CCR RULE COMPLIANCE

BOTTOM ASH PONDS
INFLOW DESIGN FLOOD CONTROL SYSTEM
INITIAL PLAN

Prepared for:

NRG Power Midwest LP
Cheswick Generating Station
Springdale, Pennsylvania

Prepared by:

CB&I Environmental & Infrastructure, Inc.
Pittsburgh, Pennsylvania 15235

October 2016

Table of Contents

1.0 Introduction

On December 19, 2014, the Administrator of the United States Environmental Protection Agency signed the Disposal of Coal Combustion Residuals (CCR) from Electric Utilities final rule (the Rule). The Rule was published in the Federal Register on April 17, 2015, became effective on October 19, 2015, and is contained within amended portions of Title 40, Part 257 of the Code of Federal Regulations (CFR). The Rule establishes a comprehensive set of requirements for the disposal/management of CCR in landfills and surface impoundments at coal-fired power plants under Subtitle D of the Resource Conservation and Recovery Act. These requirements include compliance with location restrictions, design criteria, operating criteria, groundwater monitoring and corrective action criteria, and closure and post-closure care aspects.

Included with the operating criteria under 40 CFR §257.82 are requirements to prepare an initial inflow design flood control system plan (Plan) and subsequent periodic Plans for all existing, new, or expanded CCR surface impoundments. Pursuant to the Rule, this Plan is to serve as documentation by a professional engineer that the CCR unit is designed, constructed, operated, and maintained with an inflow design flood control system that will adequately manage flow into and from the CCR unit under the peak discharge conditions of the design flood. The specific design flood under which each CCR unit must be evaluated is based on the hazard potential classification of the impoundment as determined pursuant to §257.73(a)(2). Further details regarding the required content and criteria for the Plan (pursuant to §257.82[c]) are provided in Section 2.0 of this document. The initial Plan must be prepared no later than October 17, 2016, and periodic Plans must be prepared every 5 years thereafter.

The Cheswick Generating Station (Station) is a coal-fired power plant operated by NRG Power Midwest LP (a subsidiary of NRG Energy, Inc. [NRG]) and located in Springdale, Pennsylvania. The Station has two surface impoundments that are subject to this Rule, specifically identified as the Bottom Ash Recycle Pond and the Bottom Ash Emergency Pond. The ponds are utilized as part of bottom ash management operations, and receive ash transport water via gravity flow from nearby hydrobins. Accumulated bottom ash is removed from the ponds during periodic cleanout activities and is transported to the Station's CCR landfill (the Cheswick Ash Disposal Site) for disposal. The Bottom Ash Recycle Pond serves as the primary impoundment. The Bottom Ash Emergency Pond receives ash transport water on a temporary basis during cleanout of the Bottom Ash Recycle Pond (which occurs at least once a year and as needed), or as overflow from the Bottom Ash Recycle Pond. The Station and the two bottom ash ponds are shown on Figure 1.

NRG engaged the services of CB&I Environmental & Infrastructure, Inc. (CB&I) to develop an initial Plan for both of the bottom ash ponds. This Plan development followed the review of available background and design information and a field visit conducted on May 31, 2016.

Additionally, development of this Plan occurred following an Initial Hazard Potential Classification completed by CB&I, and documented under separate cover in October 2016.

Beyond this introductory section of the Plan, Section 2.0 outlines the regulatory requirements of §257.82; Section 3.0 describes the hydrologic and hydraulic evaluation performed for the subject impoundments, and Section 4.0 provides conclusions and recommendations regarding the adequacy of the impoundments to manage the specified flood conditions. Section 5.0 contains the professional engineer certification, and Section 6.0 lists the references that were consulted during development of this Plan.

As required, this Plan will be appropriately placed in the facility's operating record pursuant to §257.105(g)(4), noticed to the State Director per §257.106(g)(4), and posted to the publicly accessible internet site pursuant to §257.107(g)(4).

2.0 Hydrologic and Hydraulic Capacity Requirements of 40 CFR §257.82

The Rule requires owners or operators of any existing CCR surface impoundment to design, construct, operate, and maintain an inflow design flood control system (Federal Register, 2015). The ability of the system to meet these requirements must be demonstrated in the form of an inflow design flood control system Plan.

2.1 Demonstration of the Adequacy of the Inflow Design Flood Control System

Pursuant to §257.82(a)(1)-(2), the design flood control system must:

- *Adequately Manage Flow Into the CCR Unit* – The inflow design flood control system must adequately manage flow into the CCR unit during and following the peak discharge of the inflow design flood.
- *Adequately Manage Flow From the CCR Unit* – The inflow design flood control system must adequately manage flow from the CCR unit to collect and control the peak discharge resulting from the inflow design flood.

Pursuant to §257.82(a)(3), the inflow design flood that must be managed is based on the type of impoundment (incised or non-incised) and hazard potential classification as determined in accordance with §257.73(a)(2). The impoundment types and classifications and the associated inflow design floods are as follows:

- *Incised CCR Surface Impoundment* – A 25-year design flood applies to an incised CCR surface impoundment.
- *Low Hazard Potential CCR Surface Impoundment* – A 100-year design flood applies to a (non-incised) Low Hazard CCR surface impoundment.
- *Significant Hazard Potential CCR Surface Impoundment* – A 1000-year design flood applies to a (non-incised) Significant Hazard CCR surface impoundment.
- *High Hazard Potential CCR Surface Impoundment* – The probable maximum flood applies to a (non-incised) Significant Hazard CCR surface impoundment.

