeability k ft./min.	Range of CBR Values	Range of Subgrade Modulus k lbs/cu in.
				Percent of Original Height								
GW	Well graded clean gravels, gravel-sand mixtures.	125 – 135	11 – 8	0.3	0.6	0	0	>38	>0.79	5×10^{-2}	40 – 80	300 – 500
GP	Poorly graded clean gravels, gravel-sand mix	115 – 125	14 – 11	0.4	0.9	0	0	>37	>0.74	10^{-1}	30 – 60	250 – 400
GM	Silty gravels, poorly graded gravel-sand-silt.	120 – 135	12 – 8	0.5	1.1	.....	.....	>34	>0.67	$>10^{-6}$	20 – 60	100 – 400
GC	Clayey gravels, poorly graded gravel-sand-clay.	115 – 130	14 – 9	0.7	1.6	.....	.....	>31	>0.60	$>10^{-7}$	20 – 40	100 – 300
SW	Well graded clean sands, gravelly sands.	110 – 130	16 – 9	0.6	1.2	0	0	38	0.79	$>10^{-3}$	20 – 40	200 – 300
SP	Poorly graded clean sands, sand-gravel mix.	100 – 120	21 – 12	0.8	1.4	0	0	37	0.74	$>10^{-3}$	10 – 40	200 – 300
SM	Silty sands, poorly graded sand-silt mix.	110 – 125	16 – 11	0.8	1.6	1050	420	34	0.67	$5 \times >10^{-5}$	10 – 40	100 – 300
SM-SC	Sand-silt clay mix with slightly plastic fines.	110 – 130	15 – 11	0.8	1.4	1050	300	33	0.66	$2 \times >10^{-6}$	5 – 30	100 – 300
SC	Clayey sands, poorly graded sand-clay-mix.	105 – 125	19 – 11	1.1	2.2	1550	230	31	0.60	$5 \times >10^{-7}$	5 – 20	100 – 300
ML	Inorganic silts and clayey silts.	95 – 120	24 – 12	0.9	1.7	1400	190	32	0.62	$>10^{-5}$	15 or less	100 – 200
ML-CL	Mixture of inorganic silt and clay.	100 – 120	22 – 12	1.0	2.2	1350	460	32	0.62	$5 \times >10^{-7}$	.....	
CL	Inorganic clays of low to medium plasticity.	95 – 120	24 – 12	1.3	2.5	1800	270	28	0.54	$>10^{-7}$	15 or less	50 – 200
OL	Organic silts and silt-clays, low plasticity.	80 – 100	33 – 21	.....	.....	.....	.....	.....	.....	.....	5 or less	50 – 100
MH	Inorganic clayey silts, elastic silts.	70 – 95	40 – 24	2.0	3.8	1500	420	25	0.47	$5 \times >10^{-7}$	10 or less	50 – 100
CH	Inorganic clays of high plasticity	75 – 105	36 – 19	2.6	3.9	2150	230	19	0.35	$>10^{-7}$	15 or less	50 – 150
OH	Organic clays and silty clays	65 – 100	45 – 21	.....	.....	.....	.....	.....	.....	.....	5 or less	25 – 100

Notes:

1. All properties are for condition of "Standard Proctor" maximum density, except values of k and CBR which are for "modified Proctor" maximum density.
2. Typical strength characteristics are for effective strength envelopes and are obtained from USBR data.
3. Compression values are for vertical loading with complete lateral confinement.
4. (>) indicates that typical property is greater than the value shown.
   (..) indicates insufficient data available for an estimate.

Table 2-26
Modified Proctor Method Optimum Moisture Content, Typical Ranges of Values (percent)

Coal Type	Fly Ash	Bottom Ash
Bituminous	13 - 30	14 - 26
Subbituminous	14 - 20	12 - 23
Lignite	10 - 12	14 - 25

Table 2-27
Modified Proctor Method Maximum Dry Density, Typical Ranges of Values (pounds per cubic foot)

Coal Type	Fly Ash	Bottom Ash
Bituminous	75 - 105	72 - 116
Subbituminous	70 - 102	65 - 76
Lignite	104 - 120	85 - 110

$1\ lb/ft^3 = 16\ kg/m^3$

Settlement is the vertical decrease in elevation due to initial settlement (settlement during undrained loading) and consolidation settlement. The magnitude of consolidation settlement is a function of the stress history of the soil, the initial void ratio, the increase in stress due to loading, the thickness of the compressible stratum, and the compression index of the soil. The maximum past pressure the soil has experienced and the compression index are determined by laboratory consolidation tests. The resulting void ratio (e) at each load is plotted as the y-axis with the logarithm of pressure (log p) as the x-axis. The resulting plot is the soil's response to loading and is sometimes referred to as the e-log p curve. The steep portion of this curve, illustrating the soils response to higher loads that the soil has ever previously experienced, is called the virgin curve. When the soil is partially unloaded then reloaded, that portion of the e-log plot is called the recompression curve. The slopes of these curves determine the compression index (C_c) and the recompression index (C_r). They are used to calculate settlement under the expected loading conditions. The compression index for fly ashes can range from 0.05 to 0.37. The recompression index for fly ash is considerably smaller. Values ranging from 0.006 to 0.04 have been

ATTACHMENT 3.3

Settlement Analysis

DISCUSSION & PURPOSE

Coal combustion residuals (CCRs) in the Montour Electric Station Basin 1 consist of primarily bottom ash and fly ash. Mill rejects are also reportedly present in some areas. These components are, and generally have been, hydraulically placed in the basin during its operation. The resulting in-situ materials are compressible and will settle when subjected to increases in effective stress. Of specific interest to Basin 1 include increases in effective stress due to the placement of additional CCRs and due to the drawdown of the water level within the basin following closure. The purpose of this analysis is to estimate the settlement magnitude and post settlement grades of the final cover system after settlement has occurred due to the placement of conditioned fly ash and the final cover system, and due to the drawdown of the water level within the basin. Upon estimation of the settlement magnitude and settlement timing within the basin, two evaluations were performed. These evaluations include the assessment of whether or not ponding will occur on top of the final cover system and also whether or not excessive settlement-related strain will be induced on the final cover system geomembrane. Both analyses were performed for two final cover system options for Basin 1. The first option is the proposed 3% final cover grade while the second option is the currently permitted 1% final cover grades. Refer to Attachment 16R-1 for details regarding the geotechnical investigations.

EXISTING AND PROPOSED CONDITIONS

Basin 1 is currently divided into three subbasin areas, A, B, and C from east to west that are physically separated by dikes referred to as splitter/median dikes. Subbasin A has reached its permitted disposal elevation and has ceased receiving additional CCRs. CCR placement is actively occurring in Subbasin B and the permitted disposal elevation has yet to be reached. Subbasin C has received some CCRs and is currently functioning as a sedimentation pond. Final grades are currently permitted at a slope of 1%. PPL is proposing to place conditioned fly ash as structural fill as a beneficial use to increase the final grades to reduce the potential for long term ponding on the final cover. The final cover system is proposed to have a maximum 3% slope draining away from the center of Basin 1 and into a proposed perimeter channel. The final cover grading is shown on Drawing E377134, Sheet 9. It is estimated that the placement of the final cover system will begin once the subgrade elevation is established across the entire basin. The placement of the final cover system is estimated to take five years to complete. Refer to Attachment 16R-3.1 for discussions of subsurface investigations and laboratory testing.

SETTLEMENT ANALYSIS FRAMEWORK

In this analysis, settlement has been estimated in two stages. Stage 1 represents current conditions to the end of Phase 3 of the Closure Plan (immediately prior to placement of the final cover system). Stage 2 represents changes to the water level within Basin 1 after the placement of the final cover system. For the settlement analysis, a critical condition considering a complete drawdown of the water level out of the basin was considered for Stage 2. The sum of the settlement magnitudes estimated during Stages 1 and 2 was used to estimate the post settlement contours and the strain on the final cover system.

Stage 1 settlement was assumed to be caused by the weight of the conditioned fly ash placed above the existing CCRs and the increase in effective stress within the CCRs due to the drawdown of the water level from existing conditions to the end of Phase 3. Settlement occurring during Stage 2 was assumed to be caused by the increase in effective stress within the CCRs due to the weight of the final cover system and the drawdown of the water level that will occur after the final cover system is constructed and the water level is drawn down below the bottom of the basin. Settlement of the native soils (primarily weathered bedrock) that may occur is insignificant and was not analyzed.

The end of Phase 3 water surface used in the settlement analysis was generated using MODFLOW (a finite-difference computer flow model) and will be presented in the Engineering Evaluation Report to be submitted as part of the Basin 1 hydrogeologic assessment. The first step in creating the MODFLOW model was to calibrate the model to reflect existing conditions measured at the site. Once the model was calibrated for the existing conditions, it was used to model the change in the water elevation due to the changing site conditions. Because of the minimal change in the rate of runoff between the proposed (3%) and permitted (1%) final cover grades, the water surface generated by MODFLOW for the 3% option was used in the settlement analyses for both the 3% and 1% final cover options.

In order to estimate the potential for excessive differential settlement that could lead to ponding on top of the final cover system, both the change in the effective stress within the CCRs and the varying compressibility characteristics of the CCRs were estimated. The time rate of settlement and the relative time it will take for settlement to occur with respect to the construction schedule was also estimated.

In order to visualize the estimated spatial variation of anticipated settlement, analysis points were selected within the limits of CCR disposal. The analysis points were selected at locations of CPT soundings and at locations where a significant change in subsurface stratigraphy occurred. The significant changes in subsurface stratigraphy generally occurred at the tops and toes of the interior dike slopes. The settlement analysis points are presented on the appended figures. The area evaluated in this analysis was the same for both the proposed 3% final cover grade and proposed 1% grade and is bounded by the toe of the proposed 3% final cover grades. Neither the area between the 3% toe and the channel, nor the channel itself were evaluated for post settlement slopes and strain because the total and differential settlements in this area are expected to be minimal. Maintenance in these areas will be performed as needed to maintain positive drainage.

Elevations from the following surfaces were generated using AutoCAD and were used in a spreadsheet to calculate settlement magnitude at each analysis point.

1. The top of fractured rock surface elevation;
2. The existing water surface elevation;
3. The interior dike slopes;
4. The top of final cover elevation (proposed 3% grades and permitted 1% grades);
5. The water surface elevation at the end of Stage 1; and
6. The water surface elevation at the end of Stage 2.

Compressibility characteristics of the CCRs were obtained from both laboratory testing and in-situ testing (CPT). The primary parameter estimated from both data sets was the constrained modulus. The constrained modulus is a relevant parameter for a one dimensional settlement analysis. From the laboratory samples, oedometer data was used to estimate the constrained modulus at various confining stress levels for multiple samples of different materials. Consolidation tests were performed in the oedometer on both relatively undisturbed Shelby tube samples. Correlations between CPT tip and corrected tip resistance were used to estimate the constrained modulus for the entire depth of each CPT sounding. The estimated constrained moduli and the change in effective stress were then used to determine the strain in the CCRs and subsequently the settlement.

The genesis of the CPT investigation at the site however was partially driven by the inability to obtain geotechnical information (Standard Penetration Tests or Shelby tube samples) within the CCRs below the upper stiff zone. This inability to sample was because the CCRs at depth were apparently too soft to offer significant resistance to the Standard Penetration Test and lacked the frictional and/or cohesive characteristics to be obtained with a Shelby tube piston sampler. It therefore appeared that the relationships developed from the laboratory data indicating increasing constrained modulus (stiffness) with depth were actually contradictory to the field condition where the CCRs apparently became softer or did not increase in stiffness with depth. Because the tip resistance measured during the CPT soundings generally reflected the observations made during the original subsurface exploration program (softer soils at depth) and the inability to construct a sensible relationship of stiffness with depth from the laboratory data, the constrained modulus was estimated based on CPT data as opposed to laboratory data.

The measured CPT tip resistance values, and subsequently the estimates of the constrained modulus, were generally highly variable between CPT soundings. Because of this observed variability, predicted settlements did not have a strong correlation with change in effective stress. Because of this weak correlation, settlement predictions at analysis points other than CPT sounding locations were made by assigning constrained modulus values based on one or more adjacent CPT soundings as assigning settlement values based on CCR estimated change in effective stress.

TIME RATE OF SETTLEMENT EVALUATION

In addition to calculating the settlement magnitude, an assessment was made to determine how long it might take for settlement to occur within the CCRs. This was performed to determine when settlements might be realized in relationship to the construction schedule. The time for settlement of a soil layer is a function of the soil coefficient of consolidation, which is related to the soil permeability, and the drainage path length. Equation 1 below expresses the time (t) it takes for a soil layer with drainage path length (H_{dr}), coefficient of consolidation (c_v), and time factor (T_v) to drain:

$$t = \frac{T_v \times H_{dr}^2}{c_v} \qquad \text{Equation 1}$$

Where:

t = *time to drain, (min)*
T_v = *time factor (1.781 for 99% consolidation)*
H_{dr} = *drainage path length (height of the soil layer for single drainage and half the soil layer height for double drainage)*
c_v = *coefficient of consolidation (ft^2/min)*

Determination of the coefficient of consolidation and the drainage path length were made to estimate the time for settlement to occur. Estimation of the drainage path length was obtained from an evaluation of the CPT sounding logs. The strata where excess pore water pressures were generated were evaluated to determine the likely time to drain in response to a change in effective stress. If the lower boundary of the strata was the bottom of the basin, then the settlement was assumed to occur with single drainage. If the strata with excess pore water pressures was underlain by a layer with moderate thickness (at least three feet) exhibiting a drained CPT response, the strata was assumed to be double drained.