Since the subject ponds are partially-diked, Low Hazard (refer to Section 3.3) impoundments, the 100-year design flood applies. Pursuant to §257.82(c), discharge from the CCR unit must be handled in accordance with the surface water requirements of §257.3-3 (i.e., the discharge must be authorized under the National Pollutant Discharge Elimination System [NPDES] program). Flow from these ponds is discharged in accordance with the Station's NPDES permit No. PA0001627 issued by the Pennsylvania Department of Environmental Protection (PADEP).

2.2 Inflow Design Flood Control System Plan

The Rule requires preparation of an initial Plan and periodic Plans to document the adequacy of the inflow design flood control system. The Plan must be supported by appropriate engineering calculations per §257.82(c)(1) and be certified by a qualified professional engineer in accordance with §257.82(c)(5).

3.0 Hydrologic and Hydraulic Evaluation

Confirmation of the adequacy of the inflow design flood control system was performed via a hydrologic and hydraulic evaluation conducted by CB&I. The overall effort consisted of four main activities, including: (1) review of background and design information, (2) a site visit, (3) development of a hazard potential classification (provided under separate cover in a report by CB&I dated October 2016, but referenced herein), and (4) preparation of stormwater calculations. These activities are described in the sections below.

3.1 Review of Background and Design Information

Prior to the field visit, CB&I collected and reviewed available background and design information regarding the impoundments and surrounding area, including mapping, aerial images, and reports and other documents provided by NRG. Mapping and aerial images were utilized to prepare Figures 1 through 3 included with this Plan. Pertinent information identified during development of the figures included ground surface elevations and topography, surface water features, and pond design information (such as geometry, crest elevations, operating water levels, and inflow and outflow features).

The impoundments are situated in a valley along Tawney Run (a tributary of the Allegheny River), and are incised on the west and diked on the east. They are located on a parcel in the northern reaches of the Station property, and are separated from the majority of the Station by Pittsburgh Street, a state-owned road that is maintained by the Pennsylvania Department of Transportation (PennDOT). The southernmost limits of the Bottom Ash Recycle Pond and Bottom Ash Emergency Pond footprints are approximately 1000 and 800 feet away from Pittsburgh Street, respectively.

Topographic information for the subject area was obtained from LIDAR mapping (PA Department of Conservation and Natural Resources, 2006). The ground surface in the vicinity of the impoundments slopes toward Tawney Run (located approximately 50 feet east of the impoundments) and southward toward the Allegheny River (located approximately 0.4 to 0.5 miles from the impoundments), and is situated on a hillside bench between contour elevations 770 and 780 feet mean sea level (ft msl). Runoff from properties uphill and to the west of the impoundments is routed around the impoundments and toward Tawney Run via a diversion channel, swales, and grading.

Google Earth imagery (Google Earth, 2016) was consulted to check select elevations. Google Earth indicated a typical elevation of 779 ft msl around the crests of both impoundments, which is in agreement with the crest elevations identified in the 1977 design plans (Duquesne Light Company Engineering and Construction Division, Revised 1977). This elevation is higher than those indicated by the 2006 LIDAR mapping, and appears reflective of NRG's regrading and placement of fill around the basins to eliminate low areas in accordance with a 2014 Action Plan.

Pond design information was obtained from drawings and previous reports provided by NRG. The Bottom Ash Recycle Pond has a normal operating capacity of 1.045 million gallons (3.2 ac-ft) while the Bottom Ash Emergency Pond has a capacity of 1.618 million gallons (5.0 ac-ft) (Peck, 1972). The ponds are connected by two 14-inch overflow pipes such that the ponds provide overflow capacity for each other. The ponds are operated so as to keep a relatively constant water level for the pond that is in service. For the Bottom Ash Recycle Pond, the operating water level is approximately 777 feet, while for the Bottom Ash Emergency Pond, the operating water level is approximately 775.5 feet (O'Brien & Gere, 2014).

The primary inflow to the ponds is ash transport water that gravity drains via piping from nearby hydrobins located just across Tawney Run. Under typical conditions, the ash transport water enters the Bottom Ash Recycle Pond via piping along the northern pond perimeter. When the Bottom Ash Recycle Pond is out of service for cleaning or maintenance, the ash transport water is directed to the Bottom Ash Emergency Pond via piping and an effluent weir along the northern side of the pond. Some additional water is introduced to the ponds via precipitation, but this is generally limited to water falling directly within the pond footprints due to the grading around the ponds.

Outflow from both ponds is sent to a common concrete stilling basin and adjacent pump station located just south of the Bottom Ash Recycle Pond. From the Bottom Ash Recycle Pond, decant water flows over a saw tooth effluent weir at the southern end of the pond, passing through NPDES Internal Monitoring Point (IMP) 303 on its way to the stilling basin. Water from the Bottom Ash Emergency Pond enters the stilling basin via IMP-203 after discharge from the southern end of the pond over an effluent trough and subsequent gravity flow through a pipe located along the western side of the pond. From the stilling basin, the water is pumped southward toward the Allegheny River and is ultimately discharged to the river via Outfall 003.

3.2 Field Visit

On May 31, 2016, Laurel Lopez (CB&I senior engineer) met with Jill Buckley (NRG Environmental Specialist) to perform a site walk and visual reconnaissance of the ponds and surrounding area. The visit was conducted to support CB&I's hazard assessment of the impoundments (provided under separate cover) and the hydrologic and hydraulic evaluation performed herein. CB&I walked the perimeter of the ponds and confirmed that inlet/outlet piping and structures appeared to be in agreement with the previously reviewed reports and documents. The Bottom Ash Recycle Pond was in use and appeared to be at normal operating water level (with water levels near the top of weir elevation). The Bottom Ash Emergency Pond was in standby mode.