Once the drainage path length and drainage conditions were evaluated, pore pressure dissipation tests within each of these strata were then used to evaluate the horizontal coefficient of consolidation. Each pore pressure dissipation test consists of monitoring the decay of pore water pressures with time until no more significant dissipation is observed signifying that drainage is essentially complete. The time to reach 50 percent drainage was then calculated. The horizontal coefficient of consolidation was obtained utilizing Equation 2 and an estimation of the strata rigidity index (I_r).

$$c_h = \frac{T^* \times a^2 \times \sqrt{I_r}}{t_{50}} \qquad \text{Equation 2}$$

Where:

- c_h = *coefficient of consolidation (ft^2/min)*
- T^* = *modified time factor (0.245 for cone shoulder porewater pressure measurements and 10cm^2 cone area)*
- a = *probe radius*
- I_r = *rigidity index (non-dimensional)*
- t = *time to reach 50% drainage as determined from pore pressure dissipation trace*

Drainage that was measured during cone penetration is in the radial direction and the calculated coefficient of consolidation was representative of radial drainage. Drainage relevant to the settlement of the CCRs is in the vertical direction. Based on research conducted by Tavenas et al. (Nov. 1983 Canadian Geotechnical Journal) $c_v \sim c_h/1.1$ for sluiced CCRs similar to the CCR in Basin 1. With the drainage path length, drainage conditions, and vertical coefficient of consolidation obtained for each strata, the estimated time to drain was obtained. The attached table summarizes the estimated time to drain for each of the layers in the CPT soundings that behaved in an undrained manner during penetration. Pore pressure dissipation traces are also attached.

Time rate of settlement oedometer (consolidation) data was also available from laboratory consolidation tests performed on select samples obtained during the subsurface exploration program. In general, the settlement observed during the application of the test loads during the consolidation test happened so quickly that meaningful interpretation of the coefficient of consolidation using conventional interpretations such as the square-root-of-time method or the logarithm of time method was not possible. This observation supports the numerical values obtained from the pore pressure dissipation tests.

Based on the estimates of the time to drain and considering that the time of placement for the final cover system is estimated to take approximately five years, this analysis assumes that any settlement associated with the placement of the conditioned fly ash to establish the final cover subgrade elevation will occur prior to the placement of the final cover system but will not occur so fast that the settlements will be corrected during grading of the final cover subgrade.

SETTLEMENT CALCULATION

The total settlement of the in-situ CCRs was calculated using Equation 3 below with the constrained modulus estimated from CPT data.

$$S_t = \sum_{i=1}^{n} \left[\frac{\Delta\sigma_{vi}}{M_{fi}} \times H_i \right] \qquad \text{Equation 3}$$

Where:

S_t = *total settlement, (ft)*
$\Delta\sigma_v$ = *change in vertical effective stress in layer i, (tsf)*
M_{fi} = *contstrained modulus during water table drop for layer i, (tsf)*
H = *thickness of compressible layer i, (ft)*

The change in vertical effective stress in Stage 1 is due to the placement of conditioned fly ash up to final cover subgrade elevation and the drawdown of the water level from existing conditions to the end of Phase 3 groundwater conditions. The change in vertical effective stress in Stage 2 is due to placement of the final cover system and drawdown of the water level to below the bottom of the basin. The equations used to calculate the change in vertical effective stress are shown as Equations 4a and 4b below.

$\Delta\sigma_{vi} = (\gamma_{CFA})\ (h_{gsf}-h_{gso,})+(\gamma_w)\ (h_o-h_{i,})$ – Layers above end-of-stage water surface — Equation 4a

$\Delta\sigma_{vi} = (\gamma_{FC})\ (h_{gsf}-h_{gso,})+(\gamma_w)\ (h_o-h_f)$ – Layers below end-of-stage water surface — Equation 4b

Where: $\Delta\sigma_{vi}$ = *change in vertical effective stress in layer i, (tsf)*
γ_{CFA} = *The unit weight of the compacted conditioned fly ash (100.1 pcf);*
γ_{FC} = *The unit weight of the compacted final cover (115 pcf);*
h_{gsf} = *Ground surface elevation at the end of the stage*
h_{gso} = *Ground surface elevation at the beginning of the stage*
γ_w = *The unit weight of water (62.4 pcf); and*
h_o = *The elevation of the water surface in the basin at the beginning of the stage*
h_i = *The elevation of the top of layer i*
h_f = *The final drawdown water elevation (assumed complete basin drawdown)*

SETTLEMENT MATERIAL PARAMETERS

As mentioned in the preceding section, the primary material parameter that needs to be obtained in order to estimate the settlement according to Equation 3 is the constrained modulus. The specific constrained modulus used in the calculation was based on recommended correlations between the cone tip resistance and the constrained modulus. The general form of the equation to determine the constrained modulus (M_o) from CPT data is given by Equation 5.

$$M_o = \alpha q \qquad \text{Equation 5}$$

Where: α = *a coefficient*
q = *cone tip resistance*

The selection of the α coefficient is based upon the soil behavior type (SBT) as identified using the corrected cone tip resistance (q_t) and the friction ratio (R_f). The friction ratio is the ratio of the cone penetrometer sleeve friction stress and the corrected cone tip resistance. The specific equations used for the determination of the α coefficient of each strata encountered during the CPT soundings is shown in Table 1. The cone tip stress values used in the selection of the α factor are values corrected for pore pressure measurements (q_t) in the case of silts, and uncorrected cone tip stress measurements (q_c) in clays and sands.

Table 1: Determination of the α Coefficient for the Estimate of the Constrained Modulus

Soil Behavior Type	Cone Tip Resistance	Determination of α	Reference
Clays (Low Plasticity)	q_c<0.7MPa 0.7<q_c<2.0MPa q_c>2.0MPa	3<α<8 (5.5 selected) 2<α<5 (3.5 selected) 1<α<2.5 (1.7 selected)	Mitchell and Gardner (1975)
Silts	q_t<2.5MPa q_t<5MPa	α=2 α=(4q_t-5) [q_t in MPa]	Senneset et al (1988).
Sand (Normally Consolidated, Unaged)	q_c<10MPa 10MPa<q_c<50MPa q_c>50MPa	α=4 α=2q_c+20 (MPa) M = 120 MPa	Lunne and Christopherson (1983)

For each CPT sounding, plots of the corrected cone tip resistance, sleeve friction stress, friction ratio, pore water pressure, and SBT were created with depth. Based on the SBT each sounding was broken down into zones and assigned an equation from Table 1 to be used in the determination of the constrained modulus at each depth. In many soundings, significant thicknesses of CCRs identified as sensitive fines by the SBT were encountered. In the instance of CCRs identified as sensitive fines, a determination of the appropriate equation from Table 1 was made on the basis of the generation of excess pore water pressure during penetration. If penetration through the material was observed to be drained (no excess pore water pressures), then the appropriate equation for silt was used from Table 1. If excess pore water pressures were generated during penetration, then the appropriate clay equation was used from Table 1. In most instances, penetration of the zones labeled as sensitive fines by the SBT behaved in an undrained manner and the clay equations from Table 1 were used to estimate the constrained modulus. Plots of each CPT sounding and the subsequent breakdown of zones throughout the depth of each sounding are appended to this attachment.

In addition to the determination of the constrained in-situ modulus at the time of the site investigation, the constrained modulus was also corrected for the change in effective stress conditions at the end of Stage 1. Equation 6 [Janbu(1963)] was used to obtain the modified constrained modulus used in Stage 2.

$$M_{fi} = M_{oi}\sqrt{\frac{\sigma'_{vio} + {\Delta\sigma'_{vi}}/{2}}{\sigma'_{vio}}}$$ Equation 6

Where: σ'_{vio} = The effective stress during the performance of the CPT sounding
$\Delta\sigma'_{vi}$ = The change in vertical effective stress during Step 1
M_{oi} = Constrained modulus as estimated from CPT data
M_{fi} = Constrained modulus corrected for change in effective stress at the end of Step 1

With the modified constrained modulus estimated throughout the depth of each CPT sounding and the change in vertical effective stress calculated according to Equations 4a and 4b, Equation 3 was used to estimate the settlement at each CPT sounding and analysis point location. Spreadsheet output for each analysis point for both the proposed 3% and 1% final cover options can be found at the end of this attachment.

POST-SETTLEMENT SLOPES

Figure 16R-3.3.3 presents an estimation of the final cover grades for 3% final cover option. These grades represent the conditions once all of the settlement estimated for Stages 1 and 2 has occurred. The post-settlement grades were generated by subtracting the calculated settlement magnitude from the proposed final cover grades at each analysis point and re-contouring the grades based on this difference. Figure 16R-3.3.5 presents the post-settlement grades for the 1% final cover option.

STRAIN CALCULATION

Possible effects of differential settlement within the proposed cover system include increased tensile strain on the geomembrane. The most critical segment identified considering both the 3% and 1% options is presented on Figure 16R-3.3.2. This segment was evaluated and compared to the allowable tensile strain of the geomembrane. Strain is defined by the following equation.

$$\varepsilon = \frac{\Delta l}{l_o}$$

Where: Δl = the change in length between two points (ft)
l_o = the original length between the same two points (ft)

The strain at yield for the HDPE geomembrane is reported to be 12% based on GRI Test Method GM 13.

CONCLUSIONS

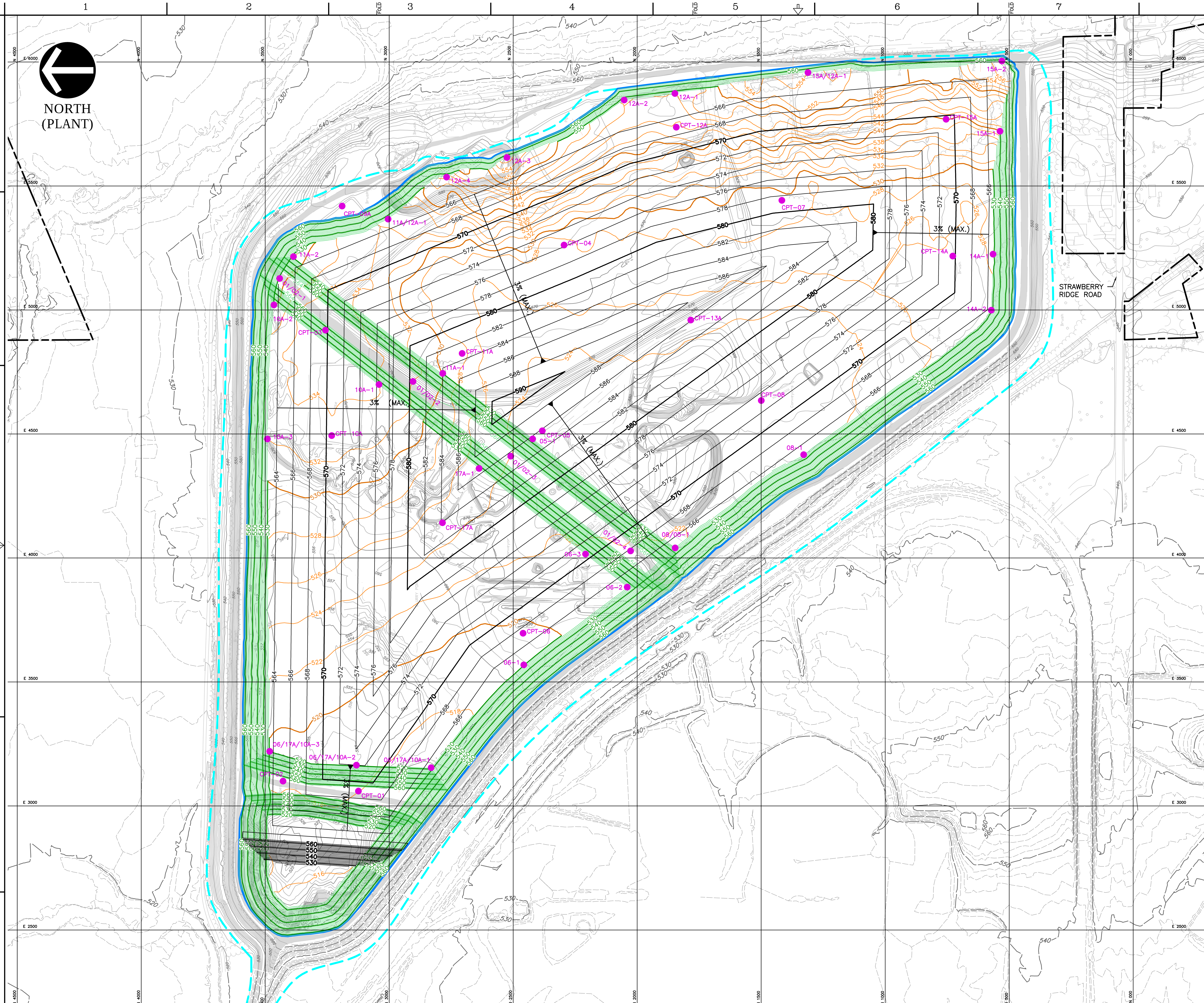
The maximum settlement magnitudes calculated for the 3% final cover option was approximately 2.5 feet. This point corresponds to a location in which both a relatively significant fill is being placed to establish the final cover subgrade and is also the location of one of the CPT soundings with the lowest average constrained modulus. Based on Figure 16R-3.3.3, all of the post settlement grades indicate positive drainage and no ponding. The flattest slope measured of the post-settlement grades is 1.8 percent. This is located at Segment C-D on Figure 16R-3.3.3.

The maximum settlement magnitude calculated for the 1% final cover option was approximately 1.0 feet. This point corresponds to the same location for which the maximum settlement was estimated for the 3% grading option because in both instances there is relatively significant fill placement and low average constrained modulus from the corresponding CPT sounding. Based on Figure 16R-3.3.4 and like for the 3% final cover option, it can be seen that all of the post settlement grades indicate positive drainage and no ponding. The flattest slope measured of the post-settlement grades is 0.7 percent. This is located at Segment E-F on Figure 16R-3.3.4.

The maximum tensile strain calculation segment (Segment A-B) is shown on Figure 16R-3.3.2. This analysis segment is the critical tensile strain segment for both the 3% and 1% final cover grading options and is the segment with the steepest settlement magnitude contours. Strain experienced by the geomembrane along this segment is expected to be 0.01% for the 3% final cover grading option. This is within the allowable limits of the manufacturer's specifications for geomembrane. The following table summarizes this calculation.