As part of the hydrologic and hydraulic evaluation, CB&I visually assessed upstream conditions for run-on potential. A small diversion channel was observed running along the bottom of the hillside west of the Bottom Ash Recycle Pond, to intercept flow and convey it around the northern side of the pond, into a culvert, and ultimately to Tawney Run. Swales and grading around the Bottom Ash Emergency Pond appeared to direct potential run-on around both the northern and southern sides of the pond. In addition, a gravel surface around the ponds was noted to serve the dual purpose of providing an access road and crest, and was sloped away from the ponds, further limiting the potential for run-on.

3.3 Hazard Potential Classification

Based on the review of background information and field observations, CB&I assigned a Low Hazard rating to both of the subject ponds. A full discussion of the process and rationale for this assignment is provided in a report entitled, "Bottom Ash Ponds Hazard Potential Classification Initial Assessment Report" (CB&I, 2016). The Low Hazard rating for each pond is based on the determination that a failure or mis-operation of these impoundments would be unlikely to cause a loss of human life and would cause minor economic or environmental losses principally limited to the surface impoundment owner's property. In addition, a failure or mis-operation would be unlikely to impact lifeline or critical facilities or cause other significant negative effects.

3.4 Hydrologic Calculations

As noted previously, the ponds are operated so as to maintain constant operating water levels. Under normal operating conditions, this is accomplished by application of pond inflow rates that are below the capacity of the pond outfall structures with very minimal increases in water levels, such that pond outflow equals pond inflow. Accordingly, the water level rises to just slightly (less than a few inches) above the crest of the effluent weir, and discharge occurs until the water level drops and becomes approximately equal to the crest of the effluent weir. For practical purposes, the normal operating water level for each pond is approximately equal to the crest of the effluent weir structure.

These calculations consider the capacity of each pond to contain stormwater from the inflow design flood. For the modeling of each pond, it is assumed that the pond is filled to its normal water operating level when the design flood occurs. The design flood is assumed to be equivalent to the design storm, since hydrologic analyses are based upon storm events rather than floods. If the available capacity of the pond between the operating water level and the crest is determined to be greater than the design storm inflow volume, the flood control system is deemed adequate to manage the flow into the pond during and following the inflow design storm. Under these conditions, the storm water inflow would temporarily raise the water level of the subject pond above the normal operating level, but would not overtop the basin crest. Conservatively, these calculations consider each pond's capacity to temporarily hold the entire storm event inflow volume. In actuality, pond discharge would occur during the storm event and the entire storm inflow volume would not need to be held at once. As an extra level of protection, overflow pipes connecting the two ponds enable the inactive pond to provide additional overflow capacity for the active pond.

Attachment A provides calculations showing the capability of each pond to hold the contents of a 24-hour, 100-year design storm within the volume between its operating water level and crest. The point precipitation associated with the specified storm event is 5.05 inches (NOAA, 2016). Since each pond is graded to limit stormwater inflow to precipitation falling directly within the pond footprint, a direct computation of inflow volume was performed as the precipitation depth for the inflow design storm times the area of the pond at its crest elevation. The available volume between the operating water level and crest elevation for each pond was computed using the areas at each elevation (determined via CAD and shown on Figure 3), freeboard height, and the average end area method. The inflow volume and available volume were computed and compared for each pond. These calculations show the available capacity for stormwater inflow to be adequate for both of the ponds. For the 100-year storm event, it is estimated that only about 22 and 13 percent of the pond volume above the operating water level would be used for the Bottom Ash Recycle Pond and Bottom Ash Emergency Pond, respectively.

3.5 Pond Outflow Considerations

Following the design storm event, the pond water level would gradually return to its normal operating water level via the regular discharge process (pumping to the Allegheny River). The additional volume would be adequately managed by the existing pond discharge structures. There would be no discharges from either pond other than via the permitted outfall. This discharge would occur in a controlled manner, and would not result in any adverse downstream impacts. As a result, the inflow design flood control system adequately manages flow from each CCR unit that results from the inflow design storm.

4.0 Conclusions and Recommendations

Based upon observations, review of information, and the hydrologic and hydraulic analyses described herein (and associated calculations contained in Attachment A), the subject ponds have flood control systems that are adequate to manage flow into and from the units under the applicable inflow design flood. All outflow from the ponds will be via an approved NPDES outfall.

These conclusions are based upon the background information provided to CB&I by NRG and field observations made around the time of the Plan preparation. The applicability of these results is dependent upon the ongoing operation and maintenance of the ponds in accordance with design documents and appropriate operating procedures. Any deviations from the crest elevations or operating conditions presented in this Plan would warrant a re-evaluation of the ponds to ensure adequate available capacity for stormwater inflow. Such a re-evaluation would fall under the provisions of §257.82(c)(2), which stipulate that the Plan must be amended whenever significant changes in CCR unit configuration/operation affect the validity of the Plan that is currently in effect. Once completed, the amended Plan must be appropriately placed into the facility's operating record. As a matter of routine maintenance/inspection, any areas of settlement, depressions, ruts, or similar features along the crest shall be regraded and filled as needed. In addition, the integrity of the grading and diversion channels around the ponds should be periodically inspected to ensure their continued functionality.

5.0 Professional Engineer Certification

I attest to being familiar with the hydrologic and hydraulic capacity requirements of 40 CFR §257.82. I have personally visited and examined the Cheswick Generating Station Bottom Ash Ponds, and have reviewed available design and operational information for the ponds as provided by NRG. Based my observations, review of information, and analyses, the subject ponds have flood control systems that are adequate to manage flow into and from the units under the applicable inflow design flood. Further, this document serves as the Inflow Design Flood Control System Initial Plan and meets the applicable requirements of §257.82(c). I hereby certify that the information contained in this Plan is true and accurate to the best of my belief.