Cover Option	3% Final Cover	
Analysis Point Designation	Point A	Point B
Final Cover El. Before Settlement	583.0	583.0
Final Cover El. After Settlement	582.8	581.8
Horizontal Dist. (ft)	85.80	
Original Distance (ft)	85.80	
Final Distance (ft)	85.81	
Pre-settlement Slope (%)	0.00%	
Post-settlement Slope (%)	1.17%	
Strain (%)	0.01%	

FIGURES



LEGEND

- PROPERTY LINE
- LIMITS OF BASIN 1 PERMIT AREA
- APPROXIMATE TOP OF DIKE/LIMIT OF CCR'S
- 570 EXISTING CONTOUR
- 570 PROPOSED CONTOUR (TOP OF FINAL GRADE)
- 550 DIKE CONTOUR
- 550 TOP OF BEDROCK CONTOUR
- ACCESS ROAD
- CPT-04 SETTLEMENT ANALYSIS POINTS

REFERENCE

1. THE EXISTING TOPOGRAPHY, DATED MAY 1, 2013 WAS GENERATED USING AERIAL PHOTOGRAPHY BY L. ROBERT KIMBALL AND ASSOCIATES, INC. THE 2013 TOPOGRAPHY IN SUBBASIN B WAS REFERENCED FROM PPL DRAWING NO. E376172 REV 3, DATED 6/2013.
2. THE 2014 ANNUAL BATHYMETRIC SURVEY IN SUBBASINS B AND C IS FROM DRAWING 750188GPS.DWG, DATED MAY 8, 2014, WHICH WAS GENERATED BY PPL.
3. A SITE SPECIFIC COORDINATE SYSTEM IS SHOWN. MONTOUR S.E.S. USES A NAVD 1929 VERTICAL DATUM INSIDE BASIN 1.
4. THE LIMITS OF THE PERMIT AREA IS FROM PPL DRAWING E244381, DATED 9/2007.
5. EXISTING CONTOURS TO SOUTH OF BASIN 1 WERE DERIVED FROM THE PAMAP PROGRAM 3.2 FT DIGITAL ELEVATION MODEL OF PENNSYLVANIA; DEVELOPED BY PAMAP PROGRAM, PA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES, BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY; DATED 2008.
6. PIPE BRIDGE AND SLUICE PIPE LOCATIONS WERE TAKEN FROM PPL MONTOUR, LLC DWG. NO. D324541 SHEET 1 OF 3, DATED 9/19/08.
7. THE APPROXIMATE TOP OF DIKE/LIMIT OF CCR'S SHOWN IS AN ESTIMATED LOCATION BASED ON REFERENCES FROM PPL DRAWINGS.
8. PROPERTY BOUNDARIES AND OWNERS HAVE BEEN PROVIDED BY PPL THROUGH A GIS DATA RELEASE AGREEMENT, DATED SEPTEMBER 4, 2014.

SCALE IN FEET: 0 — 200 — 400

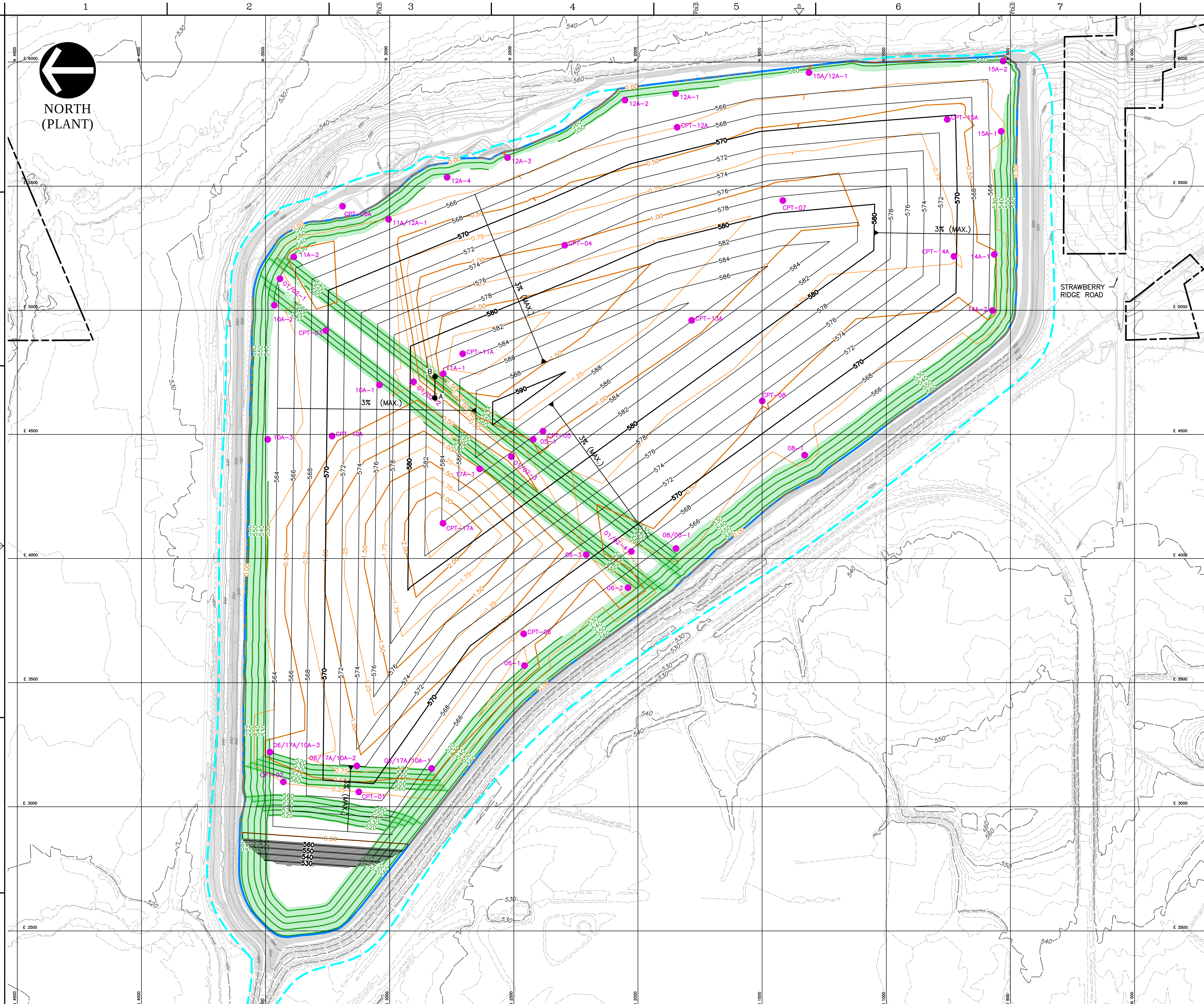
ACCT- 103650	MONTOUR S.E.S.
SCALE- 1"=200'	ASH BASIN #1
BY- MJI	MAJOR PERMIT MODIFICATION
REVIEWED: RJB	SETTLEMENT PLAN
APPROVED: JMN	DATE: 10/30/14 — PPL MONTOUR, LLC
PPL DRAWING NO.: D377137	SHEET NO.: FIGURE 16R-3.3.1 — REV. 0

132-065-GT01-020 - SETTLEMENT PLAN.dwg

REFERENCE TITLE	NUMBER	REFERENCE TITLE	NUMBER	NO.	DATE	ACCT.	REVISION	BY	REVIEWED	APPROVED

LOCATION CODES — SORTS — PC CAD

PPL CORP. FORM 41630 (4/00)
Oct. 30, 2014 - 4:31 PM



LEGEND

- PROPERTY LINE
- LIMITS OF BASIN 1 PERMIT AREA
- APPROXIMATE TOP OF DIKE/LIMIT OF CCR'S
- 570 — EXISTING CONTOUR
- 570 — PROPOSED CONTOUR (TOP OF FINAL GRADE)
- 550 — DIKE CONTOUR
- 1.50 — MAGNITUDE CONTOUR
- ACCESS ROAD
- CPT-04 — SETTLEMENT ANALYSIS POINTS
- A — B — POST SETTLEMENT SLOPE CALCULATION SEGMENT

REFERENCE

1. THE EXISTING TOPOGRAPHY, DATED MAY 1, 2013 WAS GENERATED USING AERIAL PHOTOGRAPHY BY L. ROBERT KIMBALL AND ASSOCIATES, INC. THE 2013 TOPOGRAPHY IN SUBBASIN B WAS REFERENCED FROM PPL DRAWING NO. E376172 REV 3, DATED 6/2013.
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5. EXISTING CONTOURS TO SOUTH OF BASIN 1 WERE DERIVED FROM THE PAMAP PROGRAM 3.2 FT DIGITAL ELEVATION MODEL OF PENNSYLVANIA; DEVELOPED BY PAMAP PROGRAM, PA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES, BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY; DATED 2008.
6. PIPE BRIDGE AND SLUICE PIPE LOCATIONS WERE TAKEN FROM PPL MONTOUR, LLC DWG. NO. D324541 SHEET 1 OF 3, DATED 9/19/08.
7. THE APPROXIMATE TOP OF DIKE/LIMIT OF CCR'S SHOWN IS AN ESTIMATED LOCATION BASED ON REFERENCES FROM PPL DRAWINGS.
8. PROPERTY BOUNDARIES AND OWNERS HAVE BEEN PROVIDED BY PPL THROUGH A GIS DATA RELEASE AGREEMENT, DATED SEPTEMBER 4, 2014.

SCALE IN FEET
0 200 400

ACCT- 103650
SCALE- 1"=200'
BY- MJI
REVIEWED RJB

MONTOUR S.E.S.
ASH BASIN #1
MAJOR PERMIT MODIFICATION
SETTLEMENT MAGNITUDES

APPROVED JMN
DATE 10/30/14
PPL MONTOUR, LLC

PPL DRAWING NO. D377138
SHEET NO. FIGURE 16R-3.3.2
REV. 0

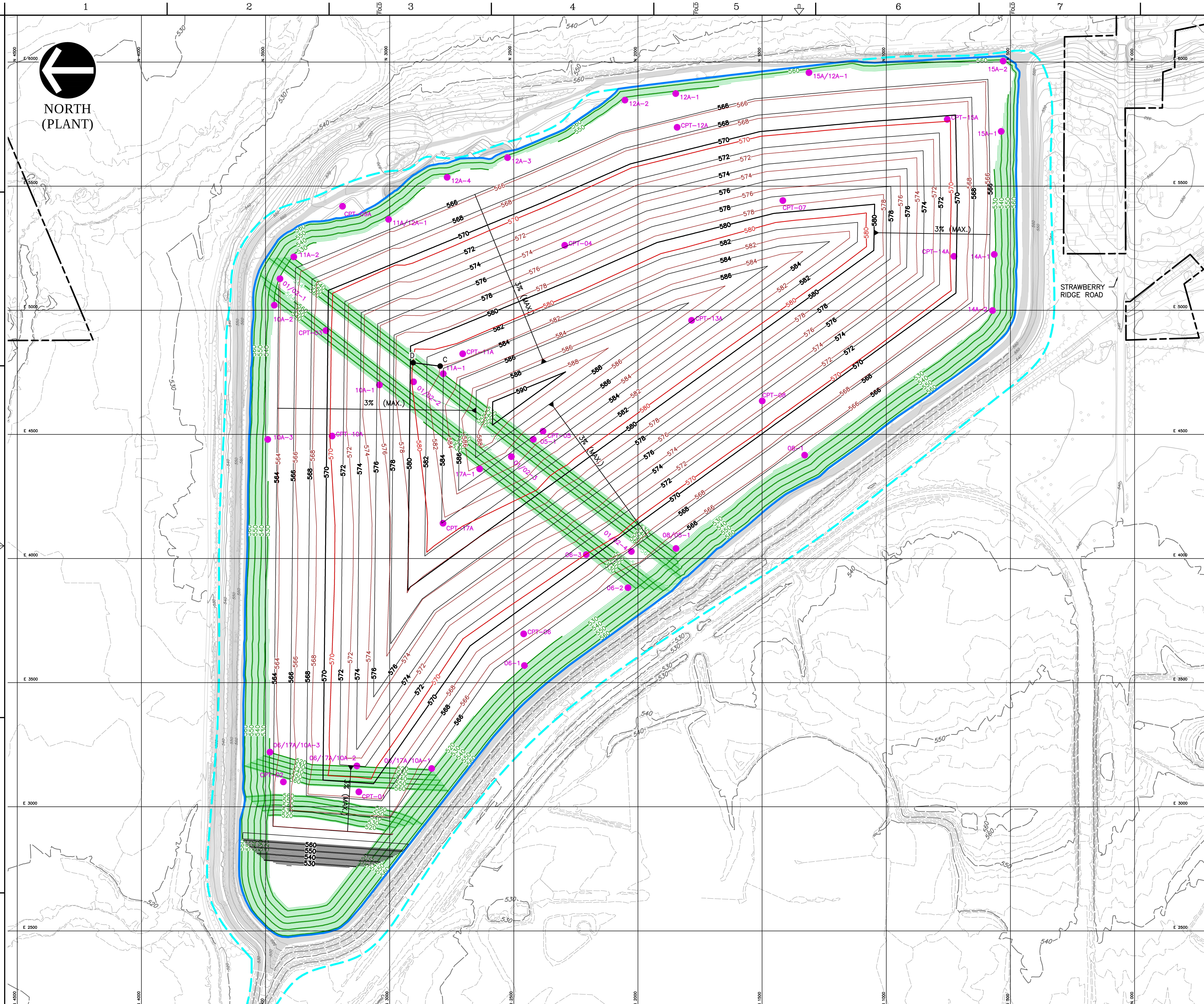
132-065-GT01-022 -
SETTLEMENT MAGNITUDES.dwg

REFERENCE TITLE	NUMBER	REFERENCE TITLE	NUMBER	NO.	DATE	ACCT.	REVISION	BY	REVIEWED	APPROVED

LOCATION CODES
SORTS

PPL CORP. FORM 41630 (4/00)
Oct. 30, 2014 - 4:31 PM

FRACTIONAL
DECIMAL
PC CAD



LEGEND

- PROPERTY LINE
- LIMITS OF BASIN 1 PERMIT AREA
- APPROXIMATE TOP OF DIKE/LIMIT OF CCR'S
- 570 EXISTING CONTOUR
- 570 PROPOSED CONTOUR (TOP OF FINAL GRADE)
- 550 DIKE CONTOUR
- 570 POST SETTLEMENT CONTOUR
- ACCESS ROAD
- CPT-04 SETTLEMENT ANALYSIS POINTS
- C D POST SETTLEMENT SLOPE CALCULATION SEGMENT

REFERENCE

1. THE EXISTING TOPOGRAPHY, DATED MAY 1, 2013 WAS GENERATED USING AERIAL PHOTOGRAPHY BY L. ROBERT KIMBALL AND ASSOCIATES, INC. THE 2013 TOPOGRAPHY IN SUBBASIN B WAS REFERENCED FROM PPL DRAWING NO. E376172 REV 3, DATED 6/2013.
2. THE 2014 ANNUAL BATHYMETRIC SURVEY IN SUBBASINS B AND C IS FROM DRAWING 750188GPS.DWG, DATED MAY 8, 2014, WHICH WAS GENERATED BY PPL.
3. A SITE SPECIFIC COORDINATE SYSTEM IS SHOWN. MONTOUR S.E.S. USES A NAVD 1929 VERTICAL DATUM INSIDE BASIN 1.
4. THE LIMITS OF THE PERMIT AREA IS FROM PPL DRAWING E244381, DATED 9/2007.
5. EXISTING CONTOURS TO SOUTH OF BASIN 1 WERE DERIVED FROM THE PAMAP PROGRAM 3.2 FT DIGITAL ELEVATION MODEL OF PENNSYLVANIA; DEVELOPED BY PAMAP PROGRAM, PA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES, BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY; DATED 2008.
6. PIPE BRIDGE AND SLUICE PIPE LOCATIONS WERE TAKEN FROM PPL MONTOUR, LLC DWG. NO. D324541 SHEET 1 OF 3, DATED 9/19/08.
7. THE APPROXIMATE TOP OF DIKE/LIMIT OF CCR'S SHOWN IS AN ESTIMATED LOCATION BASED ON REFERENCES FROM PPL DRAWINGS.
8. PROPERTY BOUNDARIES AND OWNERS HAVE BEEN PROVIDED BY PPL THROUGH A GIS DATA RELEASE AGREEMENT, DATED SEPTEMBER 4, 2014.