Name of Professional Engineer: Laurel C. Lopez

Company: CB&I Environmental & Infrastructure, Inc.

Signature: Laurel C Lopez

Date: 10-13-16

PE Registration State: Pennsylvania

PE Registration Number: PE-055673-E

Professional Engineer Seal:

COMMONWEALTH OF PENNSYLVANIA
REGISTERED
PROFESSIONAL
LAUREL C. LOPEZ
ENGINEER
PE-055673-E

Laurel C Lopez
10-13-16

6.0 References

CB&I. “Bottom Ash Ponds Hazard Potential Classification Initial Assessment Report.” October 2016.

Duquesne Light Company Engineering and Construction Division. “Cheswick Power Station Bottom Ash Water Recycle System.” Design Drawing No. 9853-B1. Approved July 7, 1971. Last Revised June 30, 1977.

Duquesne Light Company Engineering and Construction Division. “Cheswick Power Station Bottom Ash Water Recycle System.” Design Drawing Nos. 9853-B9, B10, B11, & B13. Approved July 14, 1971. Last Revised May 22, 1972.

Duquesne Light Company Engineering and Construction Division. “Cheswick Power Station Bottom Ash Water Recycle System.” Design Drawing No. 9853-B12. Approved July 14, 1971. Last Revised June 7, 1972.

Federal Emergency Management Agency (FEMA). “National Flood Hazard Layer.” Allegheny County, Pennsylvania. January 27, 2015.

Federal Register, Vol. 80, No. 74. Section 257.82 (Hydrologic and Hydraulic Capacity Requirements for CCR Surface Impoundments). April 17, 2015.

Geosyntec. “Assessment Report, Cheswick Power Station – Bottom Ash Ponds.” February 7, 2013.

Google Earth. Imagery for Cheswick, Pennsylvania. Dated April 17, 2016.

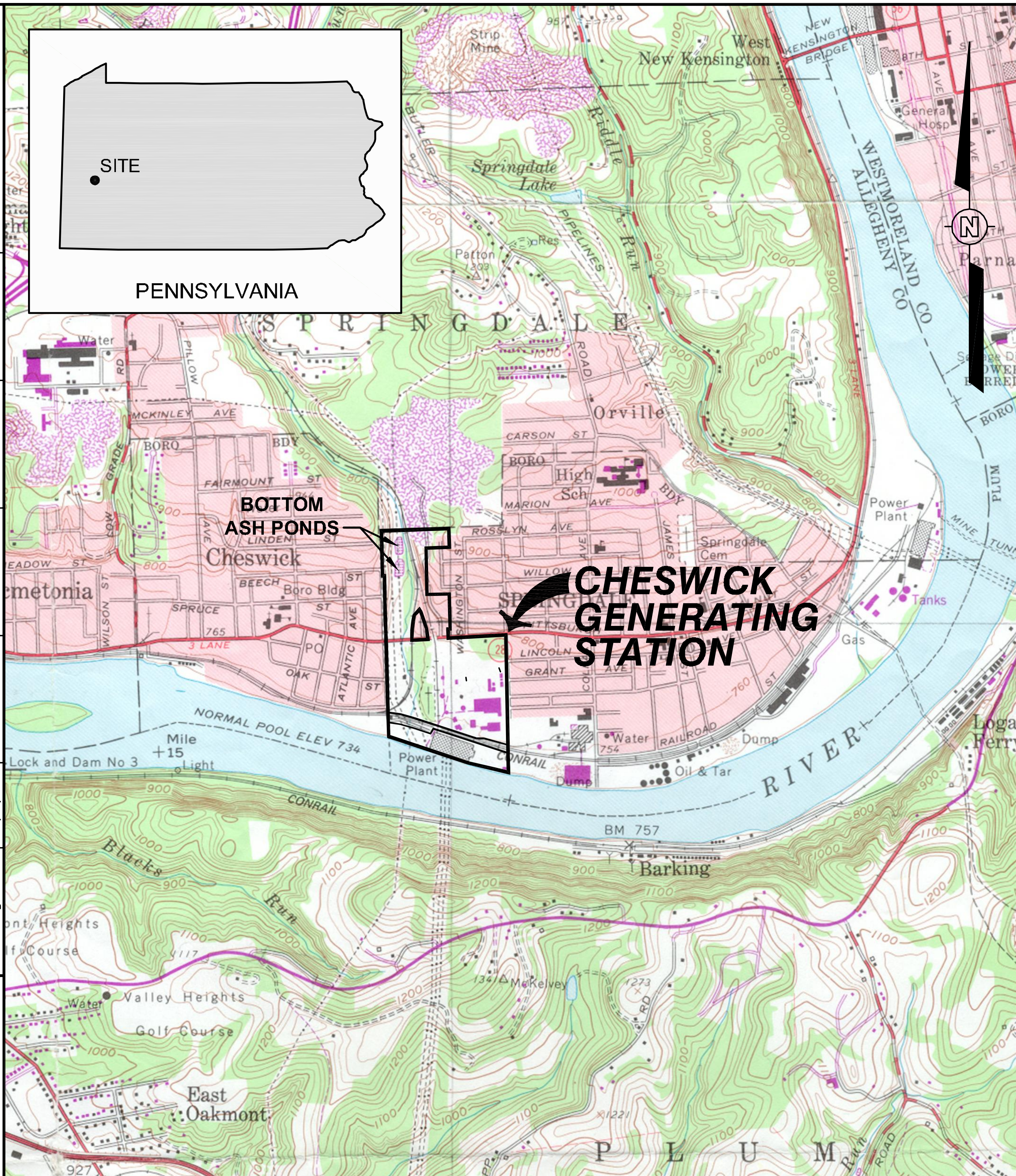
NOAA. “Point Precipitation Frequency (PF) Estimates, Springdale, PA.” NOAA Atlas 14, Vol. 2, Version 3. Accessed July 26, 2016.