SCALE IN FEET
0 200 400

ACCT- 103650	MONTOUR S.E.S.
SCALE- 1"=200'	ASH BASIN #1
BY- MJI	MAJOR PERMIT MODIFICATION
REVIEWED RJB	POST SETTLEMENT CONTOURS
APPROVED JMN	DATE 10/30/14
	PPL MONTOUR, LLC
PPL DRAWING NO. D377139	SHEET NO. FIGURE 16R-3.3.3
REV. 0	

REFERENCE TITLE	NUMBER	REFERENCE TITLE	NUMBER	NO.	DATE	ACCT.	REVISION	BY	REVIEWED	APPROVED

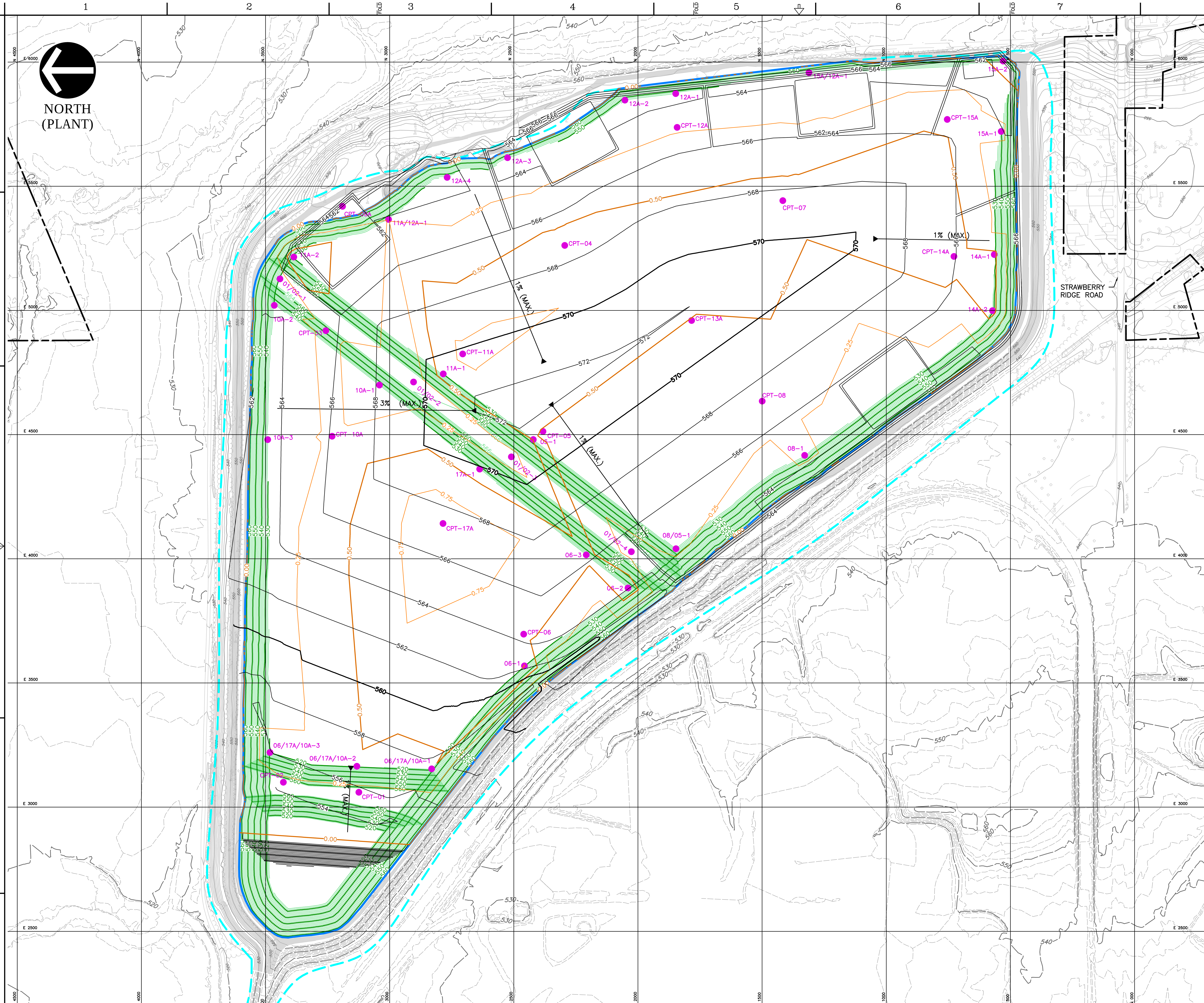
LOCATION CODES SORTS

132-065-GT01-023 - POST SETTLEMENT CONTOURS.dwg

PPL CORP. FORM 41630 (4/00) Oct. 30, 2014 - 5:06 PM

FRACTIONAL DECIMAL

PC CAD



LEGEND

- PROPERTY LINE
- LIMITS OF BASIN 1 PERMIT AREA
- APPROXIMATE TOP OF DIKE/LIMIT OF CCR'S
- 570 — EXISTING CONTOUR
- 570 — PROPOSED CONTOUR (TOP OF FINAL GRADE AT 1% SLOPE)
- 550 — DIKE CONTOUR
- 1.50 — MAGNITUDE CONTOUR
- ACCESS ROAD
- CPT-04 — SETTLEMENT ANALYSIS POINTS

REFERENCE

1. THE EXISTING TOPOGRAPHY, DATED MAY 1, 2013 WAS GENERATED USING AERIAL PHOTOGRAPHY BY L. ROBERT KIMBALL AND ASSOCIATES, INC. THE 2013 TOPOGRAPHY IN SUBBASIN B WAS REFERENCED FROM PPL DRAWING NO. E376172 REV 3, DATED 6/2013.
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6. PIPE BRIDGE AND SLUICE PIPE LOCATIONS WERE TAKEN FROM PPL MONTOUR, LLC DWG. NO. D324541 SHEET 1 OF 3, DATED 9/19/08.
7. THE APPROXIMATE TOP OF DIKE/LIMIT OF CCR'S SHOWN IS AN ESTIMATED LOCATION BASED ON REFERENCES FROM PPL DRAWINGS.
8. PROPERTY BOUNDARIES AND OWNERS HAVE BEEN PROVIDED BY PPL THROUGH A GIS DATA RELEASE AGREEMENT, DATED SEPTEMBER 4, 2014.

SCALE IN FEET
0 200 400

ACCT–
SCALE– 1"=200'
BY– MJI
REVIEWED RJB

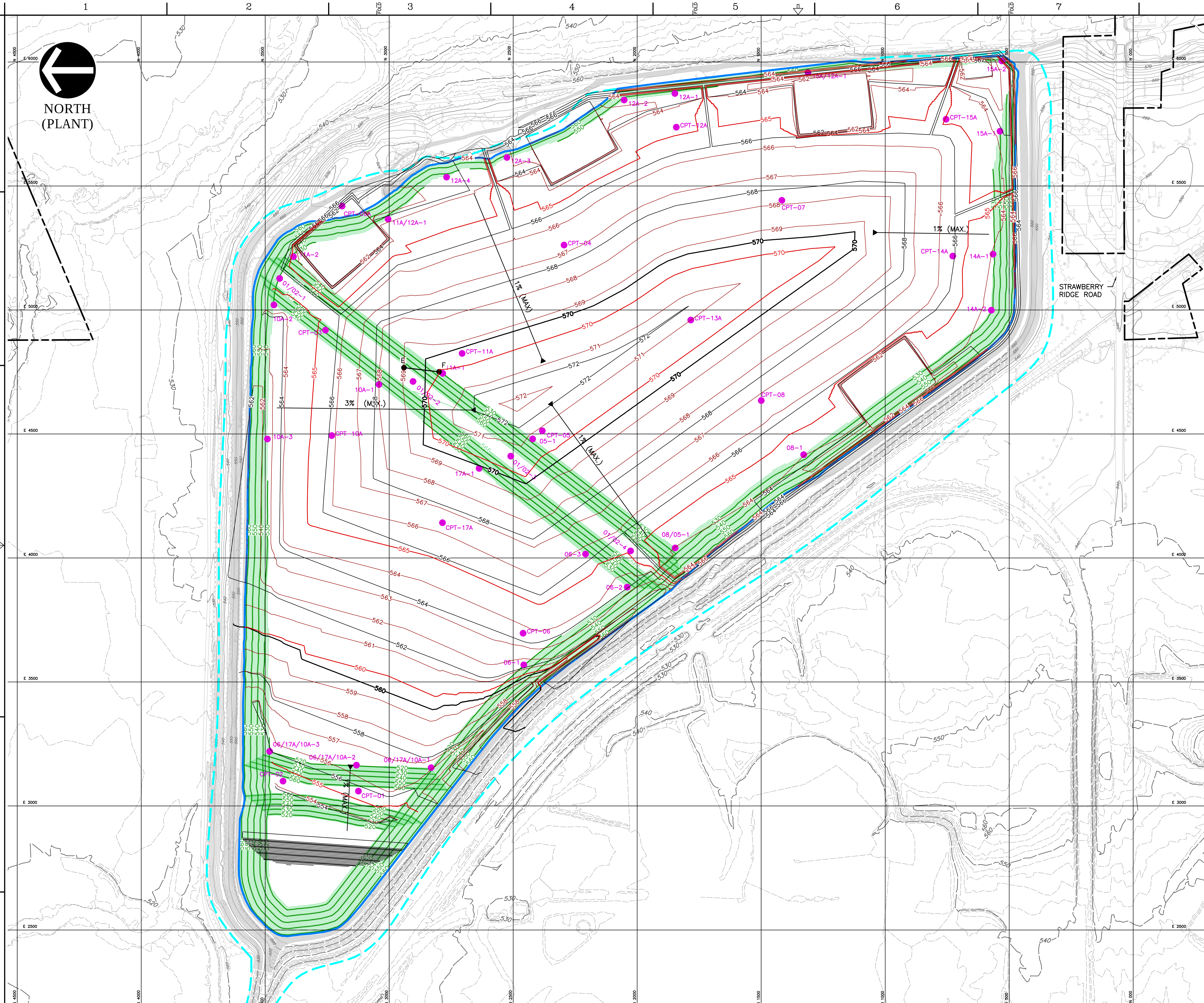
MONTOUR S.E.S.
ASH BASIN #1
MAJOR PERMIT MODIFICATION
SETTLEMENT MAGNITUDES 1%

APPROVED JMN
DATE 10/30/14
PPL MONTOUR, LLC

PPL DRAWING NO. D377140
SHEET NO. FIGURE 16R–3.3.4
REV. 0

132–065–GT01–027 –
SETTLEMENT MAGNITUDES FOR 1%

PC CAD



LEGEND

- PROPERTY LINE
- LIMITS OF BASIN 1 PERMIT AREA
- APPROXIMATE TOP OF DIKE/LIMIT OF CCR'S
- 570 EXISTING CONTOUR
- 570 PROPOSED CONTOUR (TOP OF FINAL GRADE AT 1% SLOPE)
- 550 DIKE CONTOUR
- 570 POST SETTLEMENT CONTOUR
- ACCESS ROAD
- CPT-04 SETTLEMENT ANALYSIS POINTS
- E F POST SETTLEMENT SLOPE CALCULATION SEGMENT

REFERENCE

1. THE EXISTING TOPOGRAPHY, DATED MAY 1, 2013 WAS GENERATED USING AERIAL PHOTOGRAPHY BY L. ROBERT KIMBALL AND ASSOCIATES, INC. THE 2013 TOPOGRAPHY IN SUBBASIN B WAS REFERENCED FROM PPL DRAWING NO. E376172 REV 3, DATED 6/2013.
2. THE 2014 ANNUAL BATHYMETRIC SURVEY IN SUBBASINS B AND C IS FROM DRAWING 750188GPS.DWG, DATED MAY 8, 2014, WHICH WAS GENERATED BY PPL.
3. A SITE SPECIFIC COORDINATE SYSTEM IS SHOWN. MONTOUR S.E.S. USES A NAVD 1929 VERTICAL DATUM INSIDE BASIN 1.
4. THE LIMITS OF THE PERMIT AREA IS FROM PPL DRAWING E244381, DATED 9/2007.
5. EXISTING CONTOURS TO SOUTH OF BASIN 1 WERE DERIVED FROM THE PAMAP PROGRAM 3.2 FT DIGITAL ELEVATION MODEL OF PENNSYLVANIA; DEVELOPED BY PAMAP PROGRAM, PA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES, BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY; DATED 2008.
6. PIPE BRIDGE AND SLUICE PIPE LOCATIONS WERE TAKEN FROM PPL MONTOUR, LLC DWG. NO. D324541 SHEET 1 OF 3, DATED 9/19/08.
7. THE APPROXIMATE TOP OF DIKE/LIMIT OF CCR'S SHOWN IS AN ESTIMATED LOCATION BASED ON REFERENCES FROM PPL DRAWINGS.
8. PROPERTY BOUNDARIES AND OWNERS HAVE BEEN PROVIDED BY PPL THROUGH A GIS DATA RELEASE AGREEMENT, DATED SEPTEMBER 4, 2014.

SCALE IN FEET: 0 200 400

REFERENCE TITLE	NUMBER	REFERENCE TITLE	NUMBER	NO.	DATE	ACCT.	REVISION	BY	REVIEWED	APPROVED

ACCT- 103650
SCALE- 1"=200'
BY- MJI
REVIEWED RJB

MONTOUR S.E.S.
ASH BASIN #1
MAJOR PERMIT MODIFICATION
POST SETTLEMENT CONTOURS 1%

APPROVED JMN | DATE 10/30/14 | PPL MONTOUR, LLC

PPL DRAWING NO. D377145 | SHEET NO. FIGURE 16R-3.3.5 | REV. 0

LOCATION CODES | SORTS | PC CAD

132-065-GT01-026 - POST SETTLEMENT CONTOURS FOR 1%

PPL CORP. FORM 41630 (4/00)
Oct. 30, 2014 - 4:38 PM

FRACTIONAL | DECIMAL

ATTACHMENT 3.4

Final Cover Infiltration Calculation

OBJECTIVE

Determine the infiltration through the proposed final cover system for Montour Steam Electric Station Basin No. 1.

METHODOLOGY

A HELP Model analysis was performed to estimate the potential infiltration rate through the proposed final cover system for Basin No. 1. The proposed final cover system includes:

- 40-mil geomembrane;
- 6 oz/sy non-woven geotextile; and
- 1-foot of final cover soil.

The final cover soil will be constructed using a blend of 50 percent (maximum) bottom ash fines and 50 percent soil. The final cover system will be constructed at maximum 3 percent grades. The final cover soil surface will be vegetated.

The infiltration calculations were performed using HELP Model Version 3.07 (U.S. Army Corps of Engineers, Vicksburg Station, September 1994). In order to perform the calculation using HELP Model, the hydraulic conductivity of each layer is needed. Geotextile manufacturers typically specify the permittivity of the geotextiles, but do not provide the hydraulic conductivity. The hydraulic conductivity of the geotextile was calculated based on the permittivity provided in the manufacturer's data sheets.

HYDRAULIC CONDUCTIVITY OF GEOTEXTILE

The hydraulic conductivity of the geotextile is needed as input for the HELP Model. The hydraulic conductivity of the geotextile was calculated based on the permittivity specified in the manufacturer's data sheets. Based on the manufacturer's data sheets, the permittivity of 6 oz/sy non-woven geotextile is 1.5 sec^{-1}. Refer to Attachment 1 for the manufacturer's data sheets.

The following equation can be used to determine the hydraulic conductivity from the permittivity.

$$k_{spec} = \Psi_{spec} * t$$

k_{spec} = hydraulic conductivity (based on manufacturer specified permittivity) (cm/sec)
Ψ_{spec} = manufacturer specified permittivity (sec^{-1})
t = thickness (cm)

For a 6 oz/sy geotextile, a typical thickness is 53 mils, which equates to a thickness in centimeters of:

$$53 \text{ mil} * \left(\frac{0.001 \text{ in}}{1 \text{ mil}}\right) * \left(\frac{2.54 \text{ cm}}{1 \text{ in}}\right) = 0.13 cm$$

$k_{spec} = 1.5 \text{ sec}^{-1} * 0.13 \text{ cm} = 0.20 \text{ cm/sec} = 2.0 \times 10^{-1} \text{ cm/sec}$

To determine a reduced hydraulic conductivity for the geotextile, a factor of safety of 2 was applied.

$FS = k_{spec}/k_{reduced}$

$k_{reduced} = k_{spec}/FS$

Where:

FS = Factor of Safety for permeability
k_{spec} = hydraulic conductivity (based on specified permittivity)
$k_{reduced}$ = reduced hydraulic conductivity

$k_{reduced} = 2.0 \times 10^{-1} \text{ cm/sec} / 2 = 0.1 \text{ cm/sec or } 1.0 \times 10^{-1} \text{ cm/sec}$

DESIGN ASSUMPTIONS FOR HELP MODEL

The following assumptions were assumed for the HELP Model calculations:

1. All runoff calculations were performed assuming ponding will not occur on the final cap configuration (model was set to allow 100% of potential runoff).

2. Assumptions regarding material properties used in the HELP Model analysis are provided below:
   a. Physical properties for the final cover soil such as porosity, field capacity and wilting point are based on laboratory data.
   b. Physical properties for the conditioned fly ash such as porosity, field capacity, and wilting point are typical fly ash values from the EPRI FGD Manual.
   c. The initial soil water content is set equal to the field capacity for the soil layers.
   d. The hydraulic conductivity of conditioned fly ash is based on laboratory test results.
   e. It was assumed that saturated hydraulic conductivity (k) for the final cover soil is equivalent to the default *k* value in the HELP model for that material texture classification as determined by laboratory testing (silt loam).
   f. Based on the calculation above, the hydraulic conductivity for the geotextile is assumed to be 0.1 cm/sec.

g. The depth of the evapotranspiration layer in soil cover is assumed to be the full depth of the final cover soil layer. The evapotranspiration layer does not extend beyond the geomembrane.
h. Geomembrane pinholes and installation defects were both assumed to occur at the rate of one/acre.
i. Geomembrane placement quality was assumed to be "Good."

3. A default HELP model synthetic weather database was used to generate 10 years of climatological data using averages for Danville, PA.

4. A maximum drainage length of 900 feet is assumed based on the top of conditioned fly ash grading plan shown on Permit Drawing E377134, Sheet 5.

5. "Good" grass vegetative cover was assumed for calculation of the SCS Curve Number.

6. The design slope analyzed was 3.0 percent.

CALCULATIONS

A printout of the HELP model results for the final cover system is provided in the attachment.

CONCLUSIONS

The HELP model was used to calculate the potential infiltration through the final cover system. Based on the HELP model, the potential infiltration (leakage through) the geomembrane was determined to be 0.13-inches per acre per year. This value was determined based on the maximum 3 percent grades.

```
******************************************************************************
******************************************************************************
**                                                                          **
**                                                                          **
**              HYDROLOGIC EVALUATION OF LANDFILL PERFORMANCE               **
**                HELP MODEL VERSION 3.07  (1 NOVEMBER 1997)                **
**                  DEVELOPED BY ENVIRONMENTAL LABORATORY                   **
**                    USAE WATERWAYS EXPERIMENT STATION                     **
**             FOR USEPA RISK REDUCTION ENGINEERING LABORATORY              **
**                                                                          **
**                                                                          **
******************************************************************************
******************************************************************************


PRECIPITATION DATA FILE:    C:\HELP\DVDATA4.D4
TEMPERATURE DATA FILE:      C:\HELP\DVDATA10.D7
SOLAR RADIATION DATA FILE:  C:\HELP\DVDATA13.D13
EVAPOTRANSPIRATION DATA:    C:\HELP\DV12IN.D11
SOIL AND DESIGN DATA FILE:  C:\HELP\FINAL.D10
OUTPUT DATA FILE:           C:\HELP\final.OUT


TIME:  10: 0     DATE:   5/12/2015


******************************************************************************

     TITLE:  final cover

******************************************************************************


     NOTE:  INITIAL MOISTURE CONTENT OF THE LAYERS AND SNOW WATER
              WERE SPECIFIED BY THE USER.


                                   LAYER  1
                                   --------

                      TYPE 1 - VERTICAL PERCOLATION LAYER
                          MATERIAL TEXTURE NUMBER   0
           THICKNESS                    =     12.00   INCHES
           POROSITY                     =      0.3989 VOL/VOL
           FIELD CAPACITY               =      0.3266 VOL/VOL
           WILTING POINT                =      0.0712 VOL/VOL
           INITIAL SOIL WATER CONTENT   =      0.3266 VOL/VOL
           EFFECTIVE SAT. HYD. COND.    =  0.190000006000E-03 CM/SEC


                                   LAYER  2
                                   --------

                        TYPE 2 - LATERAL DRAINAGE LAYER
                          MATERIAL TEXTURE NUMBER   0
```

```
   THICKNESS                   =      0.05   INCHES
   POROSITY                    =      0.8500 VOL/VOL
   FIELD CAPACITY              =      0.0100 VOL/VOL
   WILTING POINT               =      0.0050 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.0100 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.100000001000     CM/SEC
   SLOPE                       =      3.00   PERCENT
   DRAINAGE LENGTH             =    900.0    FEET


                         LAYER  3
                         --------

               TYPE 4 - FLEXIBLE MEMBRANE LINER
                 MATERIAL TEXTURE NUMBER   0
   THICKNESS                   =      0.04   INCHES
   POROSITY                    =      0.0000 VOL/VOL
   FIELD CAPACITY              =      0.0000 VOL/VOL
   WILTING POINT               =      0.0000 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.0000 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.189999993000E-12 CM/SEC
   FML PINHOLE DENSITY         =      1.00   HOLES/ACRE
   FML INSTALLATION DEFECTS    =      1.00   HOLES/ACRE
   FML PLACEMENT QUALITY       =  3 - GOOD


                         LAYER  4
                         --------

             TYPE 1 - VERTICAL PERCOLATION LAYER
                 MATERIAL TEXTURE NUMBER   0
   THICKNESS                   =     12.00   INCHES
   POROSITY                    =      0.4000 VOL/VOL
   FIELD CAPACITY              =      0.3260 VOL/VOL
   WILTING POINT               =      0.0200 VOL/VOL
   INITIAL SOIL WATER CONTENT  =      0.3260 VOL/VOL
   EFFECTIVE SAT. HYD. COND.   =  0.599999985000E-04 CM/SEC


           GENERAL DESIGN AND EVAPORATIVE ZONE DATA
           ----------------------------------------

 NOTE:  SCS RUNOFF CURVE NUMBER WAS COMPUTED FROM DEFAULT
          SOIL DATA BASE USING SOIL TEXTURE # 9 WITH A
          GOOD STAND OF GRASS, A SURFACE SLOPE OF  3.%
          AND A SLOPE LENGTH OF 1000. FEET.

 SCS RUNOFF CURVE NUMBER            =     73.70
 FRACTION OF AREA ALLOWING RUNOFF   =    100.0    PERCENT
 AREA PROJECTED ON HORIZONTAL PLANE  =      1.000  ACRES
 EVAPORATIVE ZONE DEPTH             =     12.0    INCHES
 INITIAL WATER IN EVAPORATIVE ZONE   =      3.919  INCHES
 UPPER LIMIT OF EVAPORATIVE STORAGE  =      4.787  INCHES
 LOWER LIMIT OF EVAPORATIVE STORAGE  =      0.854  INCHES
 INITIAL SNOW WATER                 =      0.000  INCHES
 INITIAL WATER IN LAYER MATERIALS    =      7.832  INCHES
```

TOTAL INITIAL WATER = 7.832 INCHES
TOTAL SUBSURFACE INFLOW = 0.00 INCHES/YEAR

EVAPOTRANSPIRATION AND WEATHER DATA

NOTE: EVAPOTRANSPIRATION DATA WAS OBTAINED FROM
Danville Pennsylvania

STATION LATITUDE	=	41.08 DEGREES
MAXIMUM LEAF AREA INDEX	=	3.50
START OF GROWING SEASON (JULIAN DATE)	=	100
END OF GROWING SEASON (JULIAN DATE)	=	296
EVAPORATIVE ZONE DEPTH	=	12.0 INCHES
AVERAGE ANNUAL WIND SPEED	=	7.60 MPH
AVERAGE 1ST QUARTER RELATIVE HUMIDITY	=	66.70 %
AVERAGE 2ND QUARTER RELATIVE HUMIDITY	=	65.00 %
AVERAGE 3RD QUARTER RELATIVE HUMIDITY	=	72.80 %
AVERAGE 4TH QUARTER RELATIVE HUMIDITY	=	71.20 %

NOTE: PRECIPITATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA

NORMAL MEAN MONTHLY PRECIPITATION (INCHES)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
3.00	2.50	3.20	3.70	4.00	4.40
3.80	3.80	4.00	3.30	3.30	3.00

NOTE: TEMPERATURE DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA

NORMAL MEAN MONTHLY TEMPERATURE (DEGREES FAHRENHEIT)

JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
26.10	29.00	38.10	49.10	59.50	68.10
72.60	70.80	63.10	51.60	41.20	31.30

NOTE: SOLAR RADIATION DATA WAS SYNTHETICALLY GENERATED USING
COEFFICIENTS FOR PITTSBURGH PENNSYLVANIA
AND STATION LATITUDE = 41.08 DEGREES

****

MONTHLY TOTALS (IN INCHES) FOR YEAR 1

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.75	2.31	3.78	4.09	4.78	3.83
	3.42	4.52	1.84	6.83	1.88	4.30
RUNOFF	1.795	1.719	2.880	2.064	0.000	0.000
	0.000	0.000	0.000	2.402	0.851	3.614
EVAPOTRANSPIRATION	0.319	0.643	0.519	3.055	5.265	6.056
	2.984	4.584	1.141	1.478	1.121	0.477
LATERAL DRAINAGE COLLECTED	0.0000	0.0132	0.0329	0.0360	0.0383	0.0303
FROM LAYER 2	0.0172	0.0247	0.0179	0.0357	0.0411	0.0376
PERCOLATION/LEAKAGE THROUGH	0.0000	0.0088	0.0135	0.0195	0.0190	0.0050
LAYER 3	0.0001	0.0021	0.0001	0.0200	0.0281	0.0208
PERCOLATION/LEAKAGE THROUGH	0.0000	1.8725	0.5459	0.1647	0.1021	0.0790
LAYER 4	0.0621	0.0457	0.0374	0.0143	0.0088	0.0211