O’Brien & Gere. “Dam Safety Assessment of CCW Impoundments, NRG Cheswick Power Station.” Prepared for the United States Environmental Protection Agency. January 24, 2014.

Peck, David F. “Industrial Waste Permit Application, Duquesne Light Company, Cheswick Power Station, Bottom Ash Wastewater Treatment Facilities.” Submitted to the State of Pennsylvania Department of Environmental Resources. July 1972.

Pennsylvania Department of Conservation and Natural Resources, Bureau of Topographic and Geologic Survey. LIDAR Mapping. PA Map Program. April 2006.

Figures



S C A L E

0 2000 4000 FEET

CB&I
500 Penn Center Boulevard, Suite 1000
Pittsburgh, Pennsylvania

nrg.

FIGURE 1

SITE LOCATION MAP

CHESWICK GENERATING STATION
SPRINGDALE, ALLEGHENY COUNTY, PENNSYLVANIA

REFERENCE:

U.S.G.S. 7.5–MINUTE TOPOGRAPHIC MAP NEW KENSINGTON WEST PENNSYLVANIA QUADRANGLE, DATED 1960, PHOTOREVISED: 1979
SCALE: 1"=2000'.

OFFICE	DATE	DESIGNED BY	DRAWN BY	CHECKED BY	APPROVED BY	DRAWING NUMBER
Pittsburgh, PA	10/4/16	LCL	ELS	DJS	LCL	1009134004-A1

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Plotted By: Evan.Schlegel

LEGEND:

APPROXIMATE STATION PROPERTY BOUNDARY

EXISTING DRAINAGE CHANNEL OR SWALE

SCALE 0 100 200 300feet

REFERENCE:

GOOGLE EARTH AERIAL PHOTOGRAPH DATED 4/17/2016.

REV	DESCRIPTION / ISSUE	DATE	APPROVED

CB&I
500 Penn Center Boulevard, Suite 1000
Pittsburgh, Pennsylvania 15235

nrg.

DESIGNED BY: LCL
DRAWN BY: ELS
CHECKED BY: DJS
APPROVED BY: LCL

FIGURE 2
PHOTOGRAPHIC MAP
CHESWICK GENERATING STATION
SPRINGDALE, ALLEGHENY COUNTY, PENNSYLVANIA

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OFFICE Pittsburgh, PA
DRAWING NUMBER 1009134004-B1

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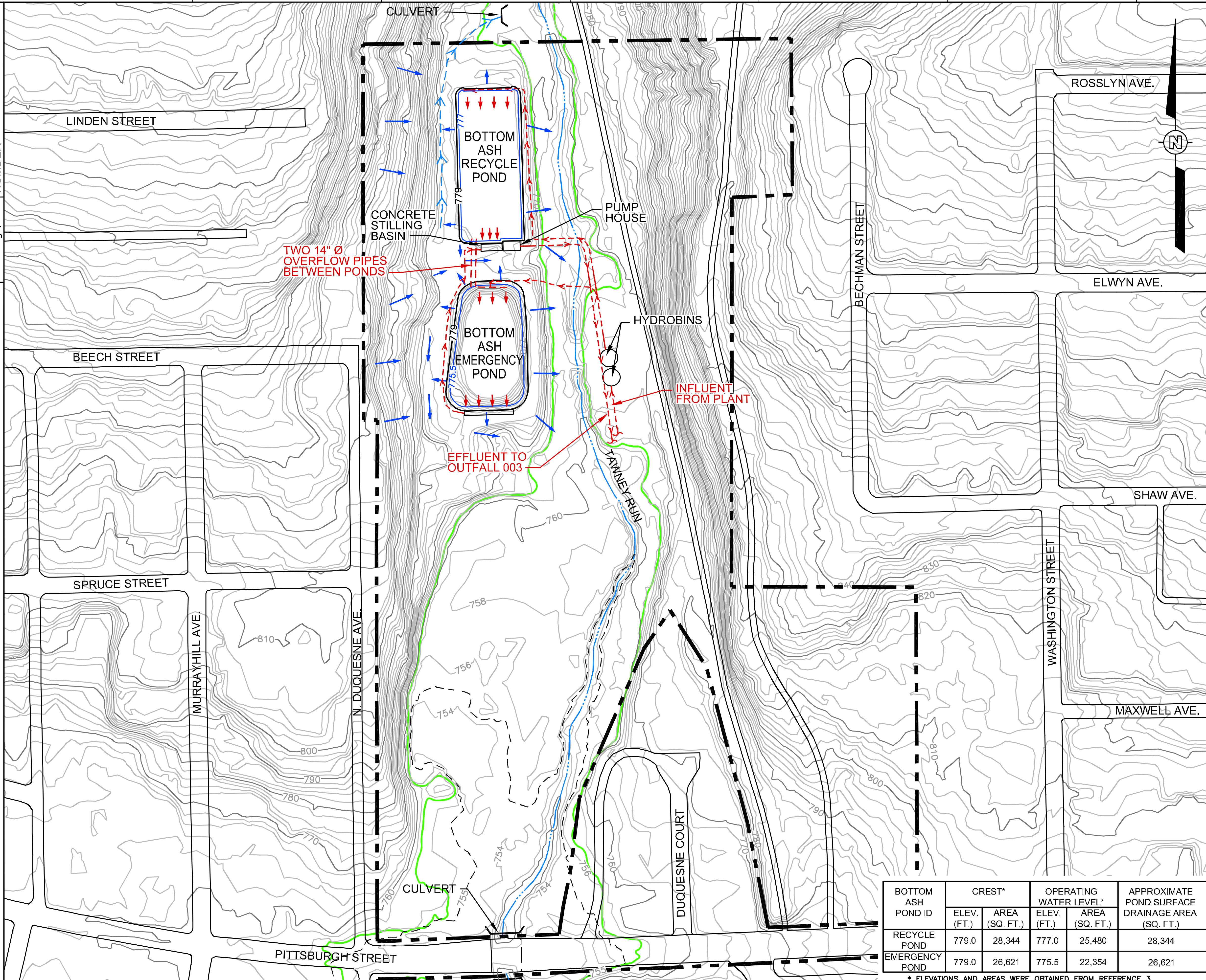