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.000	3.509	4.851	7.162	6.704	1.732
TOP OF LAYER 3	0.029	0.667	0.032	7.117	10.426	7.461
STD. DEVIATION OF DAILY	0.000	4.834	5.604	3.516	1.333	1.822
HEAD ON TOP OF LAYER 3	0.006	0.790	0.006	5.131	1.084	5.813

****

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ANNUAL TOTALS FOR YEAR 1

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.33	160917.891	100.00
RUNOFF	15.324	55626.137	34.57
EVAPOTRANSPIRATION	27.643	100343.070	62.36
DRAINAGE COLLECTED FROM LAYER 2	0.3250	1179.729	0.73
PERC./LEAKAGE THROUGH LAYER 3	0.137200	498.036	0.31
AVG. HEAD ON TOP OF LAYER 3	4.1410		
PERC./LEAKAGE THROUGH LAYER 4	2.953698	10721.924	6.66
CHANGE IN WATER STORAGE	-1.915	-6952.959	-4.32
SOIL WATER AT START OF YEAR	11.744	42629.734	
SOIL WATER AT END OF YEAR	9.828	35676.777	

SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.011	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 2

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.75	4.49	3.51	4.50	0.94	3.74
	1.98	1.66	11.06	3.83	3.63	1.58
RUNOFF	0.499	1.883	8.096	0.756	0.000	0.000
	0.000	0.000	4.867	2.053	2.375	0.954
EVAPOTRANSPIRATION	0.493	0.401	0.502	4.012	2.729	5.313
	1.987	1.625	2.452	1.464	1.184	0.577
LATERAL DRAINAGE COLLECTED	0.0168	0.0077	0.0054	0.0397	0.0349	0.0280
FROM LAYER 2	0.0168	0.0083	0.0308	0.0419	0.0417	0.0379
PERCOLATION/LEAKAGE THROUGH	0.0001	0.0001	0.0008	0.0248	0.0107	0.0016
LAYER 3	0.0001	0.0001	0.0200	0.0277	0.0296	0.0210
PERCOLATION/LEAKAGE THROUGH	0.0362	0.0275	0.0254	0.0020	0.0170	0.0231
LAYER 4	0.0221	0.0195	0.0052	0.0004	0.0004	0.0106

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.029	0.015	0.266	9.137	3.642	0.501
TOP OF LAYER 3	0.029	0.014	7.393	9.908	10.990	7.527
STD. DEVIATION OF DAILY	0.006	0.003	1.436	1.370	1.427	0.787
HEAD ON TOP OF LAYER 3	0.006	0.003	5.017	1.725	1.069	5.471

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ANNUAL TOTALS FOR YEAR 2

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.67	162152.094	100.00

RUNOFF	21.483	77984.664	48.09
EVAPOTRANSPIRATION	22.740	82544.844	50.91
DRAINAGE COLLECTED FROM LAYER 2	0.3098	1124.517	0.69
PERC./LEAKAGE THROUGH LAYER 3	0.136448	495.307	0.31
AVG. HEAD ON TOP OF LAYER 3	4.1208		
PERC./LEAKAGE THROUGH LAYER 4	0.189345	687.324	0.42
CHANGE IN WATER STORAGE	-0.052	-189.224	-0.12
SOIL WATER AT START OF YEAR	9.828	35676.777	
SOIL WATER AT END OF YEAR	9.776	35487.551	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.033	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 3

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.12	4.35	4.65	2.78	3.28	3.23
	3.21	3.90	4.33	2.94	2.48	2.73
RUNOFF	2.889	4.510	4.322	1.643	0.000	0.000
	0.000	0.013	0.000	0.000	0.844	2.145
EVAPOTRANSPIRATION	0.490	0.457	0.452	2.866	3.933	3.004
	4.168	3.499	3.028	1.727	0.961	0.479
LATERAL DRAINAGE COLLECTED	0.0172	0.0079	0.0045	0.0280	0.0349	0.0234
FROM LAYER 2	0.0215	0.0276	0.0266	0.0360	0.0412	0.0342
PERCOLATION/LEAKAGE THROUGH	0.0001	0.0001	0.0000	0.0142	0.0107	0.0006
LAYER 3	0.0002	0.0039	0.0012	0.0133	0.0283	0.0146
PERCOLATION/LEAKAGE THROUGH	0.0276	0.0216	0.0211	0.0069	0.0102	0.0185
LAYER 4	0.0175	0.0121	0.0136	0.0028	0.0000	0.0109

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON TOP OF LAYER 3	0.029	0.015	0.008	5.183	3.626	0.184
	0.037	1.314	0.391	4.603	10.504	5.230
STD. DEVIATION OF DAILY HEAD ON TOP OF LAYER 3	0.006	0.003	0.002	3.655	1.279	0.407
	0.009	1.666	0.677	1.859	1.221	5.860

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ANNUAL TOTALS FOR YEAR 3

	INCHES	CU. FEET	PERCENT
PRECIPITATION	42.00	152460.016	100.00
RUNOFF	16.367	59411.242	38.97
EVAPOTRANSPIRATION	25.064	90983.648	59.68
DRAINAGE COLLECTED FROM LAYER 2	0.3029	1099.356	0.72
PERC./LEAKAGE THROUGH LAYER 3	0.087338	317.036	0.21
AVG. HEAD ON TOP OF LAYER 3	2.5937		
PERC./LEAKAGE THROUGH LAYER 4	0.162886	591.276	0.39
CHANGE IN WATER STORAGE	0.103	374.524	0.25
SOIL WATER AT START OF YEAR	9.776	35487.551	
SOIL WATER AT END OF YEAR	9.698	35202.512	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.182	659.564	0.43
ANNUAL WATER BUDGET BALANCE	0.0000	-0.030	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 4

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.71	2.18	3.86	1.95	3.37	4.42
	4.76	5.40	4.01	2.32	3.55	4.72
RUNOFF	2.082	1.498	3.810	0.523	0.000	0.000
	0.000	0.008	1.280	0.000	2.335	1.231

EVAPOTRANSPIRATION	0.552	0.415	0.576	2.686	3.363	5.361
	6.292	3.144	2.745	0.955	0.917	0.512
LATERAL DRAINAGE COLLECTED	0.0157	0.0074	0.0040	0.0270	0.0350	0.0293
FROM LAYER 2	0.0304	0.0206	0.0366	0.0370	0.0415	0.0346
PERCOLATION/LEAKAGE THROUGH	0.0001	0.0001	0.0000	0.0144	0.0111	0.0043
LAYER 3	0.0017	0.0003	0.0173	0.0158	0.0291	0.0160
PERCOLATION/LEAKAGE THROUGH	0.0180	0.0152	0.0148	0.0041	0.0045	0.0109
LAYER 4	0.0129	0.0131	0.0008	0.0004	0.0000	0.0102

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.027	0.014	0.007	5.254	3.762	1.476
TOP OF LAYER 3	0.522	0.093	6.260	5.494	10.801	5.749
STD. DEVIATION OF DAILY	0.006	0.003	0.001	3.865	0.947	1.678
HEAD ON TOP OF LAYER 3	0.747	0.280	2.298	0.805	0.975	5.839

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ANNUAL TOTALS FOR YEAR 4

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.25	156997.531	100.00
RUNOFF	12.768	46347.859	29.52
EVAPOTRANSPIRATION	27.517	99887.836	63.62
DRAINAGE COLLECTED FROM LAYER 2	0.3190	1157.850	0.74
PERC./LEAKAGE THROUGH LAYER 3	0.110168	399.910	0.25
AVG. HEAD ON TOP OF LAYER 3	3.2881		
PERC./LEAKAGE THROUGH LAYER 4	0.105028	381.252	0.24
CHANGE IN WATER STORAGE	2.541	9222.756	5.87
SOIL WATER AT START OF YEAR	9.698	35202.512	
SOIL WATER AT END OF YEAR	9.702	35218.621	
SNOW WATER AT START OF YEAR	0.182	659.564	0.42
SNOW WATER AT END OF YEAR	2.718	9866.208	6.28
ANNUAL WATER BUDGET BALANCE	0.0000	-0.022	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 5

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.13	3.02	3.04	3.41	2.82	4.68
	2.32	5.91	5.19	2.45	5.03	2.45
RUNOFF	6.401	2.469	2.785	0.658	0.000	0.000
	0.000	0.000	0.224	0.993	3.740	1.476
EVAPOTRANSPIRATION	0.447	0.479	0.665	3.094	3.358	6.075
	3.430	3.713	3.307	1.269	1.188	0.860
LATERAL DRAINAGE COLLECTED	0.0153	0.0071	0.0100	0.0394	0.0361	0.0324
FROM LAYER 2	0.0245	0.0266	0.0363	0.0423	0.0421	0.0439
PERCOLATION/LEAKAGE THROUGH	0.0001	0.0001	0.0043	0.0240	0.0137	0.0072
LAYER 3	0.0002	0.0090	0.0166	0.0288	0.0307	0.0326
PERCOLATION/LEAKAGE THROUGH	0.0186	0.0152	0.0129	0.0000	0.0049	0.0108
LAYER 4	0.0171	0.0083	0.0019	0.0000	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
AVERAGE DAILY HEAD ON	0.026	0.013	1.545	8.841	4.727	2.465
TOP OF LAYER 3	0.044	3.148	6.021	10.342	11.402	11.711
STD. DEVIATION OF DAILY	0.005	0.002	3.574	1.265	1.201	1.378
HEAD ON TOP OF LAYER 3	0.014	3.221	1.951	0.929	0.510	0.400

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ANNUAL TOTALS FOR YEAR 5

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.45	161353.500	100.00
RUNOFF	18.746	68047.102	42.17
EVAPOTRANSPIRATION	27.885	101222.445	62.73
DRAINAGE COLLECTED FROM LAYER 2	0.3561	1292.771	0.80
PERC./LEAKAGE THROUGH LAYER 3	0.167327	607.398	0.38
AVG. HEAD ON TOP OF LAYER 3	5.0237		

PERC./LEAKAGE THROUGH LAYER 4	0.089682	325.547	0.20
CHANGE IN WATER STORAGE	-2.627	-9534.350	-5.91
SOIL WATER AT START OF YEAR	9.702	35218.621	
SOIL WATER AT END OF YEAR	9.794	35550.480	
SNOW WATER AT START OF YEAR	2.718	9866.208	6.11
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	-0.014	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 6

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.10	2.50	0.87	4.61	2.64	4.12
	1.24	4.36	4.18	3.59	3.85	4.47
RUNOFF	0.460	2.177	0.550	0.391	0.000	0.000
	0.000	0.001	0.000	1.296	2.494	0.844
EVAPOTRANSPIRATION	0.666	0.281	1.106	3.831	5.175	4.940
	1.197	2.884	3.022	1.132	1.050	0.605
LATERAL DRAINAGE COLLECTED	0.0266	0.0122	0.0178	0.0385	0.0362	0.0257
FROM LAYER 2	0.0176	0.0107	0.0312	0.0413	0.0416	0.0375
PERCOLATION/LEAKAGE THROUGH	0.0054	0.0001	0.0068	0.0220	0.0139	0.0006
LAYER 3	0.0001	0.0001	0.0050	0.0264	0.0295	0.0204
PERCOLATION/LEAKAGE THROUGH	0.0249	0.0235	0.0168	0.0024	0.0124	0.0231
LAYER 4	0.0213	0.0189	0.0116	0.0004	0.0000	0.0099

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	1.935	0.023	2.411	8.072	4.827	0.177
TOP OF LAYER 3	0.030	0.018	1.748	9.444	10.939	7.346
STD. DEVIATION OF DAILY	4.186	0.003	3.877	1.330	1.824	0.418
HEAD ON TOP OF LAYER 3	0.006	0.010	2.231	2.082	1.009	5.723

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ANNUAL TOTALS FOR YEAR 6

	INCHES	CU. FEET	PERCENT
PRECIPITATION	37.53	136233.875	100.00
RUNOFF	8.213	29814.531	21.88
EVAPOTRANSPIRATION	25.889	93978.539	68.98
DRAINAGE COLLECTED FROM LAYER 2	0.3370	1223.357	0.90
PERC./LEAKAGE THROUGH LAYER 3	0.130464	473.583	0.35
AVG. HEAD ON TOP OF LAYER 3	3.9141		
PERC./LEAKAGE THROUGH LAYER 4	0.165107	599.339	0.44
CHANGE IN WATER STORAGE	2.925	10618.095	7.79
SOIL WATER AT START OF YEAR	9.794	35550.480	
SOIL WATER AT END OF YEAR	9.748	35385.273	
SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	2.971	10783.305	7.92
ANNUAL WATER BUDGET BALANCE	0.0000	0.022	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 7

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	4.46	1.69	2.70	4.25	1.99	4.93
	1.79	6.51	2.87	3.95	5.21	4.15
RUNOFF	4.846	3.319	2.111	1.540	0.000	0.000
	0.000	0.126	0.000	0.888	4.222	3.397
EVAPOTRANSPIRATION	0.622	0.334	0.798	3.674	3.060	5.362
	2.846	4.138	2.843	1.159	1.050	0.617
LATERAL DRAINAGE COLLECTED	0.0168	0.0077	0.0220	0.0392	0.0353	0.0287
FROM LAYER 2	0.0165	0.0272	0.0330	0.0395	0.0426	0.0438
PERCOLATION/LEAKAGE THROUGH	0.0001	0.0001	0.0138	0.0235	0.0118	0.0024
LAYER 3	0.0001	0.0114	0.0084	0.0219	0.0318	0.0323

PERCOLATION/LEAKAGE THROUGH	0.0238	0.0189	0.0105	0.0016	0.0115	0.0191
LAYER 4	0.0196	0.0082	0.0100	0.0012	0.0000	0.0000

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.029	0.015	4.964	8.665	4.024	0.806
TOP OF LAYER 3	0.028	4.019	2.885	7.769	11.828	11.609
STD. DEVIATION OF DAILY	0.006	0.003	5.596	2.057	0.794	0.993
HEAD ON TOP OF LAYER 3	0.006	3.467	0.790	2.361	0.235	0.405

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ANNUAL TOTALS FOR YEAR 7

	INCHES	CU. FEET	PERCENT
PRECIPITATION	44.50	161535.000	100.00
RUNOFF	20.448	74227.109	45.95
EVAPOTRANSPIRATION	26.502	96200.500	59.55
DRAINAGE COLLECTED FROM LAYER 2	0.3522	1278.552	0.79
PERC./LEAKAGE THROUGH LAYER 3	0.157765	572.687	0.35
AVG. HEAD ON TOP OF LAYER 3	4.7201		
PERC./LEAKAGE THROUGH LAYER 4	0.124339	451.352	0.28
CHANGE IN WATER STORAGE	-2.926	-10622.516	-6.58
SOIL WATER AT START OF YEAR	9.748	35385.273	
SOIL WATER AT END OF YEAR	9.792	35546.059	
SNOW WATER AT START OF YEAR	2.971	10783.305	6.68
SNOW WATER AT END OF YEAR	0.000	0.000	0.00
ANNUAL WATER BUDGET BALANCE	0.0000	0.002	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 8

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	1.80	2.92	4.91	6.08	4.96	2.48
	5.50	5.21	3.47	2.00	3.02	3.95
RUNOFF	0.959	2.308	3.521	2.592	0.713	0.000
	0.000	0.000	0.000	0.000	0.939	2.642
EVAPOTRANSPIRATION	0.928	0.421	1.373	3.857	5.436	4.537
	3.955	5.822	2.596	1.067	0.960	0.297
LATERAL DRAINAGE COLLECTED	0.0430	0.0311	0.0336	0.0392	0.0382	0.0259
FROM LAYER 2	0.0192	0.0344	0.0312	0.0342	0.0419	0.0360
PERCOLATION/LEAKAGE THROUGH	0.0303	0.0129	0.0193	0.0236	0.0189	0.0018
LAYER 3	0.0004	0.0098	0.0043	0.0091	0.0301	0.0182
PERCOLATION/LEAKAGE THROUGH	0.0037	0.0212	0.0142	0.0120	0.0193	0.0318
LAYER 4	0.0289	0.0168	0.0197	0.0143	0.0002	0.0129

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	10.892	4.958	6.930	8.679	6.646	0.607
TOP OF LAYER 3	0.100	3.317	1.425	3.045	11.165	6.523
STD. DEVIATION OF DAILY	0.952	5.774	5.612	2.701	2.360	0.983
HEAD ON TOP OF LAYER 3	0.163	1.229	0.759	0.161	1.139	5.815

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ANNUAL TOTALS FOR YEAR 8

	INCHES	CU. FEET	PERCENT
PRECIPITATION	46.30	168069.000	100.00
RUNOFF	13.674	49638.047	29.53
EVAPOTRANSPIRATION	31.251	113442.344	67.50
DRAINAGE COLLECTED FROM LAYER 2	0.4078	1480.271	0.88
PERC./LEAKAGE THROUGH LAYER 3	0.178740	648.826	0.39
AVG. HEAD ON TOP OF LAYER 3	5.3572		
PERC./LEAKAGE THROUGH LAYER 4	0.195058	708.060	0.42
CHANGE IN WATER STORAGE	0.771	2800.254	1.67
SOIL WATER AT START OF YEAR	9.792	35546.059	
SOIL WATER AT END OF YEAR	9.764	35441.977	

SNOW WATER AT START OF YEAR	0.000	0.000	0.00
SNOW WATER AT END OF YEAR	0.800	2904.338	1.73
ANNUAL WATER BUDGET BALANCE	0.0000	0.020	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 9

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	3.21	1.71	2.95	6.53	5.56	5.54
	2.80	3.39	2.37	2.55	2.78	3.93
RUNOFF	1.813	0.639	4.726	3.810	0.489	0.790
	0.000	0.000	0.000	0.000	0.374	3.020
EVAPOTRANSPIRATION	0.606	0.647	0.369	3.664	4.551	6.424
	4.006	2.614	1.883	1.312	1.057	0.484
LATERAL DRAINAGE COLLECTED	0.0160	0.0074	0.0065	0.0408	0.0381	0.0362
FROM LAYER 2	0.0244	0.0120	0.0125	0.0337	0.0382	0.0402
PERCOLATION/LEAKAGE THROUGH	0.0001	0.0001	0.0017	0.0276	0.0186	0.0163
LAYER 3	0.0008	0.0001	0.0008	0.0078	0.0212	0.0251
PERCOLATION/LEAKAGE THROUGH	0.0261	0.0206	0.0190	0.0004	0.0059	0.0085
LAYER 4	0.0234	0.0211	0.0174	0.0098	0.0004	0.0056

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.027	0.014	0.619	10.205	6.556	5.874
TOP OF LAYER 3	0.255	0.021	0.242	2.595	7.749	9.019
STD. DEVIATION OF DAILY	0.006	0.003	2.389	1.787	2.365	1.868
HEAD ON TOP OF LAYER 3	0.592	0.004	0.593	1.667	2.110	5.189

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ANNUAL TOTALS FOR YEAR 9

	INCHES	CU. FEET	PERCENT
PRECIPITATION	43.32	157251.578	100.00

RUNOFF	15.661	56850.043	36.15
EVAPOTRANSPIRATION	27.616	100247.500	63.75
DRAINAGE COLLECTED FROM LAYER 2	0.3061	1111.066	0.71
PERC./LEAKAGE THROUGH LAYER 3	0.120136	436.093	0.28
AVG. HEAD ON TOP OF LAYER 3	3.5979		
PERC./LEAKAGE THROUGH LAYER 4	0.158179	574.189	0.37
CHANGE IN WATER STORAGE	-0.422	-1531.229	-0.97
SOIL WATER AT START OF YEAR	9.764	35441.977	
SOIL WATER AT END OF YEAR	9.682	35144.980	
SNOW WATER AT START OF YEAR	0.800	2904.338	1.85
SNOW WATER AT END OF YEAR	0.460	1670.104	1.06
ANNUAL WATER BUDGET BALANCE	0.0000	0.004	0.00

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MONTHLY TOTALS (IN INCHES) FOR YEAR 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION	2.04	1.43	3.93	5.25	2.22	4.19
	3.01	1.86	4.40	1.49	2.85	2.87
RUNOFF	1.860	1.002	2.940	2.184	0.000	0.000
	0.000	0.000	0.000	0.000	0.098	0.425
EVAPOTRANSPIRATION	0.357	0.649	1.369	3.618	4.082	5.117
	2.766	2.092	2.402	1.255	0.948	0.601
LATERAL DRAINAGE COLLECTED	0.0240	0.0122	0.0222	0.0398	0.0368	0.0274
FROM LAYER 2	0.0163	0.0081	0.0263	0.0331	0.0363	0.0388
PERCOLATION/LEAKAGE THROUGH	0.0005	0.0001	0.0124	0.0251	0.0155	0.0007
LAYER 3	0.0001	0.0001	0.0060	0.0061	0.0164	0.0225
PERCOLATION/LEAKAGE THROUGH	0.0209	0.0171	0.0101	0.0002	0.0069	0.0198
LAYER 4	0.0187	0.0168	0.0092	0.0094	0.0032	0.0058

MONTHLY SUMMARIES FOR DAILY HEADS (INCHES)

AVERAGE DAILY HEAD ON	0.138	0.023	4.426	9.259	5.378	0.204
TOP OF LAYER 3	0.028	0.014	2.064	1.985	5.955	8.099
STD. DEVIATION OF DAILY	0.541	0.004	5.338	1.597	1.675	0.446
HEAD ON TOP OF LAYER 3	0.006	0.003	1.309	0.082	3.384	5.467

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ANNUAL TOTALS FOR YEAR 10

	INCHES	CU. FEET	PERCENT
PRECIPITATION	35.54	129010.234	100.00
RUNOFF	8.509	30887.676	23.94
EVAPOTRANSPIRATION	25.255	91676.875	71.06
DRAINAGE COLLECTED FROM LAYER 2	0.3212	1165.874	0.90
PERC./LEAKAGE THROUGH LAYER 3	0.105468	382.849	0.30
AVG. HEAD ON TOP OF LAYER 3	3.1309		
PERC./LEAKAGE THROUGH LAYER 4	0.138025	501.031	0.39
CHANGE IN WATER STORAGE	1.316	4778.726	3.70
SOIL WATER AT START OF YEAR	9.682	35144.980	
SOIL WATER AT END OF YEAR	9.696	35196.742	
SNOW WATER AT START OF YEAR	0.460	1670.104	1.29
SNOW WATER AT END OF YEAR	1.762	6397.068	4.96
ANNUAL WATER BUDGET BALANCE	0.0000	0.051	0.00

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AVERAGE MONTHLY VALUES IN INCHES FOR YEARS 1 THROUGH 10

	JAN/JUL	FEB/AUG	MAR/SEP	APR/OCT	MAY/NOV	JUN/DEC
PRECIPITATION						
TOTALS	3.01	2.66	3.42	4.35	3.26	4.12
	3.00	4.27	4.37	3.19	3.43	3.51
STD. DEVIATIONS	1.12	1.06	1.14	1.41	1.46	0.87
	1.32	1.61	2.56	1.51	1.06	1.04

RUNOFF

TOTALS	2.360	2.152	3.574	1.616	0.120	0.079
	0.000	0.015	0.637	0.763	1.827	1.975
STD. DEVIATIONS	1.908	1.123	1.977	1.088	0.259	0.250
	0.000	0.039	1.539	0.920	1.422	1.145

EVAPOTRANSPIRATION

TOTALS	0.548	0.473	0.773	3.436	4.095	5.219
	3.363	3.412	2.542	1.282	1.044	0.551
STD. DEVIATIONS	0.174	0.132	0.377	0.466	0.977	0.966
	1.388	1.235	0.633	0.227	0.098	0.144

LATERAL DRAINAGE COLLECTED FROM LAYER 2

TOTALS	0.0191	0.0114	0.0159	0.0368	0.0364	0.0287
	0.0204	0.0200	0.0282	0.0375	0.0408	0.0384
STD. DEVIATIONS	0.0109	0.0073	0.0115	0.0050	0.0014	0.0036
	0.0047	0.0095	0.0078	0.0035	0.0020	0.0034

PERCOLATION/LEAKAGE THROUGH LAYER 3

TOTALS	0.0037	0.0022	0.0073	0.0219	0.0144	0.0040
	0.0004	0.0037	0.0080	0.0177	0.0275	0.0223
STD. DEVIATIONS	0.0095	0.0047	0.0070	0.0045	0.0034	0.0048
	0.0005	0.0046	0.0074	0.0085	0.0048	0.0061

PERCOLATION/LEAKAGE THROUGH LAYER 4

TOTALS	0.0200	0.2053	0.0691	0.0194	0.0195	0.0244
	0.0244	0.0181	0.0127	0.0053	0.0013	0.0087
STD. DEVIATIONS	0.0109	0.5858	0.1676	0.0512	0.0295	0.0204
	0.0139	0.0107	0.0106	0.0060	0.0028	0.0063

AVERAGES OF MONTHLY AVERAGED DAILY HEADS (INCHES)

DAILY AVERAGE HEAD ON TOP OF LAYER 3

AVERAGES	1.3131	0.8598	2.6024	8.0457	4.9892	1.4026
	0.1101	1.2625	2.8461	6.2301	10.1759	8.0274
STD. DEVIATIONS	3.4182	1.8106	2.5100	1.6839	1.2690	1.7468
	0.1610	1.6092	2.7280	3.1356	1.8478	2.2038

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AVERAGE ANNUAL TOTALS & (STD. DEVIATIONS) FOR YEARS 1 THROUGH 10

	INCHES		CU. FEET	PERCENT
PRECIPITATION	42.59	(3.413)	154598.1	100.00
RUNOFF	15.119	(4.5086)	54883.44	35.501
EVAPOTRANSPIRATION	26.736	(2.2520)	97052.76	62.777
LATERAL DRAINAGE COLLECTED FROM LAYER 2	0.33370	(0.03177)	1211.334	0.78354
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.13311	(0.02877)	483.172	0.31253
AVERAGE HEAD ON TOP OF LAYER 3	3.989	(0.872)		
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.42813	(0.88805)	1554.129	1.00527
CHANGE IN WATER STORAGE	-0.029	(2.0181)	-103.59	-0.067

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PEAK DAILY VALUES FOR YEARS 1 THROUGH 10

	(INCHES)	(CU. FT.)
PRECIPITATION	2.33	8457.899
RUNOFF	2.742	9954.5732
DRAINAGE COLLECTED FROM LAYER 2	0.00143	5.18128
PERCOLATION/LEAKAGE THROUGH LAYER 3	0.001080	3.92079
AVERAGE HEAD ON TOP OF LAYER 3	12.053	
MAXIMUM HEAD ON TOP OF LAYER 3	20.743	
LOCATION OF MAXIMUM HEAD IN LAYER 2 (DISTANCE FROM DRAIN)	124.8 FEET	
PERCOLATION/LEAKAGE THROUGH LAYER 4	0.795167	2886.45581
SNOW WATER	5.36	19465.3867

MAXIMUM VEG. SOIL WATER (VOL/VOL)	0.3989
MINIMUM VEG. SOIL WATER (VOL/VOL)	0.0712

*** Maximum heads are computed using McEnroe's equations. ***

Reference: Maximum Saturated Depth over Landfill Liner
by Bruce M. McEnroe, University of Kansas
ASCE Journal of Environmental Engineering
Vol. 119, No. 2, March 1993, pp. 262-270.

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FINAL WATER STORAGE AT END OF YEAR 10

LAYER	(INCHES)	(VOL/VOL)
1	4.7868	0.3989
2	0.0356	0.6711
3	0.0000	0.0000
4	0.9617	0.0801
SNOW WATER	1.762	

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PRODUCT DATA SHEET

GSE Nonwoven Geotextiles

GSE Nonwoven Geotextiles are a family of staple fiber needlepunched geotextiles. The geotextiles are manufactured using an advanced manufacturing and quality system to produce the most uniform and consistent nonwoven needlepunched geotextile currently available in the industry. GSE combines a fiber selection and approval system with an in-line quality control and a state-of-the-art laboratory to ensure that every roll shipped meets customer specifications.