LEGEND:

- APPROXIMATE STATION PROPERTY BOUNDARY
- 760 — 2-FOOT TOPOGRAPHIC CONTOUR (REFERENCE 1)
- 755 — APPROXIMATE TOPOGRAPHIC CONTOUR (INTERPOLATED FROM REFERENCE 1)
- EXISTING STREAM
- SURFACE WATER FLOW DIRECTION
- FEMA SPECIAL FLOOD HAZARD AREA (SFHA) LIMITS (REFERENCE 2)
- DRAINAGE CHANNEL OR SWALE (APPROXIMATE LOCATION)
- 779 — APPROXIMATE RESTORED CREST (REFERENCE 3)
- 779 — APPROXIMATE POND NORMAL OPERATING WATER LEVEL ELEVATION (REFERENCE 3)
- APPROXIMATE ASH PROCESS WATER FLOW DIRECTION

SCALE 0 80 160 240 FEET

REFERENCES:

1. GROUND SURFACE CONTOURS WERE OBTAINED FROM PAMAP PROGRAM, PA DEPARTMENT OF CONSERVATION AND NATURAL RESOURCES, BUREAU OF TOPOGRAPHIC AND GEOLOGIC SURVEY, LIDAR MAPPING, COLLECTED 4/2006.
2. SFHA LIMITS WERE OBTAINED FROM FEMA, NATIONAL FLOOD HAZARD LAYER, ALLEGHENY COUNTY, PA, 01/27/2015.
3. APPROXIMATE RESTORED CREST ELEVATIONS AND NORMAL WATER OPERATING LEVEL ELEVATIONS FOR THE PONDS WERE OBTAINED FROM "CHESWICK POWER STATION BOTTOM ASH WATER RECYCLE SYSTEM, DESIGN DRAWING NO. 9853-B1", BY DUQUESNE LIGHT COMPANY, LAST REVISED 6/30/1977.
4. PROCESS WATER FLOW DIRECTIONS WERE OBTAINED FROM O'BRIEN & GERE DRAWINGS: "BOTTOM ASH RECYCLE POND PHOTO LOCATION MAP" AND "EMERGENCY ASH POND PHOTO LOCATION MAP", DATED JANUARY 2014.

BOTTOM ASH POND ID	CREST*		OPERATING WATER LEVEL*		APPROXIMATE POND SURFACE DRAINAGE AREA (SQ. FT.)
	ELEV. (FT.)	AREA (SQ. FT.)	ELEV. (FT.)	AREA (SQ. FT.)	
RECYCLE POND	779.0	28,344	777.0	25,480	28,344
EMERGENCY POND	779.0	26,621	775.5	22,354	26,621

* ELEVATIONS AND AREAS WERE OBTAINED FROM REFERENCE 3.

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nrg.

FIGURE 3
HYDROLOGIC MAP
CHESWICK GENERATING STATION
SPRINGDALE, ALLEGHENY COUNTY, PENNSYLVANIA

DESIGNED BY:	DRAWN BY:	CHECKED BY:	APPROVED BY:	DATE:	SCALE:	DRAWING NO.	SHEET NO.
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OFFICE Pittsburgh, PA
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Plotted By: Evan.Schlegel

Attachment A

Hydrologic Calculations

I. Purpose

To evaluate the stormwater inflow volume that will result from the design flood (storm) as specified by 40 CFR §257.82(a)(3), and to compare this volume with the available storage capacity for each subject pond.

II. Given

Two CCR impoundments located in Springdale, PA, each having a Low Hazard Rating and the following design information (From Fig. 3 by CB&I, 2016):

Bottom Ash Recycle Pond

Crest Elevation, E_c:	779.0	ft msl
Pond Area at Crest, A_c:	28,344	sq ft
Operating Water Level, E_w:	777.0	ft msl
Area at Operating Water Level, A_w:	25,480	sq ft
Approximate Inflow Area, A_{IN}:	28,344	sq ft
Freeboard, FB = E_c - E_w =	2.0	ft

Bottom Ash Emergency Pond

Crest Elevation, E_c:	779.0	ft msl
Pond Area at Crest, A_c:	26,621	sq ft
Operating Water Level, E_w:	775.5	ft msl
Area at Operating Water Level, A_w:	22,354	sq ft
Approximate Inflow Area, A_{IN}:	26,621	sq ft
Freeboard, FB = E_c - E_w =	3.5	ft

III. Methodology

Step 1: Determine the appropriate Rainfall Depth (D_R) for the stormwater inflow calculations.