[*]

AT THE CORE:
A family of geotextiles used for separation, filtration, protection and drainage applications.

Product Specifications

These product specifications meet GRI GT12, GRI GT13 and AASHTO M288

Tested Property(1)	Test Method	Frequency	Minimum Average Roll Value					
			NW4	NW6	NW8	NW10	NW12	NW16
AASHTO M288 Class			3	2	1	>1	>>1	>>>1
Mass per Unit Area, oz/yd²	ASTM D 5261	90,000 ft²	4	6	8	10	12	16
Grab Tensile Strength, lb	ASTM D 4632	90,000 ft²	120	160	220	260	320	390
Grab Elongation, %	ASTM D 4632	90,000 ft²	50	50	50	50	50	50
CBR Puncture Strength, lb	ASTM D 6241	540,000 ft²	303	435	575	725	925	1,125
Trapezoidal Tear Strength, lb	ASTM D 4533	90,000 ft²	50	65	90	100	125	150
Apparent Opening Size, Sieve No. (mm)	ASTM D 4751	540,000 ft²	70 (0.212)	70 (0.212)	80 (0.180)	100 (0.150)	100 (0.150)	100 (0.150)
Permittivity, sec⁻¹	ASTM D 4491	540,000 ft²	1.80	1.50	1.30	1.00	0.80	0.60
Water Flow Rate, gpm/ft²	ASTM D 4491	540,000 ft²	135	110	95	75	60	45
UV Resistance % retained after 500 hours	ASTM D 4355	per formulation		70	70	70	70	70
TYPICAL ROLL DIMENSIONS								
Roll Length(2), ft			850	850	600	500	400	300
Roll Width(2), ft			15	15	15	15	15	15
Roll Area, ft²			12,750	12,750	9,000	7,500	6,000	4,500

NOTES:
- (1)The property values listed are in weaker principal direction. All values listed are Minimum Average Roll Values except apparent opening size in mm and UV resistance. Apparent opening size (mm) is a Maximum Average Roll Value. UV is a typical value.
- (2)Roll lengths and widths have a tolerance of ±1%.

GSE is a leading manufacturer and marketer of geosynthetic lining products and services. We've built a reputation of reliability through our dedication to providing consistency of product, price and protection to our global customers.

Our commitment to innovation, our focus on quality and our industry expertise allow us the flexibility to collaborate with our clients to develop a custom, purpose-fit solution.

GSE ENVIRONMENTAL™

[DURABILITY RUNS DEEP] For more information on this product and others, please visit us at GSEworld.com, call 800.435.2008 or contact your local sales office.

APPENDIX C

PADEP FORM 18R – CLOSURE/POST-CLOSURE LAND USE PLAN

FORM 18R
CLOSURE/POST-CLOSURE LAND USE PLAN

Revised October 2014

Form 18R – Table of Contents

2540-PM-BWM0385 6/2005

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WASTE MANAGEMENT

Date Prepared/Revised October 2014
DEP USE ONLY
Date Received

FORM 18R
CLOSURE/POST-CLOSURE LAND USE PLAN

This form must be fully and accurately completed. All required information must be typed or legibly printed in the spaces provided. If additional space is necessary, identify each attached sheet as Form 18R, reference the item number and identify the date prepared. The "date prepared/revised" on any attached sheets needs to match the "date prepared/revised" on this page.

General References: **287.117, 288.181-2, 288.291-2, 289.171-2, 289.311-2, 295.142**

SECTION A. SITE IDENTIFIER

Applicant/permittee: PPL Montour, LLC

Site Name: Montour Steam Electric Station - Basin 1

Facility ID (as issued by DEP): 301315

SECTION B. CLOSURE PLAN

Identify location of the closure plan in Application: See Attachment 1

Instructions: Narrative shall be submitted describing the activities that are proposed to occur during the post-closure period. Attach appropriate documentation referencing "Form 18R; Closure." The plan shall include:

☒ 1. Plan for decontamination and removal of equipment, structures, and related materials from the facility. ***See Attachment 1***

☒ 2. An estimate of the year in which final closure will occur, including an explanation of the basis for the estimate. ***See Attachment 1***

☒ 3. If the facility will close in stages, a description of how and when the facility will begin and implement partial closure (schedule for closure). ***See Attachment 1***

☒ 4. A description of the steps necessary for closure if the facility closes prematurely. ***See Attachment 1***

☒ 5. A narrative description, including a schedule, of measures that are proposed to be carried out after closure at the facility, including measures relating to:

a. Water quality monitoring. ***See Attachment 1***
b. Gas control and monitoring. ***See Attachment 1***
c. Leachate collection, treatment, and pumping. ***See Attachment 1***
d. Erosion and sedimentation control. ***See Attachment 1***
e. Revegetation including maintenance of the final cover. ***See Attachment 1***
f. Access control. ***See Attachment 1***
g. Other maintenance activities. ***See Attachment 1***

☒ 6. Description of means by which funds will be made available to cover cost of post closure operations, which shall include an assessment of projected post-closure maintenance costs, a description of how the necessary funds will be raised, a description of relevant legal documents, and a description of how the funds will be managed prior to closure. ***See Attachment 1***

☒ 7. The name, address, and telephone number at which the operator can be reached during the post-closure period.

See Attachment 1

SECTION C. POST-CLOSURE LAND USE PLAN

Identify location of post-closure land use plan in Application: See Attachment 1

Instructions: Narrative shall be submitted which contains a detailed description of the proposed use of the proposed facility following closure, including a discussion of the utility and capacity of the revegetated land to support a variety of alternative uses, and the relationship of the use to existing land use policies and plans. Attach appropriate documentation referencing "Form 18R; Closure."

☒ 1. How the proposed post-closure land use is to be achieved and the necessary support activities which may be needed to achieve the proposed land use. ***See Attachment 1***

☒ 2. The consideration which has been given to making the proposed post-closure land use consistent with landowner plans and applicable State and local land use plans and programs. ***See Attachment 1***

ATTACHMENT 1

Form 18R Narrative for Major Permit Modifications

ATTACHMENT 1

FORM 18R NARRATIVE FOR DESIGN CHANGES

PPL Montour, LLC (PPL) operates the Montour Steam Electric Station (MSES) located in Derry Township, Montour County, Pennsylvania. Basin No. 1 was constructed to dispose of coal combustion residuals (CCRs) and to treat wastewater at the MSES. Virtually all of the CCRs generated by MSES are beneficially used. Currently, only incidental quantities of bottom ash carried over from the bottom ash/sluice water separation system are added to Basin No. 1. This Major Permit Modification Application is being submitted for design changes to the Permit No. 301315 for Basin No. 1. The modification revises the proposed final grades within the currently permitted Basin No. 1 area, which will be accomplished by placement of conditioned fly ash (fly ash conditioned with moisture). This Major Permit Modification Application also requests equivalency for an alternative final cover system. A surface water management system will include a lined perimeter channel and sedimentation pond within Basin No. 1.

NARRATIVE SHALL BE SUBMITTED DESCRIBING THE ACTIVITIES THAT ARE PROPOSED TO OCCUR DURING THE POST-CLOSURE PERIOD.

SECTION B: CLOSURE PLAN

B1. Plan for decontamination and removal of equipment, structures, and related materials from the facility.

Basin No. 1 does not accept waste streams that would necessitate having to decontaminate disposal equipment or structures, hence, no decontamination procedures will need to be implemented upon closure. The mobile, vibratory screens, and conveyors used to process the bottom ash will be decommissioned and moved from the facility.

B2. An estimate of the year in which final closure will occur, including an explanation of the basis for the estimate.

The modification revises the proposed final grades within the currently permitted Basin No. 1 area, which will be accomplished by placement of conditioned fly ash. The proposed grades are maximum grades based on conditioned fly ash generation during the 10-year permit length. Based on the estimated remaining capacity of 1,346,900 cubic yards, the facility has the capacity to operate through 2025. The life expectancy is an estimate and is subject to change based on the availability of conditioned fly ash which is influenced by the amount of coal burned at MSES, the ash content of the coal, and the quantity of ash beneficially used at other off-site locations.

B3. If the facility will close in stages, a description of how and when the facility will begin and implement partial closure (schedule for closure)

The final cover system installation will begin after conditioned fly ash placement is completed. The final cover system installation will occur in phases over 5 years as presented on Permit Drawing E377134, Sheet 9.

B4. A description of the steps necessary for closure if the facility closes prematurely.

If the facility closes prematurely, it will likely be necessary to redesign the closure grading plan including a redesign of the erosion and sedimentation control facilities. This is because the grading plans are dependent on the amount of conditioned fly ash expected to be placed in the facility prior to closure. Prior to facility closure, PPL will decommission the bottom ash processing area and dewatering troughs. PPL will place conditioned fly ash as needed within the basin, so that the basin drains to the perimeter channels and ultimately to a sedimentation pond. Prior to closure, conditioned fly ash will be placed in the open water area of Sub-Basin B to facilitate drainage in this area. The conditioned fly ash will be placed to provide a minimum slope of 1 percent to promote long term drainage from the final cover system.

The sedimentation pond will be constructed in Sub-Basin C. Sub-Basin C will temporarily be dewatered for construction of the sedimentation pond. A structural fill embankment will be constructed and will serve as the northern pond embankment and the southern limit of Basin No. 1. CCRs that have accumulated in the proposed sedimentation pond area will be removed and placed to the north of the embankment, within the Basin No. 1 area. When Sub-Basin C is dewatered, the necessary modifications will be made to the existing outlet structure. After construction of the embankment, the perimeter channels will be extended to discharge into the sedimentation pond.

The final cover system will be installed, and the diversion berm will be constructed.

B5. A narrative description, including a schedule, of measures that are proposed to be carried out after closure at the facility, including measures relating to:

a. Water quality monitoring

Water quality monitoring will continue for the facility's monitoring wells, monitoring points, and storm water outfall in accordance with the residual waste regulations and NPDES regulations. Unless requested and approved by the PADEP, water quality monitoring procedures after closure will be the same as those implemented while the facility was in operation. The quarterly groundwater sampling schedule will be maintained.

b. Gas control and monitoring

This facility manages CCRs which do not generate gasses. Gas control monitoring is not required for this facility.

c. Leachate collection, treatment, and pumping

Basin No. 1 does not have a liner or leachate collection and treatment system.

d. Erosion and sedimentation control

An erosion and sedimentation control plan has been prepared for the facility and is included in the Surface Water Management Plan and Soil Erosion and Sedimentation Control Plan, which is an Attachment to the Form I. During closure of the facility, the main erosion and sedimentation control measure implemented will be the establishment of permanent vegetation on the cover soil. Inspection of the surface water and erosion controls will be continued.

e. Revegetation including maintenance of the final cover

Permanent vegetation will be established on the final cover system. Areas with inadequate vegetative cover will be reseeded. If necessary, eroded cover soil will be replaced, surfaces regraded and soil amendments, seed and/or mulch will be applied. To the extent possible, and if practical, revegetation work will be done in a manner that avoids disturbance of existing vegetation. Damage to cover by burrowing animals will be controlled and repaired as needed.

f. Access control

The access control measures currently implemented for the active basin will be continued after the basin is closed. The entrances from Strawberry Ridge Road on the east and SR 1003 on the west are gated and padlocked to prevent unauthorized access. The dikes limit vehicle access to the basin.

g. Other maintenance activities.

Inspection of the surface water and erosion controls will be continued and maintenance will be performed as necessary. Inspections will be performed semi-annually and after unusually heavy rainfalls (greater than 2-inches of rain in a 24 hour period). During the inspections, the final cover soil and basin dike slope will be inspected for erosion, sliding, and the condition of the vegetation. Channels and culverts will be inspected and any sediment/debris that has accumulated will be removed. Any sediment/debris that has accumulated in the spillway structures will be removed, and repairs will be made as necessary to maintain design capacity. The procedures are presented in the Surface Water Management Plan and Soil Erosion and Sedimentation Control Plan, which is included as an Attachment to the Form I.

B6. Description of means by which funds will be made available to cover cost of post closure operations, which shall include an assessment of projected post-closure maintenance costs, a description of how the funds will be raised, a description of relevant legal documents, and a description how the funds will be managed prior to closure.

PPL or its successor(s) will maintain ownership of its closed waste disposal facilities. The Power Plant associated with each disposal facility has money budgeted each year for maintenance of the disposal facility. It is expected that maintenance costs will be less for the disposal facility after it is closed than when it was active. Current maintenance costs budgeted for Basin No. 1 exceeds $25,000 per year. Monitoring costs, primarily related to the ground water wells, will continue to be PPL or its successor(s) responsibility.

B7. The name, address, and telephone number at which the operator can be reached during the post-closure period.

John Weeks
Plant Manager – Fossil Generation
PPL – Montour SES
P.O. Box 128
Washingtonville, PA 17884
Telephone (717)-437-1201

SECTION C: POST-CLOSURE LAND USE PLAN

NARRATIVE SHALL BE SUBMITTED WHICH CONTAINS A DETAILED DESCRIPTION OF THE PROPOSED USE OF THE PROPOSED FACILITY FOLLOWING CLOSURE, INCLUDING A DISCUSSION OF THE UTILITY AND CAPACITY OF THE REVEGETATED LAND TO SUPPORT A VARIETY OF ALTERNATIVE USES, AND THE RELATIONSHIP OF THE USE TO EXISTING LAND USE POLICIES AND PLANS.

C1. How the proposed post-closure land use is to be achieved and the necessary support activities which may be needed to achieve the proposed land use.

The anticipated post-closure land use is open space (meadow). This will be the end result of the post-closure soil cover and vegetation work. All CCRs including conditioned fly ash will be covered with a final cover system, which includes 1-foot of final cover soil. The final cover soil will be seeded to establish a vegetative cover. No support activities are necessary to achieve the intended use.

C2. The consideration which has been given to making the proposed post-closure land use consistent with landowner plans and applicable state and local land use plans and programs.

The basin is a captive disposal impoundment owned and operated by PPL. After closure it will be owned and maintained by PPL or its successor(s). The anticipated use will be open space (meadow). The land may also be used for Power Plant needs that will not compromise the integrity of the cap or cover over the basin.

The closed impoundment will be maintained in compliance with applicable state and local land use plans and programs.