From 40 CFR §257.82(a)(3), the CCR units must adequately manage flow resulting from the following design floods:

* For an incised impoundment, the 25-year flood
* For a non-incised, Low Hazard impoundment, a 100-year design flood
* For a non-incised, Significant Hazard impoundment, a 1000-year design flood
* For a non-incised, High Hazard impoundment, the probable maximum flood

Step 2: Determine the Inflow Volume (V_{IN}). For a pond with a limited inflow area (i.e., with inflow limited to rainfall directly on top of the pond footprint and on berm areas right around the pond perimeter), compute the volume directly as the Rainfall Depth (D_R) times the Inflow Area (A_{IN}). For ponds with run-on from additional upstream areas, compute V_{IN} using HydroCAD.

Step 3: Compute the Available Capacity (V_{AVAIL}) of each pond to contain stormwater runoff as the volume between the pond operating water level and the pond crest elevation. Use the Average End Area method.

Step 4: Compare the volume of inflow (V_{IN}) for the specified design flood (storm) to the pond's available capacity (V_{AVAIL}) for stormwater runoff to determine if the pond will manage the specified stormwater inflow without overtopping.

IV. Calculations

Step 1: Determine the appropriate Rainfall Depth (D_R).

Neither pond is completely incised, and both are assigned Low Hazard classifications. Pursuant to 40 CFR §257.82(a)(3), both ponds must manage flow from the 100-year flood (storm).

From NOAA (NOAA, 2016), the rainfall depth (D_R) associated with the 24-hour, 100-year storm is:

D_R = 5.05 " = 0.4208 ft

Step 2: Determine the Inflow Volume (V_{IN}).

Inflow is limited to rainfall directly on top of the pond footprints due to grading away from the ponds beginning at the approximate crest elevations. Therefore, directly compute V_{IN} as follows:

Inflow , V_{IN} (cu ft) = Rainfall depth, D_R (ft) x Inflow Area, A_{IN} (sq ft)

For the Bottom Ash Recycle Pond:

V_{IN} = 0.4208 ft x 28,344 sq ft
= 11,928 cu ft

For the Bottom Ash Emergency Pond:

V_{IN} = 0.4208 ft x 26,621 sq ft
= 11,203 cu ft

Step 3: Compute the Available Capacity (V_{AVAIL}) of each pond to contain stormwater runoff as the volume between the pond operating water level and the pond crest elevation. Use the Average End Area method.

Available Capacity, V_{AVAIL} (cu ft) = $[(A_c + A_w)/2]$ x FB

For the Bottom Ash Recycle Pond:

V_{AVAIL} = [(28,344 + 25,480) / 2] x 2.0
= (53,824 / 2) x 2.0
= 53,824 cu ft

For the Bottom Ash Emergency Pond:

V_{AVAIL} = [(26,621 + 22,354) / 2] x 3.5
= (48,975 / 2) x 3.5
= 85,706 cu ft

V. Results

Step 4: Compare the Inflow Volume (V_{IN}) for the specified design flood (storm) to the pond's Available Capacity (V_{AVAIL}) for stormwater runoff to determine if the pond will manage the specified inflow without overtopping.

Percent of Freeboard Capacity Utilized, $\%V_{FB} = \frac{V_{IN}}{V_{AVAIL}}$

For the Bottom Ash Recycle Pond:

$\%V_{FB}$ = 11,928 / 53,824
= 22%

For the Bottom Ash Emergency Pond:

$\%V_{FB}$ = 11,203 / 85,706
= 13%

VI. Conclusions

Both the Bottom Ash Recycle Pond and the Bottom Ash Emergency Pond have adequate capacity to meet the temporary storage requirements for a 100-year design flood (storm).

VII. References

CB&I. "Figure 3 Hydrologic Map, Cheswick Generating Station. Drawing No. 1009134004-B2." Dated October 4, 2016.

NOAA. "Point Precipitation Frequency (PF) Estimates, Springdale, PA." NOAA Atlas 14, Vol. 2, Version 3. Accessed July 26, 2016.

Attachment A-1

NOAA Point Precipitation Frequency (PF) Estimates

NOAA Atlas 14, Volume 2, Version 3
Location name: Springdale, Pennsylvania, US*
Latitude: 40.5442°, Longitude: -79.7941°
Elevation: 777 ft*
* source: Google Maps

POINT PRECIPITATION FREQUENCY ESTIMATES

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NOAA, National Weather Service, Silver Spring, Maryland

PF_tabular | PF_graphical | Maps_&_aerials

PF tabular

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]

Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	0.317 (0.287-0.350)	0.379 (0.344-0.419)	0.458 (0.415-0.507)	0.520 (0.469-0.573)	0.597 (0.538-0.658)	0.657 (0.590-0.722)	0.714 (0.639-0.784)	0.774 (0.689-0.849)	0.852 (0.754-0.933)	0.910 (0.802-0.997)
10-min	0.493 (0.446-0.544)	0.591 (0.536-0.653)	0.712 (0.645-0.787)	0.802 (0.724-0.884)	0.914 (0.823-1.01)	0.996 (0.894-1.10)	1.08 (0.962-1.18)	1.16 (1.03-1.27)	1.25 (1.11-1.37)	1.33 (1.17-1.45)
15-min	0.604 (0.547-0.667)	0.723 (0.656-0.799)	0.874 (0.792-0.967)	0.987 (0.891-1.09)	1.13 (1.02-1.24)	1.23 (1.11-1.36)	1.34 (1.20-1.47)	1.44 (1.28-1.58)	1.56 (1.38-1.71)	1.66 (1.46-1.81)
30-min	0.799 (0.723-0.882)	0.967 (0.878-1.07)	1.20 (1.08-1.32)	1.37 (1.24-1.51)	1.59 (1.44-1.76)	1.76 (1.58-1.94)	1.93 (1.73-2.12)	2.10 (1.87-2.30)	2.32 (2.05-2.54)	2.48 (2.19-2.72)
60-min	0.976 (0.883-1.08)	1.19 (1.08-1.31)	1.50 (1.36-1.66)	1.74 (1.57-1.92)	2.07 (1.86-2.28)	2.32 (2.09-2.55)	2.58 (2.31-2.83)	2.85 (2.53-3.12)	3.20 (2.84-3.51)	3.49 (3.07-3.82)
2-hr	1.12 (1.03-1.23)	1.37 (1.25-1.50)	1.72 (1.57-1.89)	2.00 (1.81-2.18)	2.38 (2.15-2.59)	2.68 (2.42-2.92)	2.99 (2.69-3.25)	3.32 (2.97-3.59)	3.76 (3.34-4.07)	4.11 (3.63-4.44)
3-hr	1.20 (1.09-1.31)	1.45 (1.32-1.59)	1.82 (1.66-1.99)	2.11 (1.93-2.31)	2.52 (2.29-2.75)	2.85 (2.58-3.11)	3.19 (2.87-3.47)	3.55 (3.18-3.85)	4.05 (3.59-4.38)	4.45 (3.92-4.80)
6-hr	1.43 (1.32-1.57)	1.72 (1.58-1.89)	2.14 (1.97-2.34)	2.48 (2.27-2.71)	2.97 (2.71-3.23)	3.37 (3.05-3.65)	3.79 (3.41-4.09)	4.22 (3.78-4.56)	4.85 (4.30-5.22)	5.35 (4.70-5.74)
12-hr	1.69 (1.56-1.85)	2.03 (1.87-2.22)	2.51 (2.30-2.74)	2.89 (2.65-3.15)	3.46 (3.15-3.76)	3.92 (3.55-4.25)	4.41 (3.97-4.76)	4.93 (4.41-5.31)	5.68 (5.02-6.09)	6.29 (5.52-6.73)
24-hr	2.02 (1.90-2.17)	2.41 (2.26-2.59)	2.94 (2.76-3.16)	3.38 (3.17-3.62)	4.00 (3.73-4.28)	4.51 (4.19-4.81)	5.05 (4.67-5.37)	5.60 (5.16-5.96)	6.39 (5.84-6.78)	7.03 (6.39-7.45)
2-day	2.35 (2.22-2.52)	2.80 (2.63-2.99)	3.39 (3.19-3.63)	3.87 (3.64-4.13)	4.54 (4.25-4.83)	5.08 (4.74-5.40)	5.64 (5.24-5.99)	6.21 (5.76-6.59)	7.01 (6.46-7.43)	7.65 (7.00-8.10)
3-day	2.53 (2.39-2.69)	3.00 (2.83-3.20)	3.61 (3.41-3.85)	4.11 (3.86-4.37)	4.79 (4.49-5.09)	5.34 (4.99-5.67)	5.91 (5.51-6.26)	6.49 (6.03-6.87)	7.30 (6.74-7.72)	7.94 (7.29-8.40)
4-day	2.71 (2.56-2.87)	3.21 (3.03-3.41)	3.83 (3.62-4.07)	4.34 (4.09-4.60)	5.04 (4.74-5.34)	5.61 (5.25-5.93)	6.18 (5.78-6.54)	6.77 (6.31-7.16)	7.58 (7.02-8.01)	8.23 (7.57-8.69)
7-day	3.24 (3.08-3.43)	3.83 (3.63-4.05)	4.52 (4.29-4.78)	5.07 (4.80-5.36)	5.82 (5.49-6.14)	6.40 (6.04-6.75)	7.00 (6.58-7.37)	7.59 (7.11-8.00)	8.39 (7.82-8.84)	9.00 (8.36-9.48)
10-day	3.75 (3.58-3.94)	4.41 (4.21-4.64)	5.16 (4.92-5.42)	5.75 (5.47-6.04)	6.54 (6.21-6.87)	7.15 (6.78-7.50)	7.76 (7.34-8.15)	8.38 (7.90-8.78)	9.18 (8.62-9.63)	9.80 (9.15-10.3)
20-day	5.26 (5.02-5.51)	6.16 (5.89-6.47)	7.11 (6.79-7.45)	7.85 (7.49-8.23)	8.82 (8.40-9.24)	9.57 (9.10-10.0)	10.3 (9.76-10.8)	11.0 (10.4-11.5)	11.9 (11.2-12.5)	12.6 (11.8-13.2)
30-day	6.62 (6.34-6.93)	7.74 (7.41-8.10)	8.83 (8.46-9.25)	9.70 (9.28-10.1)	10.8 (10.3-11.3)	11.7 (11.1-12.2)	12.5 (11.9-13.1)	13.3 (12.6-13.9)	14.3 (13.6-14.9)	15.0 (14.2-15.7)
45-day	8.49 (8.14-8.84)	9.88 (9.49-10.3)	11.2 (10.7-11.6)	12.1 (11.6-12.7)	13.4 (12.8-13.9)	14.3 (13.7-14.9)	15.2 (14.5-15.8)	16.0 (15.3-16.7)	17.0 (16.2-17.7)	17.7 (16.9-18.5)
60-day	10.2 (9.85-10.6)	11.9 (11.4-12.4)	13.3 (12.8-13.8)	14.4 (13.9-15.0)	15.8 (15.2-16.4)	16.8 (16.1-17.4)	17.7 (17.0-18.4)	18.6 (17.8-19.3)	19.6 (18.7-20.4)	20.3 (19.4-21.1)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS).

Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.

Please refer to NOAA Atlas 14 document for more information.

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PF graphical